Exchange rate regime and productivity in Bulgaria: Is there some evidences of "reverse supply" side effects?

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Abstract

Bulgaria is a small open and ex-centrally planned economy specialized in the production of homogenous manufactured goods. After a dismal failure in the first part of the transition (1990-1997), Bulgaria chooses a currency board in order to achieve the monetary stabilization. The currency board considerably hardens the budgetary constraint and leads to real appreciation. Seven years later in spite of a sharp real appreciation, the competitiveness of Bulgaria is always high due to an important increase in productivity. We assume that the real appreciation produces some incentives that enhance productivity growth. We note that our hypothesis is converse to Balassa-Samuelson supply side determination of real exchange rate. We run a set of empirical tests funded upon total factor productivity for manufacturing sectors during the period 1999-2003 that reveals a significant "reverse" effect. The positive effect is conditional to the level of appreciation *i.e.* beyond a certain level the negative effects outweigh the favorable ones. During the period the threshold was evaluated at 5324 deflated *Levas* for a given technological level.

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1. Introduction and motivations

Since 1997, Bulgaria is pursuing a policy of nominal exchange rate fixity. We assume

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that this policy is close to the « hard currency » strategy followed by Great Britain and United States during the 80's (Krugman, 1989). This policy is funded upon a "deliberate" real appreciation which aims at improving firms' competitiveness. In Bulgaria, authorities abandoned managing the exchange rate in order to not accommodate the decrease in cost-competitiveness in front of foreigners' competition. It is likely that nominal fixity has been combined with real appreciation (Pashev, 2003, Chobanov and Sorsa, 2004).

The analyses done until now on competitiveness highlight a form of paradox: the real exchange rate as computed by the Bulgarian National Bank strongly appreciates that leads to real wage increases. In compensation, the unit labor cost decreases during the period. This result is due to an important improvement in labor productivity. We assume that this increase in productivity is not independent from real appreciation.

The aim of the article is thus to investigate if some real appreciation could bring incentives to productivity in the special case of Bulgaria under the Currency Board (1997-2004). We test by a quadratic form the linearity of this relation. However, we assume that on average the positive effects have outweighed the negative ones over the period.

The first part of the article highlights the arguments of the supporters of « hard currency » and the arguments of those against. We also stress the consequences on real exchange rate and productivity of the policy ran by Bulgaria under the Currency Board. In a second part, we give some evidences about the effect of real appreciation on productivity thanks to an econometrical test.

2. First part: What is expected from a « hard currency » strategy?

The competitiveness is widely determined by the productivity level that the firms reach. For Bulgaria, the goods produced are assumed homogenous and incorporating few services or technologies (cf. table 5); they comply thus with the law of one price. The firms' competitiveness is funded upon the cost and the productivity of production factors. The state is not able to determinate the level of competitiveness, however it could choose a macroeconomic policy that changes the firms' incentives in order to increase productivity. In this article, we are interested by policies based on exchange rate.

As highlighted by Balassa (1964), an increase in the real exchange rate is not all time disequilibria. In the tradable goods sector the increase of productivity could not result in a decrease of tradable good prices because they are fixed by international markets. In consequence, productivity growth leads to increase in real wages of tradable good sector workers. However, as the labor mobility between tradable and non tradable sectors is assumed

to be perfect, the raise of wages in a sector induces a raise of wages in the other. Higher wages induce higher costs for the non tradable sector, assumed less productive, that increases thus the price of the non traded goods. This is the dominant approach funded upon the supply side and productivity differentials; the real exchange rate appreciates because of productivity growth and without loss of competitiveness. This approach is relevant to Solow classical production function; the total factor productivity is exogenous to real and nominal variables.

De Gregorio and *ali* (1994) highlight a demand effect on real appreciation independent from productivity increases. Indeed, if we relax the hypothesis of perfect capital mobility, the supply is no more perfectly elastic; hence the demand growth could change the relative price of tradable and non tradable. An increase of real wage in the tradable sector leads to an increase of costs inconsistent with international competition. The firms should thus produce enough efficiency improvement (rises in total factors productivity) in order to match the raising costs. The total factor productivity should not be considered as exogenous and could dependant of real variable as real appreciation. Hence, the real exchange could have positive and/or negative effects on productivity. The active policy partisans consider appreciation as deterrent for productivity. To the opposite the supporters of hard currency think that real appreciation could enhance it.

2.1. Active policy

Active policies try to influence the price of production factors especially labor. They consist in keeping the relative price consistent with good external trade performances. Hence, in a factor cost objective, the authorities could let the currency depreciate or devaluate for lowering the price of non tradable goods i.e. real wage in order to reduce the cost of labor. Those in favor of this policy argue that maintaining a high level of cost-competitiveness has a positive effect on productivity *via* stimulating the export sector.

Following Feder (1982), the tradable good sector is more competitive because it should cope with international competition. A reallocation of resources in favor of tradable goods (to the detriment of non tradable goods sector) should result in an improvement of the average productivity. If appreciation is seen as a phenomenon that reduces tradable good sector growth, it would also deter technical efficiency by misallocating production factors.

The reduction of the profitability of the export sector due to real appreciation leads to a lowering of foreign direct investment in tradable good sector. This kind of investment is well known to be a source of innovation imports.

If labor and capital are not perfectly substitutable, real wages appreciation could lead

to an underemployment of production factors. This underemployment lowers total factor productivity as stressed by the new Keynesians.

Table 1: Negative relation between total factor productivity and real exchange rate

Phenomenon	consequence	Effects on productivity
Factor reallocation between tradable goods and non tradable goods sectors	...in favor of non tradable sectors which is less productive	Loss of technical efficiency
	Lower foreign direct investment	Lower innovations imports
Real wages appreciation	Underemployment of production factors	Loss of technical efficiency

An active exchange rate policy has however limited effects. Hence, if the monetary authorities are well known for having an active exchange rate policy, the gain in term of cost-competitiveness is lowered because people anticipate the *pass through* of exchange rate variations on prices. As the gain is funded upon monetary illusion, the inflationary expectations reduce the effectiveness of the devaluation *i.e.* its ability to lower the non tradable good price mainly real wage. We already know that workers in small countries as Bulgaria are less prone to monetary illusion because of the high degree of trade openness, which encourages them to estimate their purchasing power in currency.

In addition, this kind of policy is often used in order to preserve the competitiveness of sectors with a low or decreasing productivity as, for example, outdated industrial sectors confronted to a more efficient international competition (Harris 2001). In consequence, the relation is reversed and exchange rate depreciation is now correlated with a decreasing productivity.

2.2. “Hard currency” strategy

A pro-competitive alternative to cost-based strategies could be a productivity-based strategy. This one looks at increasing the productivity of production factors instead of influencing their costs. On the contrary to previous policy, it is funded upon exchange rate real appreciation indeed on some overvaluation. This is the so called « hard currency policies ».

2.2.1. Effects funded upon real wage appreciation.

The accommodation of increasing cost of labor induces an increase in capital intensity due to the substitution of capital to labor. The phenomenon is supported by real appreciation

because it lowers the cost of imported machinery and innovations. We remember that at this development stage most of the technological progress should be imported from abroad.

In addition, the worker that benefits from a real increase of its wage should provides a more efficient labor. Leinbestein (1966) introduces the concept of X-inefficiency: a well paid worker is more educated and healthier, and hence its productivity is higher. This idea is very important for developing country where initial wages are low. Pashev (2003) indicates that the Bulgarian wages are among the lowest of the accession countries. Moreover a well paid worker should have higher incentives to work efficiently. Real wage appreciation for the most educated workers also influences « brains drain » phenomenon. For a developing country, it could reduce the fly of educated workers abroad.

2.2.2. Effects funded upon behaviors change

In facts, some overvaluation increases the competition on domestic market that imposes firms to improve their level of efficiency. There are some natural or political barriers which protect the domestic market from foreign competition. The abandon of an active exchange rate policy and some exchange rate appreciation erode these barriers and allow foreign competition to be more briskly. We could remember that in the words of Porter (1990), the level of competition belongs to the micro-environment of firms and is assumed to be favorable to productivity growth.

Hence, two effects are expected from competition: first a reallocation of resources from unproductive outdated sectors or firms toward more efficient firms and productive sectors. The production factors meet thus a more productive allocation that results in an increase in global efficiency. This phenomenon is a « creative destruction »: the more efficient firms should develop by removing production factors to firms unable to become more efficient. If the economic policy consists in protecting outdated firms from external competition by devaluations, it deters the growth of more productive sectors and thus maintains the global productivity at a low level.

The second argument highlights the effect of the introduction of a new and non cooperative player which threatens the position of domestic firms. In fact, Krugman (1989) highlights from the case of United States and United Kingdom during the 80's, the presence of an inefficacy margin. Certain firms prefer not to maximize their profits in order to save exertion. This point of view could seem quite puzzling because it aims at abandoning the assumption that rational producers maximize their profits. Krugman explains this paradox by an agency relation between owners (the principal) and managers (agents). The agent has not

the same incentives that the principal because it benefits only of a part of the profit. He thus looks at maximizing his utility that includes a share of the profit and the trouble of exertion. Obviously the principal implements a scheme of incentives and contrition in order to bring the preferences of the agent close of his. However, the manager always disposes of some discretionary margins that allow him to deviate for the principal's wishes of profit maximization.

How foreign competition could change the behavior of managers? The apparition of a new and non cooperative player transforms exertion in a strategic variable. The non cooperative player could captivate the market by choosing a higher level of exertion and it has no incentives to cooperate in order to maintain inefficacy margin. The other players aware about this threat should thus increase their level of exertion or disappear. The principal could also take the observed level of exertion of new players as the benchmark opposable to their own managers.

Table 2: Positive impact of real appreciation on productivity

variables	Effects 1	Effects 2	Effects 3
Real wage	Firms re-organization	+ in capital intensity	+ technical efficiency
		- cost of imported capital/ innovations	+ factor (labor) productivity
	+ education & health	- X inefficiency	+ labor productivity
	+ workers incentives	- brain drain	+ labor productivity + assimilation of innovations
Incentives	Production factor reallocation	+ « destructive creation »	+ technical efficiency
	Change in behaviors	+ managers exertion	+ technical efficiency

The total factor productivity is commonly spared between producing technologic progress (R&D) and improving the efficiency of the production with a given technology. The real appreciation does not directly produce technical progress[3] but it could be an incentive to factors reallocation and change in the managers' behaviors which are able to significantly influence technological efficiency. For Bulgaria, the expected effects of real appreciation are funded upon factors reallocation and labor X inefficiency respectively because of the

[3] Indirectly, the appreciation could improve technical progress by easing the importation and the assimilation of foreign innovations. As we have seen (Porter 1990) developing and transitional countries produce few R&D (technological progress), hence they are dependent from importations of developed countries R&D.

economic transition and the initial low level of wages.

In conclusion, since we remove the assumption of TFP exogenity, real appreciation could have effects on productivity. However, the sign of the relation is not theoretically established. The average impact would depend on the equilibrium between positive and negative determinants. We could assume that this equilibrium is conditional on the level of real appreciation. Hence, it should be some real appreciation level above which the negative effect outweighs the positive ones. Hence, we assume a non linear (quadratic) relation.

2.3. The Bulgarian case 1: The monetary regime.

Bulgaria adopted a currency boards in July 1997[4] in order to stop a hyperinflation crisis (1996-1997). This crisis was the result of the failure of the first stage of the transition from a centrally planned economy toward a market economy. The failure results in delaying reforms and privatizations. The state owned enterprises that control a large share of the economy was outdated and unproductive. In order to maintain the competitiveness and to alleviate the financial burden of these firms on state budget, the government imposes that the monetary authorities apply a soft budget constraint to the economy. This policy results in a high and chronicle inflation, and rapid depreciation of the Lev until the fatal crisis of 1996-1997.

The soft budget constraint aimed at preserving the unproductive state owned firms which captivate most of the productive factors (labor, capital and intrans). This policy contributed to restrain the development of new and private productive sectors and to pursue the waste of productive resources. The emergence of hyperinflation imposes the choice of robust reforms, especially on the monetary ground, which dramatically change the conduct of macroeconomic policy. One of these reforms was the introduction of the currency board. This monetary regime has two characteristics:

Firstly, the nominal exchange rate is fixed by law. The article 29 of the Bulgarian National Bank chart states that the nominal exchange rate is fixed to 1 Lev for 1 Deutsch Mark (that corresponds to approximately 2 Leva for 1 euro). The modification of this rate could be achieved only by a change in the law.

Secondly, the central bank should only accept external assets as counterpart of the base money supply. In facts, the central bank applies a principle of base money coverage by exchange reserve of at least 100%. Exchange rate reserves accumulated in excess of 100%

[4] The reform process starts truly in February 1997 with the government changes, however the currency board has been appointed by law in July 1997.

coverage could be used in order to restore some margin for independent monetary policy.

The constraints imposed to monetary policy aimed at achieving the monetary stabilization. They had two kinds of consequences on the Bulgarian economy and its productivity. On the domestic side, the currency board has dramatically hardened the budgetary constraint. The base money counterpart regulation deters the monetary financing of public spending. The government is thus forced to balance the budget or to borrow in order to finance fiscal unbalance. Hence, the government implements important privatization plans in order to alleviate the fiscal burden of state owned enterprises. The privatization should have two expected effects on the growth of productivity in Bulgaria. The injection of foreign capital should increase productive investment inside the firms and modify the production methods. Moreover, the closing of unproductive firms should lead to a reallocation of production factors toward more productive uses.

The hardening of budgetary constraint restrains also the private sector because the regulation of issues affects both private and public base money counterparts. In particular, the lender of last resort vanished. Three effects could be expected from this constraint: A dramatic reduction in commercial bank moral hazard because the banks become completely liable for their management. The reduction of moral hazard should lead to a better allocation of credit that is to say a more productive intermediation. Under currency boards' arrangement, we commonly attend to banking sector reorganization in the sense of more concentration and internationalization. The concentration should achieve economy of sale consistent with a more efficient intermediation and the internationalization should support the introduction of foreign capital in the Bulgarian economy. All the Bulgarian Banks have been privatized (except the *Encouragement Bank*). However, the abandon of the lender of last resort could lead to excessively cautious behaviors of commercial banks which result in the reduction of firms' access to bank credits. In 2002, only 18.5 % of firms have access to commercial banks loan that is less than the other accession countries. However, since 2002 a credit boom is occurring due in part to a catching up effect.

On the external side, the nominal exchange rate fixation should be compared to a « hardening of the external constraint » that effects are comparable to those highlighted for the real exchange rate appreciation. The economic literature (Calvo and Reinhardt, 2002) insists on the positive effects for trade and foreign investment of the suppression of nominal exchange rate uncertainty. The Bulgarian firms should borrow currency in order to buy machinery and innovation from foreign markets, hence an uncertain exchange rate produces balance sheet effects that could result in losses and deter foreign investments.

One well-known drawbacks of fixed exchange rate regime is the likely misalignment of exchange rate (Hinkle and Montiel 1999, Krugman, 1979, Edwards 1988). Theoretically, the misalignment of real exchange rate should be adjusted alternatively by a modification in the nominal exchange rate, a decrease in the price of non tradable good (wages), an improvement of the term of trade or an increase in productivity. Without the possibility to change the nominal rate, the adjustment rests on the two others tools.

The productivity growth is a structural phenomenon which is not under the direct control of politics. We however note that the currency board provides a favorable environment for productive reforms because of the hardening of the budgetary constraint. In addition, real appreciation itself may positively influences productivity that strengthens the viability of the board.

The trump of a currency board is that it disposes of an automatic adjustment mechanism of real exchange rate funded upon the non neutralization of currency flux comparable to the price species flow mechanism of Hume (1752). The real exchange rate could appreciate only if the appreciation is sustainable *i.e.* if the appreciation does not lead to a structural degradation of competitiveness. Indeed, foreign rational creditors should finance the external unbalance only if they expect that the unbalance is sustainable. Otherwise, the exchange reserve should lower and, because of the currency board, base money would lower in the same proportion. Hence, the currency board initiates deflationary pressures (decreasing prices and increasing interest rate) that correct the misalignment.

A drawback of deflationary adjustment is that it is funded upon the ability to decrease of the price of non tradable goods including real wage. If the automatic adjustment constrains the growth of real wages, it could have a negative effect on X inefficiency. Deflationary pressures on wage lead to reduce the incentive for exertion of workers and thus reduce the labor productivity. However, we do not note deflationary tendencies of wages in Bulgaria over the period 1997-2002 (Pashev 2003).

It is also possible that automatic adjustment funded upon deflation could result in deflationary crisis as in Argentina (2001). Bulgaria benefits of some characteristics which could support the deflationary adjustment: Bulgaria is a small open country where the labor market is flexible that increases the flexibility of relative price of the tradable and non tradable goods. Bulgaria is endowed with an important informal sector able to increase the flexibility of the whole economy and to dampen external shocks. Finally, Argentina had fixed its exchange rate on the dollar despite the fact that the USA were not its main trading partner. The Brazilian devaluation leads thus to an important real exchange rate shock hardly

rectifiable by deflation. To the opposite Bulgaria fixes its exchange rate on the currency of its main trade and investment partner, the EU. Indeed, Bulgaria avoids the occurrence of external shocks supposing important deflationary adjustment. The openness and the size of Bulgaria make the global demand very sensitive to external demand (i.e. annex 3).The Following table give us figures on the integration of Bulgaria in the EU economic zone from the point of view of trade (export) and investment (FDI).

Tableau 3: Bulgaria – EU integration

	% of export to the EU	Export to EU as % of GDP	% of FDI from EU	FDI from as % of GDP
2001	54.8%	21%	89%	5.4%
2002	55.7%	20%	61%	3.7%
2003	56.6%	22%	54%	4.0%

The following table remembers the main effects of exchange rate regime on total factor productivity.

Table 4: Currency board features and productivity

	Positive effects	Negative effects
Domestic side	Efficiency : hardening of the budgetary constraint	Intermediation : restriction to credit access
External side	Technology : reduction of exchange rate uncertainty	Automatic adjustment : increase in X inefficiency

In conclusion, we are thinking that the real exchange rate appreciation in the framework of a currency board is a good indicator for the hardening of the domestic and external economic constraint in Bulgaria. This hardening should induce productivity growth due mainly to the improvement of technical efficiency. The misalignment of exchange rate is dampened by the automatic adjustment; hence, productivity induced by the real appreciation should lead to an improvement of the Bulgaria competitiveness. As the automatic adjustment is a macroeconomic mechanism, the situation could differ among the sectors and firms.

2.4. Bulgarian case 2: comments on competitiveness since 1997 (Pashev 2003).

Bulgaria is a small and open country from the Balkan which apply for the EU integration in 2007. Its income level is one of the lowest from the candidate countries. We assume the production deeply oriented toward homogenous manufactured and agricultural goods that embodied a low level of technology. This kind of goods is assumed to comply with the law of one price. The manufactured sector was privately owned at 95% in 2002. The

following table gives some figures about the specialization of exports and output in Bulgaria over the period 1999-2003.

Table 5: exports and output composition

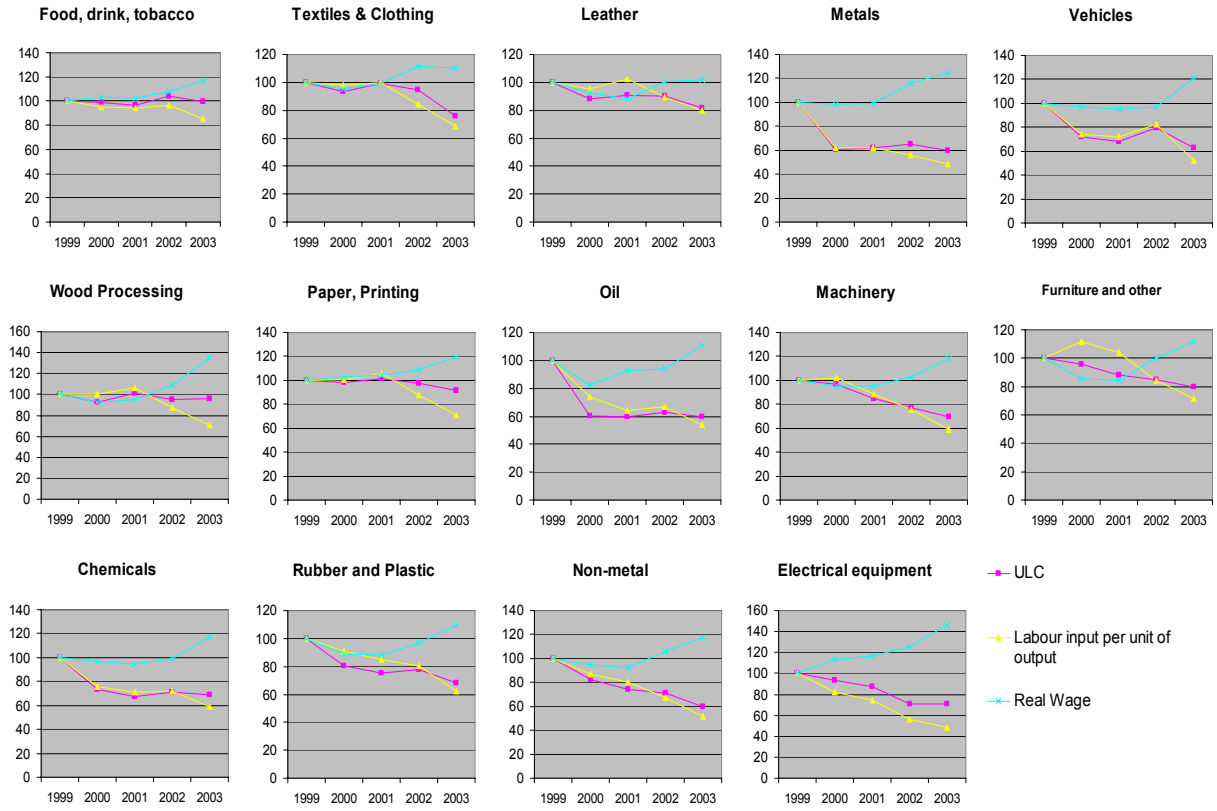
Fields\Dates	1999	2000	2001	2002	2003
Decomposition of exports					
Clothing and footwear	16,6%	16,3%	20,0%	20,8%	21,9%
Iron and steel	6,6%	8,0%	6,9%	6,5%	8,1%
Other metals	7,0%	10,2%	8,3%	7,8%	8,0%
Other raw materials	6,8%	7,1%	6,9%	7,3%	6,4%
Petroleum products	7,3%	11,2%	8,9%	5,9%	5,8%
Machines and equipment	5,3%	4,5%	4,6%	4,9%	4,7%
Food	4,9%	3,3%	3,8%	4,1%	4,5%
Textiles	3,4%	3,0%	3,6%	4,0%	4,2%
Furniture and household appliances	2,5%	2,2%	2,6%	3,5%	3,7%
Chemicals	3,8%	4,1%	3,9%	3,6%	3,4%
Other investment	5,1%	3,0%	2,8%	3,3%	3,4%
Raw materials for the food industry	4,9%	2,8%	3,0%	5,3%	3,3%
Wood products, paper and paperboard	3,3%	2,8%	2,5%	2,6%	3,0%
Spare parts and equipment	2,3%	2,3%	2,7%	2,8%	2,9%
Other consumer	2,6%	2,4%	2,3%	2,6%	2,8%
Plastics and rubber	3,0%	2,6%	2,5%	2,5%	2,6%
Other energy	2,0%	3,4%	4,6%	3,9%	2,6%
Medicines and cosmetics	3,7%	3,4%	3,1%	2,8%	2,4%
Electrical machines	1,4%	1,3%	1,4%	1,1%	1,7%
Fertilizers	0,9%	2,0%	1,7%	1,0%	1,2%
Beverages	2,3%	1,6%	1,4%	1,2%	1,1%
Vehicles	1,2%	0,5%	0,6%	1,1%	1,0%
Raw tobacco	1,6%	1,0%	0,8%	0,8%	0,7%
Cement	0,7%	0,7%	0,6%	0,5%	0,4%
Tobacco	0,9%	0,7%	0,4%	0,3%	0,3%
homogenous manufactured goods	76,0%	80,6%	79,7%	77,9%	77,4%
Decomposition of the ouput					
Mining	5,7%	5,2%	4,8%	4,8%	4,5%
Food, beverages, tobacco	20,5%	17,4%	17,0%	16,8%	17,1%
Textiles and clothing	5,5%	5,6%	5,9%	6,9%	8,4%
Leather	0,9%	0,9%	0,9%	0,9%	1,0%
Wood-processing	1,3%	1,2%	1,1%	1,3%	1,4%
Paper; printing	3,4%	3,0%	2,9%	3,1%	3,2%
Oil-processing	11,4%	15,6%	15,9%	13,9%	12,3%
Chemicals	7,7%	7,9%	8,3%	7,5%	6,7%
Rubber and plastics	1,6%	1,6%	1,6%	1,6%	1,9%
Non-metal	3,9%	3,5%	3,6%	3,8%	4,0%
Metals and metal products	10,7%	12,2%	10,6%	10,0%	10,5%
Machines and equipment	5,6%	5,1%	5,4%	6,2%	6,0%
Electrical equipment	3,4%	3,1%	3,3%	4,0%	3,8%
Vehicles	1,4%	1,3%	1,3%	1,2%	1,3%
Furniture and other nonclassified	1,2%	1,1%	1,2%	1,3%	1,6%
Electricity and heating	15,9%	15,1%	15,9%	16,5%	16,6%

homogenous manufactured goods	88,4%	89,3%	88,3%	87,2%	87,3%

The gray lines stress the small homogenous goods and commodities. Our assessment is funded upon a wide acceptation of homogenous goods, it includes labor intensive goods as textile, leather. We notice that for exports as for output the homogenous goods largely dominate the production.

The analyses of productivity in Bulgaria agree with the statement of preserved total factor productivity instead of some degradation of cost competitiveness due to real appreciation. Real wages robustly grow that reduces cost competitiveness. In compensation, the labor productivity increases of 7% per years, but still represents only 30% of the European Union productivity. Labor productivity growth passes the real wage increase, indeed the country benefits from Unit Labor Cost (ULC) gains of approximately 25%. The gain varies following the sectors and could be due to a change in capital intensity more than to an increase of labor productivity. The following graphs represent UCL evolution for the manufacturing sector that is to say mainly for tradable goods during the period 1999-2003.

Graph 1: UCL by manufacturing sectors over the period 1999-2003.

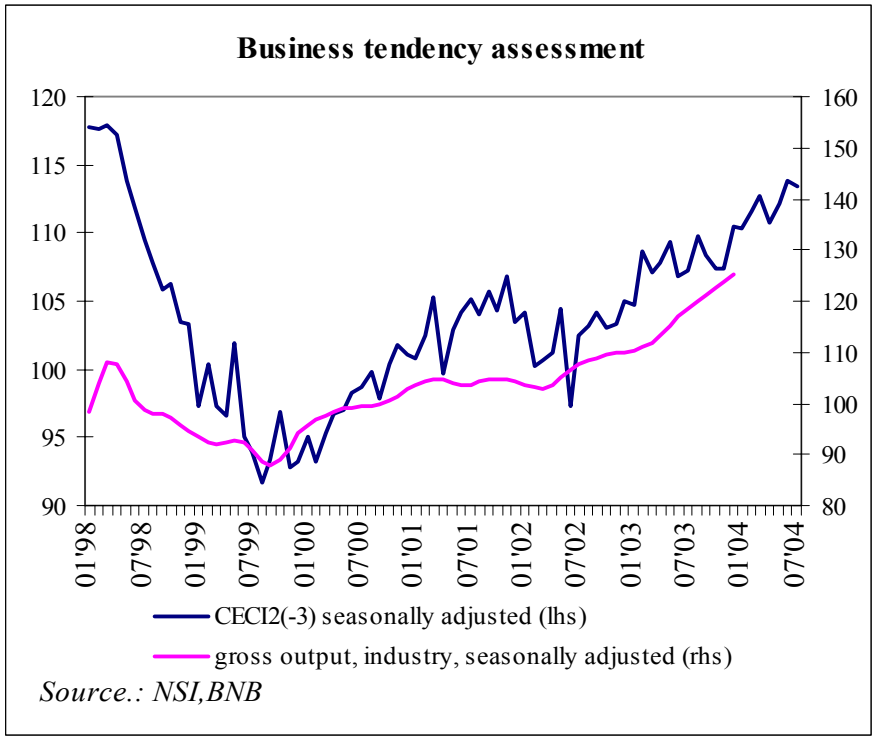


ULC is the ratio between the factor cost (real wage) and the factor productivity; hence it is an indicator of competitiveness. We note that competitiveness increases in all sectors in

important proportions except for wood, tobacco and paper-printing production. We decompose the ULC between labor cost and labor productivity, that highlights the parallel increase of cost and productivity. However, ULC decomposition does not highlight the sense of the causality between factors cost and factors productivity.

The firms do not seem to exploit all the advantages of the business marco-environment which is rather favorable. The main delays are recorded in human resources, marketing and technologies. The main advantages concern the wage and employment flexibility, and the labor productivity. However, the qualitative data (opinion poll) show a strong consistence between the quantitative data (economic growth) and the opinion of mangers. Hence, the stabilization of 1997 has enhanced the quality of expectations. The following graph exhibits the integration of business cycle and managers expectations approximated by BNB opinion pools since 1998.

Graph 2: Expected and actual GDP.

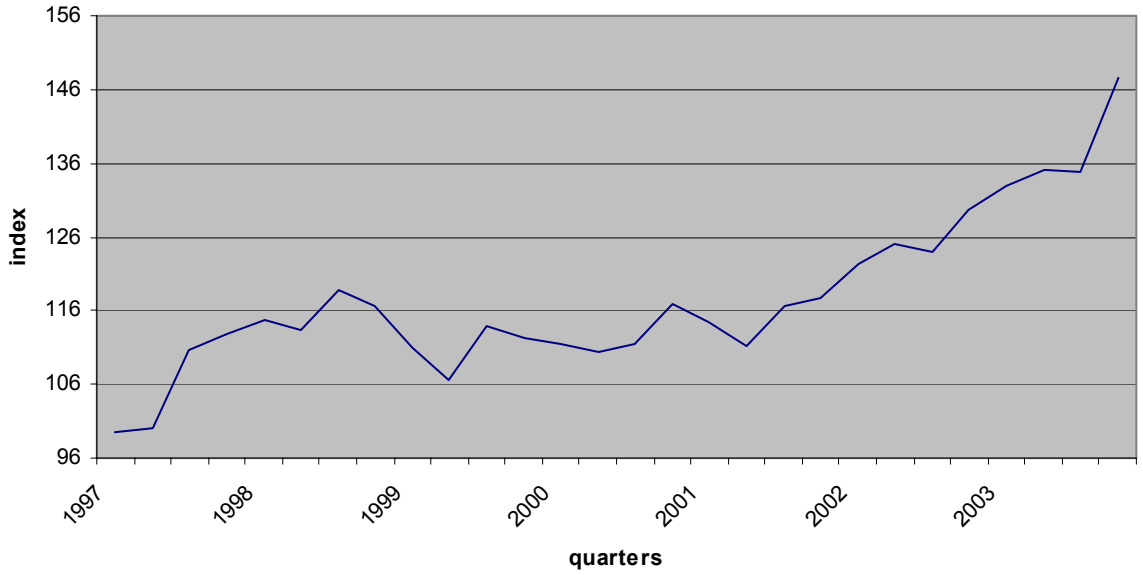


The Bulgarian industry has to face the collapse of the specialization imposed by the COMECOM. Indeed, the majority of the production flew away from concentrated sectors toward smaller firms producing manufactured goods as textile and clothing. The productivity potential from Bulgaria is funded upon the factors reallocation due to economic transition (cf. annex 4). An important part of it has been used after 1997. The catching up due to EU accession should also induce high productivity growth rate.

The real exchange rate is computed by the Bulgarian National Bank since 1997. The

index is funded upon the ratio of Bulgarian CPI to the CPI of the most important currencies used in the Bulgarian external balance (57% USD, 42% Euro). This index appreciated of 30% on the period over 1997-2003

Graph 3 :Real exchange rate index (BNB 05/2004)



It is likely that the index overestimated the weight of the dollar despite that a great part of the trade and investment are done with the EU. A non negligible part of the appreciation could be due to the Dollar fluctuations. However, the bilateral exchange rate with the EU also appreciates significantly. The decrease of cost competitiveness with EU seems to be more progressive due to nominal exchange rate fixity. The effect on foreign trade is ambiguous because the raise of price of exports could be compensated by the decrease of price of imports. In compensation, the increased competition for exports and the reduced price of foreign machineries could support the productivity growth.

As labor is a typical non traded good; the real appreciation induces an important increase of real wages[5]. This increase should be put in perspectives with the deep drop of real wages in 1996-1997 (33%); an important part of the wage growth could be due to the catching up after crisis. In addition, the average salary stays inferior to half of the lower salary in accession countries and to 10% of the lower salary in the EU countries before May 2004.

3. Second part: Empirical tests on the relation between productivity and

[5] Profits could also grow.

real appreciation.

3.1. The sample

We have data on value added (*y)*, employment *(L)* and real wages *(W)* over the period 1999-2003 (5 years) for seventeen Bulgarian manufacturing sectors. The annex 1 shows the relative share of each sector in the total value added. The data on investment are available for 16 sectors over the period 1996-2003. We compute the capital stock from the investment data assuming that the initial capital stock is null in 1996 because of the delayed transition that impedes the renewal of obsolete pre-transitional capital and the hyperinflation crisis. In addition, we compute capital stock since 1996, whereas the estimations are run since 1999. Hence, the consequences of mistakes in initial capital are dampened by capital depreciation.

The real wages are computed as the ratio between the nominal wages for each sector and their respective price indexes. If we assume that labor is not internationally mobile and that the industrial goods are tradable, we get for each sectors the relative price of non tradable (labor) and tradable (industrial production) goods. This ratio is a consistent proxy of real exchange rate by sectors for a small and open economy (Canavese 2004). The expected effect of real appreciation for a small country is an increase in cost mainly through the increase of non tradable goods prices i.e. real wage. We remember that the currency board should lead to real appreciation because it removes the possibility to adjust nominal wage increases by an exchange rate modification. The following table presents the increase of real wages over the period 1999-2003.

Table 6: real wage changes 1999-2003

real wage, % change, 1999=100	2003
Industry	7,8
Mining	12,9
Manufacturing	10,0
Food, drink, tobacco	16,8
Textiles and clothing	10,5
Leather	2,1
Wood processing	34,8
Pulp, paper, cardboard; printing and publishing	19,8
Coke, refined petroleum products, nuclear fuel	11,2
Chemicals and synthetic fibres	17,4
Rubber and plastic products	9,8
Other non-metal mineral products	17,0
Metals and metal products	24,7

Machinery and equipment	18,1
Electrical, optical and other equipment	45,8
Vehicles	20,9
Other manufacturing	11,6
Electricity, heating, gas and water supply	-8,5

We have thus a cylindered panel of 90 observations. The limited depth of the panel (5 years) does not allow us to work on the time dimension of the panel. The following table summarizes the variables used in the estimations and the variable names.

Table 7: variables names and description

variables	Variables name	Period & sectors	comments
Value added	y	1999-2003 – 18 sectors	Output of the production function
labor	l	1999-2003 – 18 sectors	Number of workers by sectors
capital	k	1996-2003 – 16 sectors	Computed from investment data
Real appreciation	w	1999-2003 – 18 sectors	Approximate by real wage by sectors
Technological level	A_i	1999-2003 – 16 sectors	Assume time invariant over the period
Efficiency change	$\lambda_{i,t}$	1999-2003 – 16 sectors	Estimated from the production function

3.2. The simultaneity bias

The main problem is the simultaneity between productivity and real appreciation. Indeed, the real exchange rate is determined by a supply (EO) and a demand (ED) effect. Under the assumption of perfect capital mobility and the law of one price, the supply completely determines the real exchange rate. This supply effect, highlighted by Balassa and Samuelson (1964), is funded upon productivity. The supply effect has been a subject of extensive researches and empirical estimations (Guillaumont and Hua, 2002, Chobanov and Sorsa, 2004). Under the supply dominance assumption, the total factor productivity could be estimated as a classical Solow residual. We know that this kind of production function assumes constant return to scale, perfect competition and full utilization of production factors. In this case, the residual is exogenous that to say independent from real factors as exchange rate appreciation.

The possibility of incomplete capital mobility or an incomplete law of one price leads to an imperfect supply elasticity to demand variations. Indeed, the demand influences the relative price of tradable and non tradable i.e. the real exchange rate. The factors able to

influence the demand are miscellaneous, variation of domestic output, term of trade shocks ... we assume that these factors determine the real exchange rate, but are independent from productivity. In compensation, we assume that the real exchange rate level which is dependent from the supply and the demand effects influences also the productivity. In fact, we look for the "converse relation" to that highlighted by Balassa and Samuelson. This relation bas been not much investigated empirically (Guillaumont and Hua 2003).

The series of estimation is funded upon the relation between total factor productivity (TFP) and real appreciation. The TFP is inferred from the estimation of a stochastic production frontier obtained by the regression of the value added on production factors (capital and labor) for each sectors. This method permits to avoid the bias due to factors substitution, to take in account measurement errors and random shocks. The estimation of the production function is funded upon a traditional Cobb Douglas function:

$$y_{i,t} = Ae^{\lambda ti} L^{\alpha} k^{\beta} \quad (1)$$

We could write the function *(3)* as a translog. Commonly, constant return to scale, full capacity utilization and competition are assumes that is to say $\beta = 1 - \alpha$. The transition process could induce incongruence in the production function due the suppression of redundant employment at a great scale or the liquidation of outdated capital. This process could also lead to under employment of production factor for example labor unemployment is above 10 % over the period. Hence, we let the return to scale free as $v = \alpha + \beta$.

$$\ln(y_{i,t}) = \ln(A_i) + \lambda_{i,t} + v\ln(L) + \beta[\ln(k) - \ln(l)] \quad (2)$$

The estimation of equation *(2)* allows us to evaluate the return to scale of the Bulgarian industries. The residual includes the standard measurement error and a set of variables able to influence the production which are unobserved by the econometrician but known by the manager. In particular, it includes factors determining the productivity as technological level and innovation. The decomposition of the residual gives us an individual specific effect (fixed) $\ln(A_i)$ and the term $\lambda_{i,t}$. The first term is the technological level of each sector, we assume that it captivates the differences in education between sectors likely stable over the short period. The use of the panel permit to reduce the relevance of the criticisms of Cobb-Douglas like estimations funded upon the simultaneity bias due to time invariant unobservable effects (Griliches and Mairesse 1995). The second term should sizes the efficiency of the production process; it includes the innovation and the standard errors term. The residual $\lambda_{i,t}$ gives an indication of the position of the sector on it production frontier. A negative result indicates that the firms of the sector produce less value added than what they

could given their technological level and the production factors used. Hence, these sectors have a loss due to inefficiency. On the contrary, positive numbers indicate efficiency gains. We assume that managers' exertion and corporate efficiency dominate the innovation term on the period 1999-2003. The following table gives the OLS estimation of the equation *(2)* with fixed effects.

Empirical results

variables	coefficients
LOG(L1?)	0.469024 (0.0)
LOG(INV?)-LOG(L1?)	0.402765(0.0)
Fixed effect	
COKE--C	12,05340
FOOD--C	11,55093
ELECTRICITY--C	11,25747
METALS--C	11,10706
CHEMICALS--C	11,05779
TEXTILES--C	10,86737
ELECTRICAL--C	10,65383
PRINTING--C	10,33644
NONMETAL--C	10,29724
MINING--C	10,29531
RUBBER--C	10,19866
OTHER--C	9,962125
VEHICLES--C	9,814886
LEATHER--C	9,702389
WOOD--C	9,561183
R^2 =0.98	
N° 80	

We deduce from the production function estimation that the coefficient of production to labor is close to null and the coefficient to capital is 0.40. We understand that we have decreasing return to scale in the manufacturing sector in Bulgaria. We explain that by the decomposition of large scale sectors consecutive to the transition, the under use of production factor due to the transitional adjustment and the growing productivity of small and medium size firms.

The level of technology $\ln(A_i)$ is estimated by fixed effect. They reflect the new specialization of Bulgaria in small and homogenous manufactured goods as chemicals,

clothing and foods which benefit from among the highest technical levels. The heavy industries and leather are lower in the classification. We note the good result of oil and electricity; this could be explained by the extreme concentration of these sectors (monopoly). These highly concentrated sectors survive to transition because oil and electricity are indispensable inputs whatever the economy. Our specification does not allow controlling for concentration effects in the estimation of productivity.

We should now test the correlation between efficiency assumed to be $\lambda_{i,t}$ and the real appreciation by sectors approximates by the real wages. As we assume the non linearity of the relation, we had a quadratic term. Here, we get the simultaneity problem, however we suppose that the control for technical level by sector in the first step could vanish the simultaneity due to structural productivity funded upon education… we run nevertheless two sets of estimation the first one tests a direct correlation, the second uses two stage least square with the lagged appreciation as instrument in order to directly control for simultaneity. We also add fixed effects in order to control for eventual time invariant effects in efficiency. The estimation is as follow:

$$\lambda_{i,t} = \alpha_i + \alpha_1 W_{i,t} + \alpha_2 W_{i,t}^2 + e_{i,t} \qquad (3)$$

	OLS		TSLS	
	(1)	(2)	(1)	(2)
LOG(W?)	0.33 (0.0)	4.32 (0.0)	0.58 (0.0)	5.0 (0.0)
LOG(W?)²		-0.25 (0.0)		-0.29 (0.0)
R-squared	0.17	0.23	..	..
Durbin-Watson stat	1.85	2.01	...	...
observation	80	80	65	65

A robust positive correlation appears between real appreciation and efficiency improvement. We remember that $\lambda_{i,t}$ indicates if the sectors are in the efficiency or the inefficiency zone. The positive correlation means that real appreciation could support the exit from the inefficiency zone and increase in efficiency. A monetary strategy of hard currency funded upon real appreciation could be useful in a context of transition when an important number of firms sticks to the inefficiency zone. To the opposite decreases in real wage should lead to more inefficiency, thus an active monetary policy, a "soft currency" policy, could delay the transition process.

We notice that the quadratic form is significant. The real appreciation has a strong positive effect on TFP until a level of real appreciation of 5324 deflated Leva. Above this

level more real appreciation tends to have a negative effect on productivity. This real appreciation level calculated for the all the sample could be compared with the actual real wage in each sectors presented in the following table.

Table 8: descriptive statistics on wages

	Mean	Median	Maximum	Minimum	Std. Dev.
Chemicals and synthetic fibres	3921.489	3710.131	4906.254	3348.607	640.9382
Coke, refined petroleum products, nuclear fuel	6713.320	7044.220	8689.428	4737.214	1515.147
Electrical, optical and other equipment	2906.634	2734.743	3682.584	2317.697	529.5451
Electricity, heating, gas and water supply	5005.989	5060.397	5447.097	4511.266	346.4733
Food, drink, tobacco	2706.595	2595.564	3126.940	2430.018	285.1301
Industry	2985.749	2960.457	3498.795	2552.647	382.0518
Leather	1706.220	1616.897	1992.747	1467.665	218.5085
Machinery and equipment	2903.501	2794.779	3693.200	2347.580	554.0259
Manufacturing	2436.228	2390.039	2899.682	2049.354	336.5667
Metals and metal products	3673.069	3549.247	4323.023	3110.651	569.8544
Mining	4389.300	4456.254	5260.138	3645.550	714.1755
Other manufacturing	3149.617	2884.227	3908.035	2629.723	553.6447
Other non-metal mineral products	1925.196	1804.604	2431.833	1439.553	413.4425
Pulp, paper, cardboard; printing and publishing	2975.518	2840.043	3762.608	2480.991	531.0611
Rubber and plastic products	2482.910	2346.759	3131.597	2028.786	419.1644
Textiles and clothing	1807.582	1825.799	2101.471	1511.604	258.4562
Vehicles	3205.937	3034.019	4197.292	2749.343	582.6484
Wood processing	1985.753	1896.795	2672.400	1520.449	461.7235

We notice that most of the sectors have a mean and a median under the estimated level that gives us some evidence for further productivity enhancement by real appreciation for this given technology. Only oil is already out passing the “limit”. This threshold is probably conditional to the economic structure prevailing over the period 1999-2003. Especially, it could change with the level of capital and technology.

The policy implication of the study is first a quite satisfactory statement. Bulgaria keeps room for positive appreciation for the given technological level i.e. some “productivity reserve”. Some figures could encourage policy action aiming at supporting real remuneration or social actions in sectors where wage are really depreciate as in leather, non mineral product and textile. The catching up process with the Bulgarian average wage could support productivity growth.

However, the study also highlights upper bounds for a positive relation. The bound could be quickly reached and different consequences could be expected following the sectors. We assume that the threshold of the relation is able to move with the technological level, controlled here by the fixed effect (A). Indeed, the technological level which is assumed time invariant in the short run, could change in the end mainly because of long run pro-competitive

polices. Polices funded upon education and R&D are likely to push up the appreciation bound and thus to avoid costly loss of competitiveness. The European integration gives strong perspectives to enhance the technological level in three domains. First, the compliance with the "acquit" should improve the legal and regulatory Bulgarian framework which influences in return technological level. The increase in exchange of goods, capital (FDI) and people (for education or work) should ease the technological importation. Finally, some of the subsidies granted to candidates will be aimed at improving infrastructure as transportation which also makes part of the technological level. An important part of the responsibility stays however in the government hands especially on the side of education and health.

4. Summary and Conclusion

Bulgaria adopted a currency board in 1997. This kind of fixed nominal exchange rate regime is prone to real appreciation which is often taken as harmful because of the misalignment risk. However, the currency board also brings a favorable environment for productive reforms because of the budgetary constraint hardening. In this paper, we highlight strong reasons to believe in a "converse effect" to Balassa-Samuelson. Indeed some real appreciation could improve productivity mainly for three purposes: the reduction of X inefficiency, the increase of foreign competition and the modification of managers' incentives. These phenomena are enhanced in the Bulgarian case. Actually, Bulgaria is a small transitional country with low income level. The appreciation should support the factors reallocation and the improvement of labor productivity.

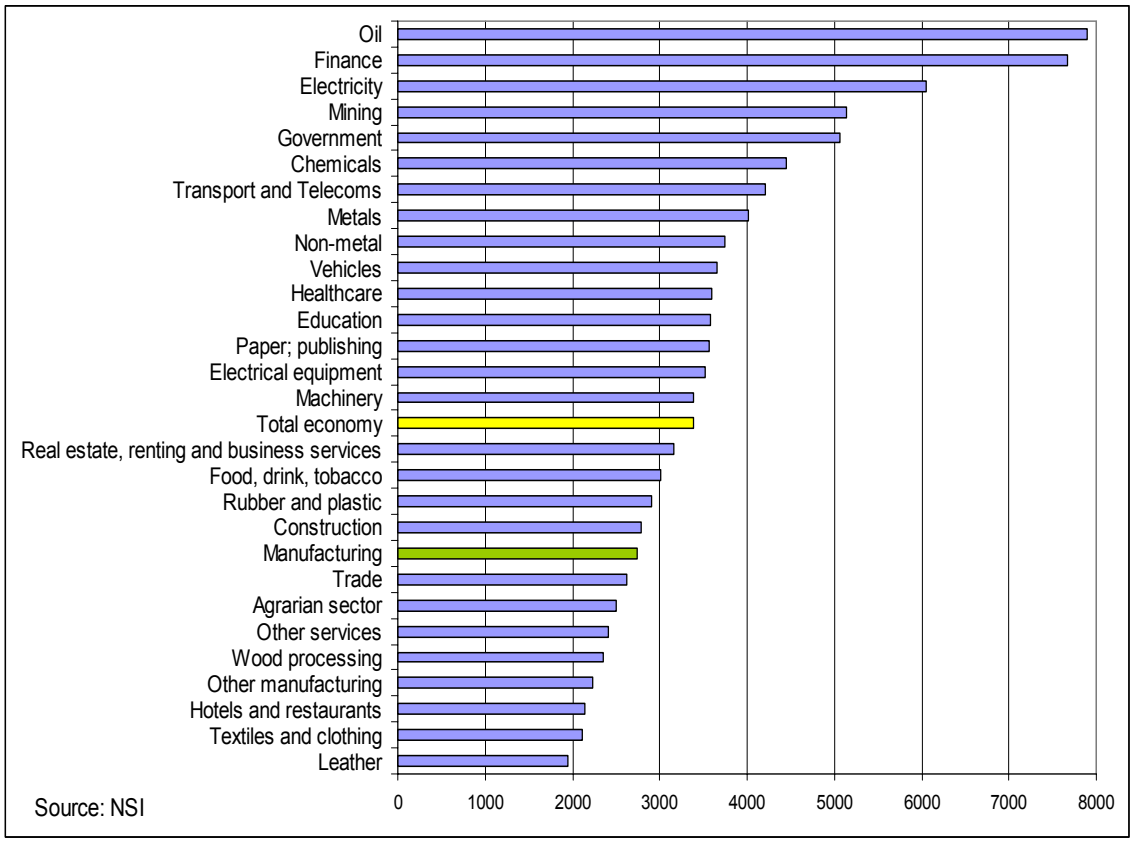
The empirical tests are funded upon total factor productivity. We benefit of data on 17 industrial sectors over the period 1999-2003. The real wage is taken as an approximate for real appreciation by sectors. The results of miscellaneous empirical framework corroborate the hypothesis of a positive correlation between real appreciation and productivity. The impact is positive in average over the period. However, we notice a significant quadratic effect which means that there is an upper bond to the positive correlation.

5. Appendix 1: value added share of industrial sectors in Bulgaria

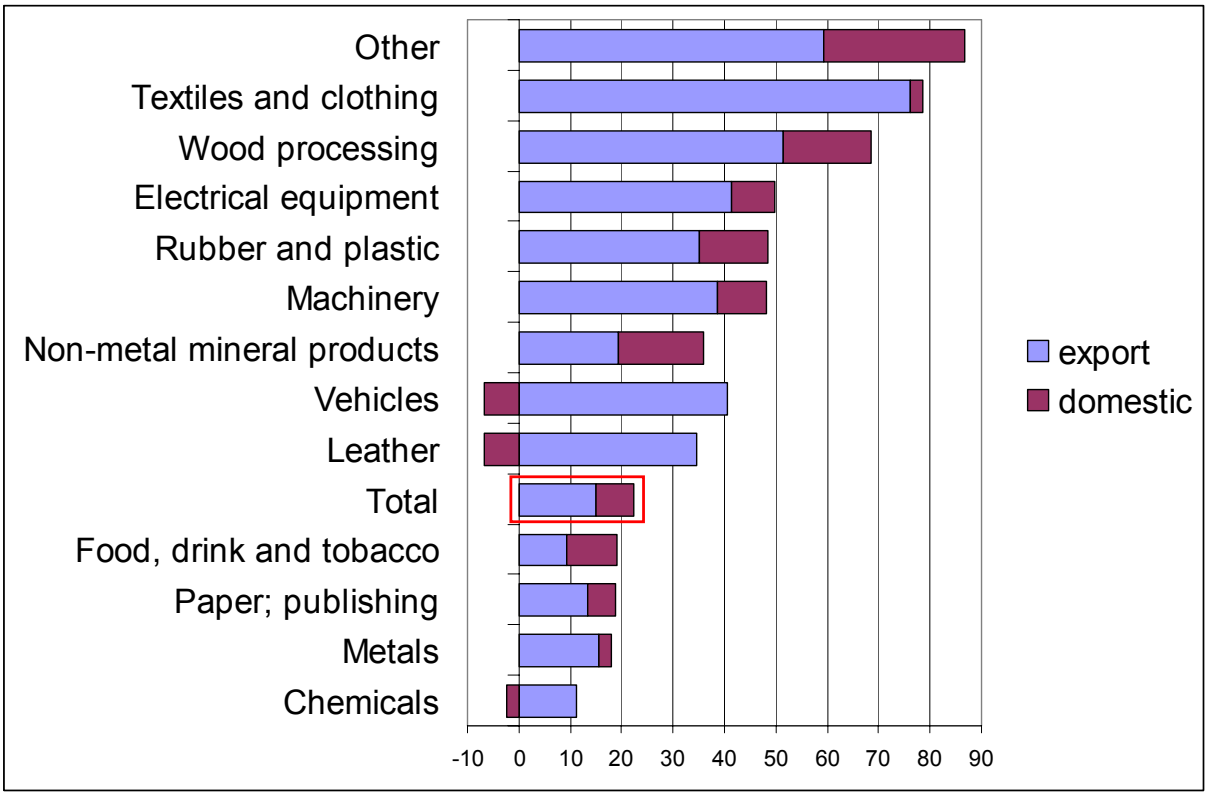
sales	1999	2000	2001	2002	2003	period average
Industrial sectors						
Industry	100	100	100	100	100	100
Electricity, heating, gas and	15.87121	15.85603	16.6101	16.21363	14.14117	15.73843

water supply						
Mining	5.70435	5.049928	4.556105	4.552366	4.152614	4.803073
Manufacturing	78.42444	79.09922	78.91338	79.27635	81.62578	79.46783
Manufacturing sectors						
Food, drink, tobacco	26.17029	24.25645	23.45612	23.15099	22.86191	23.97915
Textiles and clothing	6.977542	6.961704	7.434673	9.020132	9.845708	8.047952
Leather	1.168363	1.11742	1.08221	1.162464	1.131252	1.132342
Wood processing	1.608546	1.416437	1.3603	1.679162	1.889583	1.590805
Pulp, paper, cardboard; printing and publishing	4.283859	4.002452	3.674842	3.699455	3.764344	3.88499
Coke, refined petroleum products, nuclear fuel	14.57155	16.6019	18.40426	15.59092	14.18715	15.87116
Chemicals and synthetic fibres	9.763429	10.08734	10.17253	9.355658	8.709248	9.61764
Rubber and plastic products	2.0853	1.948912	1.964117	1.932128	2.292335	2.044558
Other non-metal mineral products	4.994598	4.554315	4.421538	4.787662	4.907899	4.733202
Metals and metal products	13.63773	15.7526	13.90485	13.9091	14.70995	14.38284
Machinery and equipment	7.161105	6.231181	6.410848	7.394301	7.307606	6.901008
Electrical, optical and other equipment	4.301638	4.431195	4.554913	5.575549	5.252399	4.823138
Vehicles	1.758596	1.625808	1.649048	1.505554	1.722248	1.652251
Other manufacturing	1.517457	1.291018	1.32759	1.577241	1.909693	1.5246

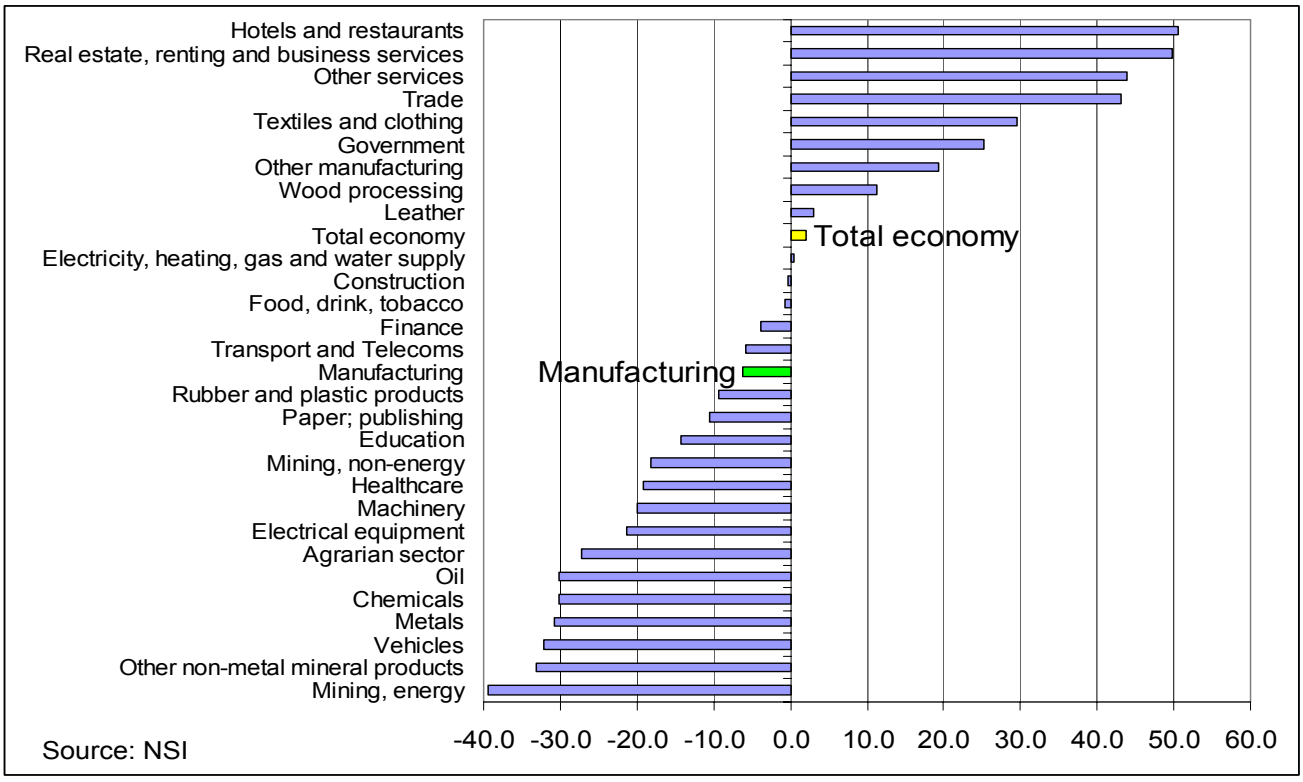
6. Appendix 2 :wage levels.



7. Appendix 3: Contribution of external demand to output growth of sectors



8. Appendix 4: variation of employment in sectors during the period 1999-2003.



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