



**DISCUSSION PAPERS**

**DP/85/2011**

BULGARIAN  
NATIONAL  
BANK

# **Trade, Convergence and Exchange Rate Regime: Evidence from Bulgaria and Romania**

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**Emilia Penkova-Pearson**

July 2011

## DISCUSSION PAPERS

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ISBN: 978-954-8579-43-8

Printed in the BNB Printing Centre.

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Elements of the 1999 banknote with a nominal value of 50 leva are used in cover design.

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**SUMMARY:** The aim of the paper is to reveal the similarities and differences of export and import demand functions of Bulgaria and Romania over the period 2000–2008 using quarterly data. On the one hand, the countries are similar in respect to the convergence process with the euro area that they are undergoing, on the other hand, they have different exchange rate regimes: Bulgaria has a currency board arrangement, Romania’s exchange rate regime is characterized by a managed float. The empirical analysis will therefore contribute to the debate if the countries with flexible exchange rates are in a more advantageous position concerning competitiveness compared to the countries with fixed exchange rates. The study shows that the export dynamics of Bulgaria and Romania over the period of investigation is largely explained by the EU growth, while the increasing market shares of the two countries are partly due to strong FDI inflows. A key conclusion of the paper is that the real exchange rate appreciation, which was more prominent in Romania than in Bulgaria, did not have significant impact on export developments of neither of the two countries. This is mainly due to the fact that the real exchange rate appreciation during this period of convergence is likely to reflect an upward movement in its equilibrium value, not a loss in competitiveness. Another important conclusion is that the convergence process in respect to trade in both economies is similar irrespective of their exchange rate regime, currency board or managed float.

*Keywords:* Competitiveness, exchange rate regime, trade, transition economies, EU accession.

*JEL Classifications:* F15, F17, O24, O52.

Bulgarian National Bank, email: Penkova.E@bnbank.org. The paper expresses the views of the author and not of the Bulgarian National Bank. The author would like to thank Kalin Hristov and Mariella Nenova for their valuable comments. The author is also grateful for all comments and suggestions received at the workshop “Twenty Years of Economic Reforms in Central and Eastern Europe”, Germany, June 2010.

## I. Introduction

Bulgaria and Romania are small open economies operating in the highly integrated Single Market of the EU. They registered strong export, import and GDP growth over the analyzed period (2000–2008). This period is characterized by nominal and real convergence, illustrated by catching-up developments in both countries' productivity, income and price levels towards the prevailing EU average levels<sup>1</sup>, and by process of deepening trade and financial integration. In 2007 the accession to the EU intensified the restructuring of the two economies. Furthermore, the anticipation of high growth and the relatively high risk-adjusted expected returns before and after the accession accelerated the foreign capital inflows. The catching-up process was also accompanied by a trend of real exchange rate appreciation of the two countries' currencies which is likely to affect their competitiveness.

The aim of the paper is to investigate empirically export and import demand functions of Bulgaria and Romania over the period 2000–2008 using quarterly data. This is a first empirical analysis on trade of Bulgaria and Romania which provides the contributions of the main determinants of exports and imports of the two countries. Following Allard (2009)<sup>2</sup> rather than just providing the elasticities, this method combines the elasticities with the evolution of the explanatory variables to quantify their impact during the period of investigation. Furthermore, Bulgaria has a currency board arrangement, Romania's exchange rate regime is characterized by a managed float. The empirical analysis will therefore provide some insights not only in the context of the convergence process of the two countries with the euro area but also in relation to the exchange rate regime<sup>3</sup>, and will contribute to the debate if the countries with flexible exchange rates are in a more advantageous position concerning competitiveness compared to the countries with fixed exchange rates.

The rest of the paper is organized as follows: Section II summarizes the initial conditions in Bulgaria and Romania and the evolution of trade during transition to a market economy. Section III provides different views on the effect of the exchange rate regime on trade. Section IV outlines the stylized facts of the analyzed period. Section V presents the theoretical framework of the empirical models. Section VI describes the data. Section VII summarizes the empirical estimation and results. Section VIII concludes the paper.

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<sup>1</sup>The convergence is one of the most used concepts which originates in the Solow neoclassical theory of economic growth, the convergence being defined as the pattern that a country follows towards the stability state.

<sup>2</sup>Allard (2009) analyzes the developments in the external sector in Poland, the Czech Republic, Hungary and Slovakia over the period 2002–2007.

<sup>3</sup>The analysis does not aim to cover all possible differences and similarities in the external sector of the two countries and thus may need to be complemented with country specific analyses.

## II. Initial conditions and the evolution of foreign trade during transition

Foreign trade liberalization is one of the most dynamic areas of economic transformation among other reforms undertaken by transition countries. After the collapse of communism, in a relatively short period of time, Bulgaria and Romania abandoned the inward-oriented trade within the Council for Mutual Economic Assistance (CMEA) for an open system of commercial exchange, with the EU becoming one of the most important trade partners.

The last decade before transition to a market economy, the socialist economies were as export-oriented as other developing countries (Krugman and Obstfeld, 1977), with the two groups following a similar path. The collapse of the communist regimes in the late 80's induced a dramatic fall in exports – mainly due to the abandonment of the CMEA agreement. However, foreign exchange liberalization allowed for a quick re-orientation and an increase of trade volume in the case of transition countries because their degree of openness and diversification was close to the level existing in the EU (Havrylyshyn and Al-Atrash, 1998).

As emphasized by Brenton (1999) the evolution of foreign trade for countries in transition is characterized by two main tendencies: a reorientation of exchange towards EU countries and an increase in trade deficits. A trade deficit does not necessarily mean that a country's position deteriorates in terms of foreign trade as long as the inflow of capital is significant. The trade balance deficit in Bulgaria and Romania during the period of investigation should be therefore considered within the overall context of the balance of payments. Hence, foreign trade is more complex and more important than the simple exchange of commodities between a transition country and the rest of the world. Foreign direct investment is a crucial component affecting foreign trade and should be taken into account when analyzing trade performance.

## III. Exchange rate regime and trade

The choice of an exchange rate regime and its macroeconomic implications – a well debated subject since the collapse of the Bretton-Woods system in the early 1970s gained renewed interest of researchers and policy makers with the series of the Asian financial crises in the late 1990s<sup>4</sup>. Most of the research focused on the effect of exchange rate regimes on economic

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<sup>4</sup>Indonesia, South Korea and Thailand were the countries most affected by the crisis.

growth and inflation, but the seminal work of Rose (2000), which investigates the effect of monetary union on bilateral trade, has generated considerable interest in investigating the influence of exchange rate regimes on international trade (Klein and Shambaugh, 2006; and Adam and Cobham, 2007). These studies almost unanimously find that exchange rate regimes with lower uncertainty and transaction costs – namely, conventional pegs and currency unions are significantly more pro-trade than flexible regimes.

In Bulgaria in mid-1997 a currency board arrangement was introduced by fixing the national currency to the Deutsche mark (and since 1 January 1999 – to the euro). The sustainability of the currency board arrangement is guaranteed by its design (law). The main characteristics are as follows: full coverage of the Bulgarian National Bank's monetary liabilities with liquid foreign exchange reserves; lending to the Government and banks forbidden by law; interest rates are market-based<sup>5</sup>.

Romania's exchange rate regime is characterized by a managed float against the euro. Starting from June 2004 the National Bank of Romania adopted several flexibility measures of the exchange rate through decreasing the dimension and frequency of interventions in the currency market. From November 2004 the central bank increased the exchange rate flexibility measure undertaken for the transition to a crawling band. The National Bank of Romania introduced the inflation targeting regime in 2005. However, the monetary policy is not of a pure inflation targeting as the exchange rate regime is still a managed float.

The role of the exchange rate regime for the competitiveness of a given country and its economic development is subject to theoretical and empirical debates. One of the standard understandings of this issue is that the nominal depreciation of the currency of a country with a floating exchange rate supports its competitiveness in the short-term by making its exports cheaper. The floating exchange rate also provides an opportunity for implementing an autonomous counter-cyclical monetary policy. In practice, however, there are transmission channels, which can cushion or fully neutralise the short-term positive effects of the currency depreciation and the possibilities for implementation of autonomous monetary policy. Among the factors which neutralise the positive effects of the currency depreciation are making imports more expensive, the increase in inflation, salaries and inflation expectations, the effect on the balances of companies and banks. These factors are more strongly expressed with small and open economies like Bulgaria, for which the opportunities for implementing autonomous monetary policies

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<sup>5</sup>For details, see Appendix I: Currency board arrangement in Bulgaria.

are limited. In the medium term, the depreciation of the local currency does not lead to a sustainable improvement of the competitive position of the country.

In practice, the channels that can mitigate the positive effects of currency depreciation on exports are as follows: First, the depreciation of the national currency results in appreciation of the import component of production (imports of raw materials and investment goods) thus leading to higher expenditure of companies and deteriorating exports' competitive positions. Second, the higher import price increases the inflation rate. This higher inflation in turn exerts pressure towards nominal wage rises further pushing up expenditure of companies. Third, local currency depreciation also has a direct negative effect on the financial performance of companies since the service of liabilities in foreign currency becomes more costly (a balance sheet effect).

The paper will therefore contribute to the debate if the countries with flexible exchange rates are in a more advantageous position concerning competitiveness compared to the countries with fixed exchange rates.

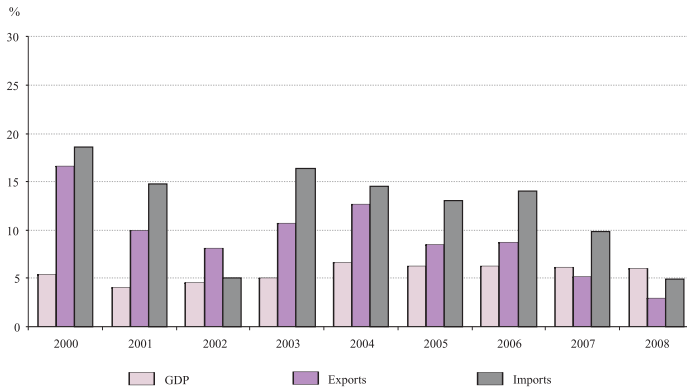
#### **IV. Stylized facts of the analyzed period (2000–2008)**

The analyzed period is characterized by catching-up developments of Bulgaria and Romania in their productivity, income and price levels towards the prevailing EU average levels as well as by a process of a deepening trade and financial integration within the Single Market of EU. The catching-up process is likely to be a long-term one as the initial productivity and price level gap is substantial. In view of the long-term horizon of this process and the high degree of openness and integration of the Bulgarian and Romanian economy with the EU, the importance of maintaining and strengthening competitive advantages in the medium and long run cannot be overestimated. Higher stage of economic development (*i.e.* convergence), on the other hand, implies a more competitive economy, as the companies are expected to rely more heavily on quality improvement and innovation strategies, abandoning low-cost competitive advantages. Over the 2000–2008 period all transition economies in Eastern and South-Eastern countries experienced real and nominal convergence. The main factors behind this favorable trend are the EU membership, the increased integration within the Single Market of the EU and the improved macroeconomic stability. Bulgaria and Romania were also successful in achieving higher level of economic convergence during the analyzed period.

Since 2000 till the third quarter of 2008 when the global economic and financial crisis affected the two economies, GDP, export and import growth were strong (see Graph 4.1).

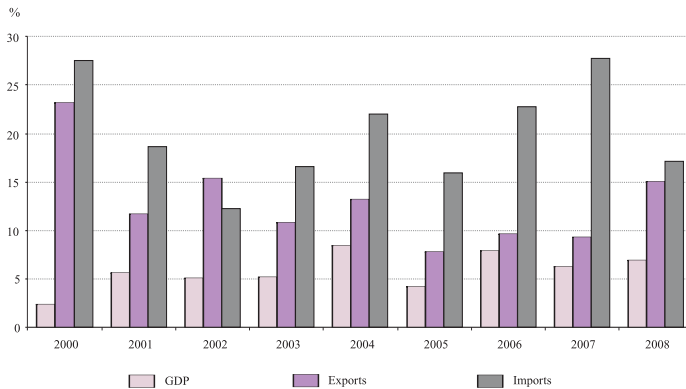


### REAL GROWTH RATES OF BULGARIAN GDP, EXPORTS AND IMPORTS



Source: Bulgarian National Bank.

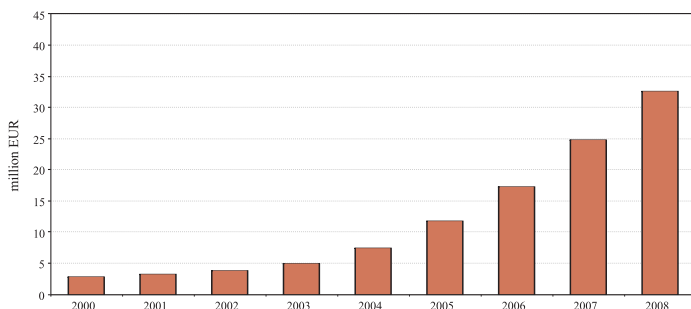
### REAL GROWTH RATES OF ROMANIAN GDP, EXPORTS AND IMPORTS



Source: Eurostat and Romanian Central Bank.

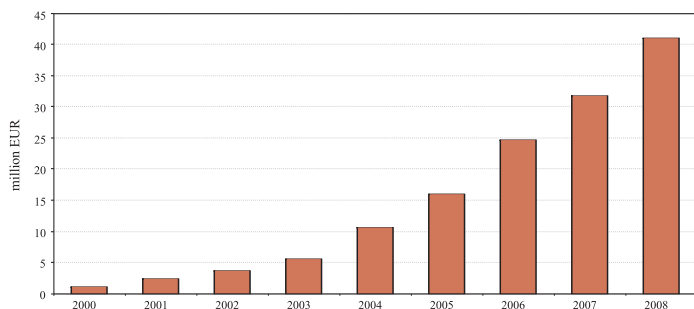
Bulgaria and Romania witnessed large FDI inflows prior to and after the EU accession (see Graph 4.2). In 2007 (the accession year) FDI as per cent of GDP in Bulgaria was 29 per cent, and in Romania it was 6 per cent. As of 2008 FDI accumulated inflows in Bulgaria amounted to around 33 million euro and in Romania were around 41 million euro.

## FDI STOCK IN BULGARIA



Source: BNB.

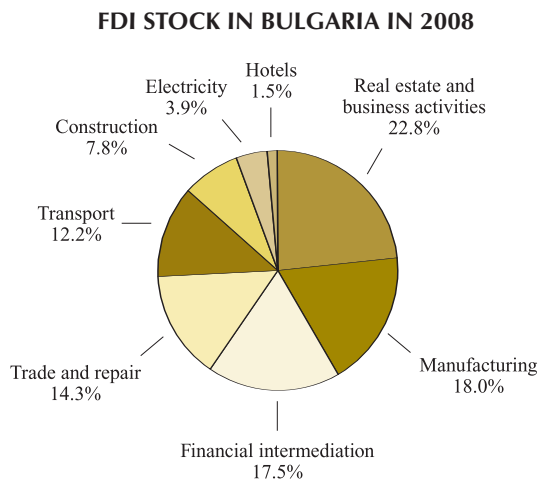
## FDI STOCK IN ROMANIA



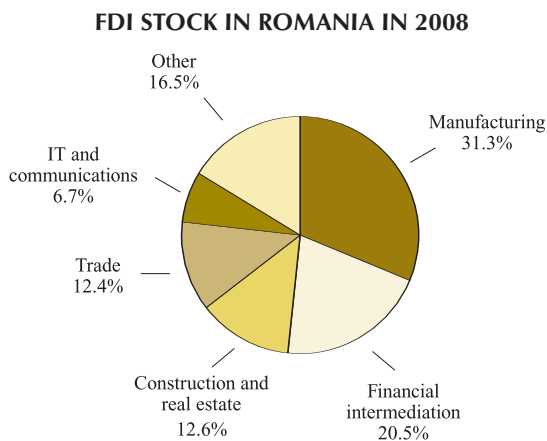
Source: Romanian Central Bank.

In Bulgaria, accumulated FDI were mainly in real estate (22.8 per cent), manufacturing (18 per cent) and financial intermediation (17.5), illustrating that part of it was in export-oriented sectors (see Graph 4.3). In Romania, a large share went to manufacturing (31.3 per cent), financial intermediation (20.5 per cent) and construction and real estate (12.6 per cent)<sup>6</sup> (see Graph 4.3).

<sup>6</sup>As a large share of FDI went to real estate, we subtract it from the total FDI in the empirical estimation for Bulgaria and Romania.



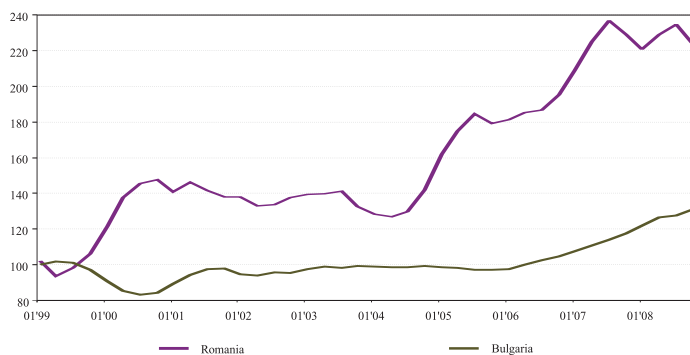
Source: BNB.



Source: Romanian Central Bank.

The catching-up process was also characterized by a trend of real exchange rate appreciation in both countries (see Graph 4.4). The appreciation is mainly driven by fundamentals and the successful economic convergence achieved by these countries both in nominal and in real terms.

### REAL EFFECTIVE EXCHANGE RATE, BASED ON ULC, 1999=100



**Source:** European Commission, Price and Cost Competitiveness, May 2009.

**Note:** The REER index for each of the countries is calculated relative to a basket of 36 industrial countries.

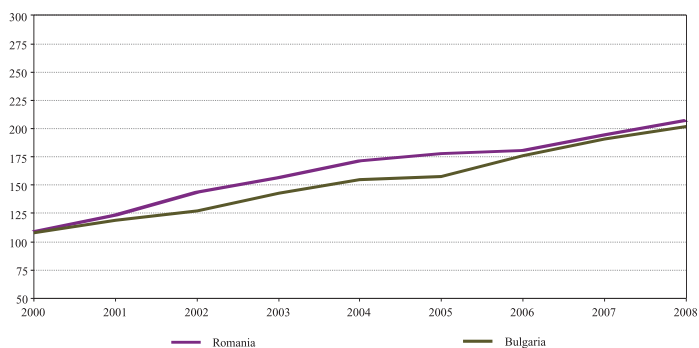
The degree of the real exchange rate appreciation in the run-up to the financial turmoil was higher in Romania than in Bulgaria despite the fact that the latter is with a fixed exchange rate in the currency board regime. The factors which explain the difference in the appreciation of the real exchange rate in both countries are subject to a different piece of research which will complement this paper. However, empirical research on Bulgaria shows that the observed appreciation over the analyzed period is due to fundamentals such as labour productivity, FDI, terms of trade and savings. Econometric estimation of these determinants show that they have the expected signs: an increase in labour productivity and FDI leads to an appreciation of the real exchange rate, positive terms of trade and lower savings also cause an appreciation. Furthermore, the empirical evidence supports the view that during the analyzed period labour productivity growth was the main determinant of the real effective exchange rate dynamics and it had the highest contribution to its annual average appreciation.

In the medium run, the real effective exchange rate is expected to continue to appreciate in both countries due to fundamentals (with the main contribution of labour productivity) and the successful economic convergence of the countries. The rate of an appreciation will depend on the speed of the convergence process.

Over the period of investigation there was a sustainable increase in the share of Bulgarian and Romanian exports in world exports (see Graph 4.5). The main exporting partner of the two countries is the EU. Furthermore, the important role played by the EU as a main trading partner is evident by the significant increase of the share of Bulgarian and Romanian exports in the EU27 imports, by 98 per cent in 2008 for Bulgaria and by 90 per cent for Romania.

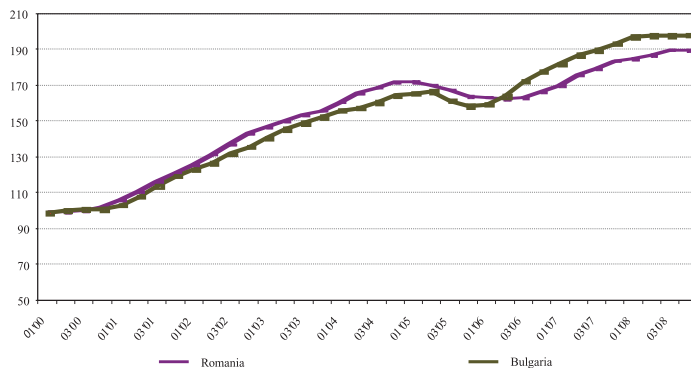
Graph 4.5

### SHARE OF EXPORTS OF GOODS IN WORLD EXPORTS (ANNUALIZED INDEX, 1999=100)



Source: European Commission, AMECO database, last update: 22 April 2009.

### EXPORT SHARES OF NEW EU MEMBER COUNTRIES IN EU27 IMPORTS (ANNUALIZED INDEX, 2000=100)

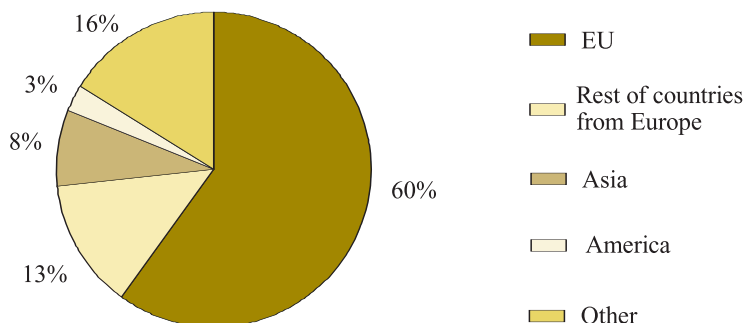


Source: Eurostat, BNB.

The two countries are also characterized by geographical diversification of their exports (see Graph 4.6).

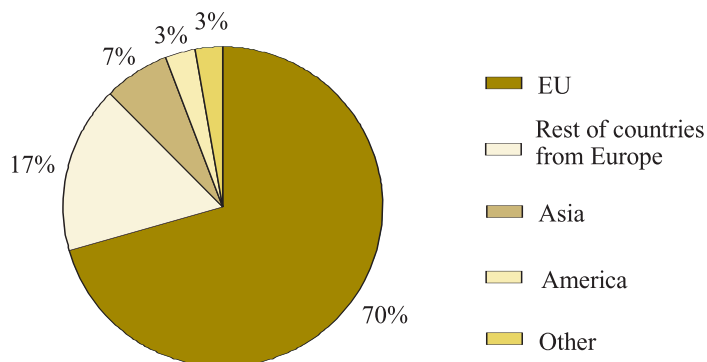
Graph 4.6

### GEOGRAPHICAL DISTRIBUTION OF BULGARIAN EXPORTS IN 2008



Source: Bulgarian National Bank.

### GEOGRAPHICAL DISTRIBUTION OF ROMANIAN EXPORTS IN 2008



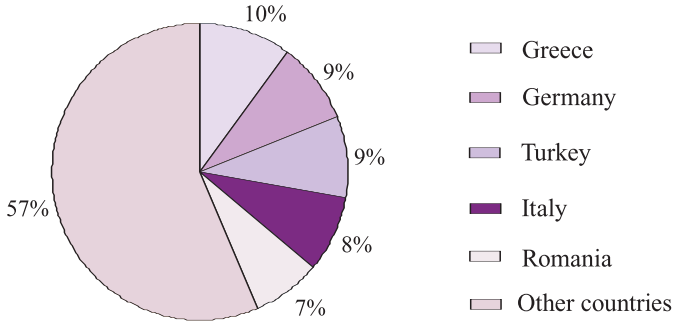
Source: Romanian Central Bank.

As of 2008 the main exporting partners of Romanian exports are Germany (16.4 per cent), Italy (15.5 per cent), France (7.4 per cent) and Turkey (6.5 per cent) (see Graph 4.7). As for Bulgaria, these are Greece (9.9 per cent), Germany (9.1 per cent), Turkey (8.8 per cent) and Italy (8.4 per cent) (see Graph 4.7), illustrating that during the analyzed period there is an improve-

ment in the quality of exports in both countries as their exports are oriented towards developed countries which create entry opportunities for transition economies to progress on the quality ladder.

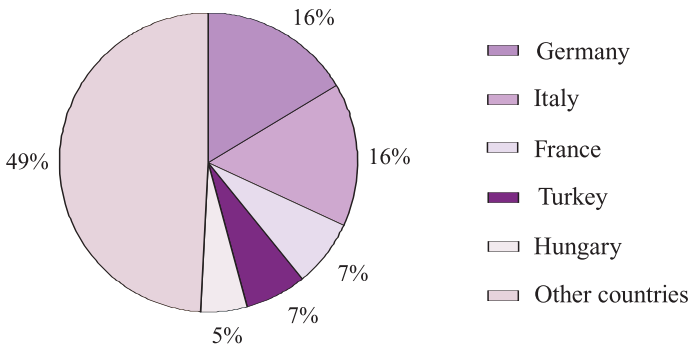
Graph 4.7

**THE MAIN PARTNER COUNTRIES OF BULGARIAN EXPORTS IN 2008**



Source: Bulgarian National Bank.

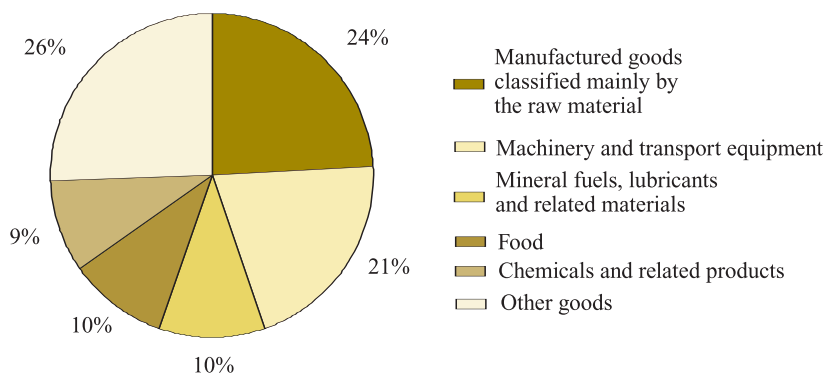
**THE MAIN PARTNER COUNTRIES OF ROMANIAN EXPORTS IN 2008**



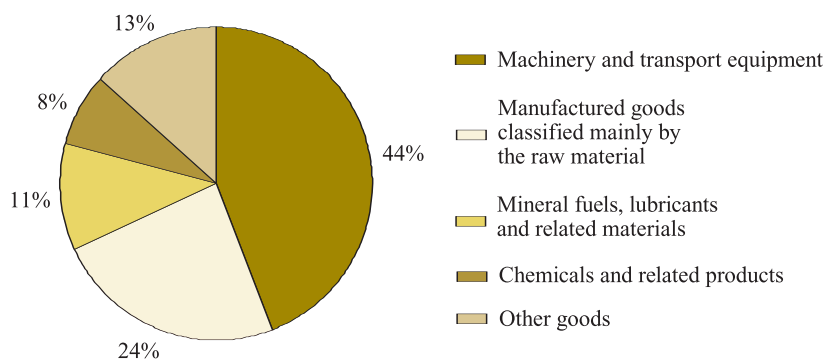
Source: Romanian Central Bank.

Product diversification is another important feature of Romanian and Bulgarian exports (see Graph 4.8).

### BULGARIAN EXPORTS BY MAIN SECTIONS ACCORDING TO SITC IN 2008



### ROMANIAN EXPORTS BY MAIN SECTIONS ACCORDING TO SITC IN 2008



The highest share of exports for both Romania and Bulgaria is occupied by machinery and manufactured goods which provides further support to the hypothesis that there is an improvement in the quality of export goods during the analyzed period. Although the share of machinery is higher in Romanian exports than in the Bulgarian, the transition towards more technology intensive production in Bulgaria is evident and illustrated by the developments in the two sectors – textile and clothing, on the one hand, and electrical equipment, electronics, transport equipment and other machinery,



on the other (data are from short-term indicators of the National Statistical Institute). Textile industry decreased its share in total manufacturing exports at constant prices from 15 per cent in 2004 to 11 per cent in 2008. Exports of electrical equipment, electronics, transport equipment and other machinery grew from 16 per cent in 2004 to 22 per cent in 2008 and increased its exports between 2005 and 2008 by 85 per cent in real terms.

## V. Theoretical framework

There are several different methods of modeling demand for exports and imports. The appropriate model depends on different factors: whether the purpose of the model is hypothesis-testing or forecasting; data availability and the level of disaggregation; and the type of traded goods. However, there are two general models of trade – perfect and imperfect – substitutes models. If the trade studies deal with aggregate imports (exports), the two models could be viewed as competitors. If, however, disaggregation is permitted, the two models could be viewed as complements – one dealing with trade for differentiated goods, and the other with trade for close – if not – perfect substitutes.

### *The perfect–substitutes model*

The following equations (5.1)–(5.8) below constitute a simple perfect substitutes model of trade for a representative country (i), outlined by Goldstein and Khan (1985):

$$D_i = I(P_i, Y_i) \quad l_1 < 0, l_2 > 0 \quad (5.1)$$

$$S_i = n(P_i, F_i) \quad n_1 > 0, n_2 < 0 \quad (5.2)$$

$$I_i = D_i - S_i \quad (5.3)$$

$$X_i = S_i - D_i \quad (5.4)$$

$$PI_i = P_i = PX_i = eP_w \quad (5.5)$$

$$D_w = \sum_{i=1}^m D_i \quad (5.6)$$

$$S_w = \sum_{i=1}^m S_i \quad (5.7)$$

$$D_w = S_w \quad (5.8)$$

In this perfect-substitutes model,  $D_i$  is the total quantity of traded goods demanded in country  $i$ ;  $S_i$  is the supply of traded goods produced in country  $i$ ;  $I_i$  and  $X_i$  are the quantities of country  $i$ 's imports and exports;  $PI_i$ ,  $PX_i$ ,  $P_i$  and  $P_w$  are the import, export, domestic and world prices of traded goods;  $D_w$  and  $S_w$  are the world demand and supply of traded goods; and  $Y_i$  and  $F_i$  are money income and factor costs in country  $i$ .

There are two main features of the perfect-substitutes model. First, there are no separate import and export demand functions. Instead, the demand for imports and the supply of exports represent the "excess" demand and "excess" supply respectively for domestic goods; see eqs. (5.3) and (5.4). Second, when we abstract from transportation costs and other trade barriers (e.g. tariffs) and express all prices in a common currency, then there is only one traded goods price in the perfect-substitutes model (i.e.  $P_i = PI_i = PX_i = P_w$ ). Furthermore, this (world) price is determined by the interaction of world supply and world demand for the traded good. The perfect-substitutes model is therefore more appropriate for modeling trade relationships of homogeneous commodities (wheat, copper, sugar, etc.) that are traded on international commodity markets at a common price.

### ***The imperfect-substitutes model***

In equations (5.9–5.8) an imperfect substitutes model of country  $i$ 's imports from, and exports to, the rest of the world (\*) outlined by Goldstein and Khan (1985) is presented:

$$I_i^d = f(Y_i, PI_i, P_i) \quad f_1, f_3 > 0, f_2 < 0 \quad (5.9)$$

$$X_i^d = g(Y_i^*, PX_i, P_i^* e) \quad g_1, g_3 > 0, g_2 < 0 \quad (5.10)$$

$$I_i^s = h[PI_i^*(1+S_i), P_i^*] \quad h_1 > 0, h_2 < 0 \quad (5.11)$$

$$X_i^s = j[PX_i(1+S_i), P_i] \quad j_1 > 0, j_2 < 0 \quad (5.12)$$

$$PI_i = PX_i^*(1+T_i)e \quad (5.13)$$

$$PI_i^* = PX_i(1+T_i^*)/e \quad (5.14)$$

$$I_i^d = I_i^s e \quad (5.15)$$

$$X_i^d = X_i^s \quad (5.16)$$

These eight equations determine the quantity of imports demanded in country  $i$  ( $I_i^d$ ), the quantity of country  $i$ 's exports demanded by the rest of the world ( $X_i^d$ ), the quantity of imports supplied to country  $i$  from the rest of the world ( $I_i^s$ ), the quantity of exports supplied from country  $i$  to the rest of the world ( $X_i^s$ ), the domestic currency prices paid by importers in the two regions ( $PI_i$  and  $PI_i^*$ ), and the domestic currency prices received by exporters in two

regions ( $PX_i, PX_i^*$ ). The exogenous variables are the levels of nominal income in the two regions ( $Y_i, Y_i^*$ ), the price of (all) domestically produced goods in the two regions ( $P_i, P_i^*$ ), the proportional tariff ( $T_i, T_i^*$ ) and subsidy rates ( $S_i, S_i^*$ ) applied to exports and imports in the two regions, and the exchange rate ( $e$ ) linking the two currencies (expressed in units of country  $i$ 's currency per unit of the rest-of-world's currency).

The main characteristic of the model is that the consumer is postulated to maximize utility subject to a budget constraint. The demand functions for imports and exports therefore represent the quantity demanded as a function of the level of (money) income in the importing region, the imported good's own price, and the price of domestic substitutes. Often, an additional assumption is made that the consumer has no money illusion, so that a doubling of money income and all prices leaves demand constant, *i.e.*  $f_1 + f_2 + f_3 = 0, g_1 + g_2 + g_3 = 0$ . Such homogeneity of the demand function is expressed by dividing the right-hand side of eq. (5.9) by  $P_i$  so that the two arguments of the demand function become the level of real income ( $Y_i/P_i$ ) and the relative price of imports ( $PI_i/P_i$ ). Accordingly, if we divide the right-hand side of eq. (5.10) by  $P_i^*$  the two arguments of the demand function for exports become the level of external demand ( $Y_i^*/P_i^*$ ) and the relative price of exports ( $PX_i/P_i^*$ ). These are the two equations that are usually estimated in empirical work modeling export and import of a given country. The prevailing practice is therefore to assume that the supply-price elasticities for imports and exports (*i.e.*  $h_i$  in eq. (5.11) and  $j_i$  in eq. (5.12) respectively) for small economies are infinite which permits satisfactory estimation of the import and export demand equations (5.9) and (5.10) by single-equation methods, since  $PI_i$  and  $PX_i$  can be viewed as exogenous.

### ***The import and export demand functions for Bulgaria and Romania***

The imperfect-substitutes model is more appropriate for the purpose of this paper due to the fact that neither exports nor imports are perfect substitutes for domestic goods. If domestic and foreign goods were perfect substitutes, then countries would specialize, either only importing or only exporting each particular good. In practice, however, both domestic and imported goods can be found coexisting on markets, indicating that countries do not in fact specialize to such a high degree.

#### ***Import demand functions***

Studies by Khan and Ross (1977) and Salas (1982) suggest that in modelling an aggregate import demand function, the log-linear specification is

preferred to the linear formulation. The use of the log-linear formulation constrains the price and income elasticity estimates to be constant over the estimation period while the linear form of the import demand equation implies a decreasing price elasticity and an income elasticity tending towards one.

Accordingly, following the imperfect-substitutes model, the long run import demand function for Bulgaria and Romania is specified as follows:

$$\ln(M^d) = m_0 + m_1 \ln(DD) + m_2 \ln\left(\frac{IMP}{GDP}\right), \quad m_1 > 0, m_2 < 0 \quad (5.17)$$

where DD is domestic demand, IMP is the import deflator, GDP is the GDP deflator.

Therefore, the demand for imports depends positively on domestic demand and negatively on the real exchange rate which is the relative price of import and GDP deflators.

### ***Export demand functions***

Following the imperfect-substitutes model the following export demand function for Bulgaria and Romania can be derived:

$$X^d = x(Y^f, PX_h, PX_c) \quad f_1 > 0, f_2 < 0, f_3 > 0 \quad (5.18)$$

where  $X^d$  = the quantity of the domestic good which is exported to the foreign market,  $Y^f$  = the real foreign income,  $PX_h$  = the price of the domestic good,  $PX_c$  = the price of competing suppliers in the foreign market in a common currency, and  $f_i$  = the expected partial derivatives of the export function with respect to the  $i^{th}$  argument .

In the paper, we also incorporate FDI in the export demand function to investigate if it has a significant effect on export performance. Foreign direct investment influence supply-side determinants of exports, reflecting to some extent the quality of physical capital as well as worker skills and market penetration potential. The so called New Trade Theory, influenced by the theory of industrial organization has added this new insight into the possible factors affecting the demand for exports, such as FDI or the quality of traded goods. There are several papers that find a positive relationship between FDI and exports. Using aggregate data Driver and Wren-Lewis (1999) derive a specification for exports that allows for traditional relative-price effects as well as effects from innovation in variety and quality. They estimate this model for the panel of the G-7 countries using time series and panel co-integration techniques. In addition, Pain and Wakelin (1998) analyze the export perfor-

mance and also relate foreign direct investment to innovation in industries. They estimate conventional panel of 11 OECD countries specified as an error correction mechanism. Finally, Bajo and Montero (1995, 2001) estimate Spanish demand for exports using FDI and examine the causality relationship between FDI and trade. Based on the above-mentioned arguments, equation (3.2) can be extended with the introduction of FDI stock as a proxy for quality:

$$X^d = x(Y^f, PX_h, PX_c, FDI), \quad f_4 > 0 \quad (5.19)$$

The log-linearization of the equation (5.19) is:

$$\ln(X^d) = x_0 + x_1 \ln(Y^f) + x_2 \ln\left(\frac{PX_h}{PX_c}\right) + x_3 \ln(FDI), \quad x_1 > 0, x_2 < 0, x_3 > 0 \quad (5.20)$$

The above equation represents the long-run co-integrating relationship among exports and their determinants, illustrating that real exports depend positively on external demand, negatively on real exchange rate which is the ratio of home to competitor's price, and positively on FDI stock which is a proxy for quality.

## VI. Data

All the data are in real terms (2005=100 for Bulgaria and Romania). The data on real exports, real imports and domestic demand for Bulgaria are from the Bulgarian National Accounts of the Bulgarian National Statistical Institute. The data on real exports, real imports and domestic demand for Romania are taken from the Romanian Central Bank. The import, export, GDP and investment deflators for Bulgaria are taken from the Bulgarian National Statistical Institute. The import, export, GDP and investment deflators for Romania are from the Romanian Central Bank. The FDI accumulated inflows for Bulgaria are from the Bulgarian National Bank, they are in national currency and investment in real estate is subtracted. The FDI accumulated inflows for Romania are from the Romanian Central Bank, they are also in national currency and investment in real estate is subtracted. Manufacturing export price for advanced economies from the IMF is used as a proxy for external price for Bulgaria and Romania. However, it is in US dollars, so we convert it in national currencies by using the exchange rate of Bulgarian lev per US dollar from the Bulgarian National Bank, and the exchange rate of the Romanian leu per US dollar from Eurostat. The external demand of Bulgarian and Romanian exports is based on calculations of the OECD and the Bulgarian National Bank.

## VII. Empirical estimation and results

The empirical estimation includes four stages and employs the Engle-Granger (1987) two step procedure.

The four stages of the overall empirical estimation of the export and import demand functions of Bulgaria and Romania are as follows:

First, we determine the order of integration of the variables by employing Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The PP test was designed to be robust for the presence of autocorrelation and heteroscedasticity.

The regression equation for the ADF test (see Dickey and Fuller, 1979) is given as follows:

$$\Delta Y_t = a + bt + cY_{t-1} + \sum_{i=1}^k d_i \Delta Y_{t-i} + e_t \quad (4.1)$$

where  $\Delta$  is first difference operator,  $t$  refers to time trend, and  $k$  are additional terms in the first differences for the Augmented Dickey-Fuller (ADF) test  $e_t$  is the regression error assumed to be stationary with zero mean and constant variance. The Phillips Perron test is also based on equation (4.1) but without the lagged differences. Both tests were carried out to reject the null hypothesis of a unit root ( $c=0$  for ADF, and  $c=1$  for PP). The results are presented in Appendix I, and they show that all variables are integrated of order one,  $I(1)$ , i.e. stationary in their first differences.

Second, we estimate the long-run equation which is the first step of the Engle-Granger two step procedure.

Third, as we find that the variables are co-integrated (the error term is stationary, the results are in Appendix II), we specify error correction models and estimate them – this is the second step of the Engle-Granger two step procedure. In the short run, we include four lags, and non-significant lags are eliminated sequentially starting with the least significant one until only significant variables are left.

In a final step following Allard (2009), dynamic contributions are computed to assess the role of the various explanatory variables in the evolution of exports and imports over the 2000–2008 period.

The results from the estimated equations are enclosed in Appendix III. The estimated coefficients take the theoretically expected sign except for the short-run relative price for Romanian exports. In most cases, the coefficients are significant at 5 or 10 per cent level.

Table 7.1

**EXPORTS LONG-TERM ELASTICITIES RELATED TO NON-PRICE COMPETITIVENESS**

	Bulgaria	Romania
External demand	0.96	0.78
FDI accumulated inflows	0.20	0.19

Table 7.2

**EXPORTS LONG-TERM ELASTICITIES TO PRICE COMPETITIVENESS**

	Bulgaria	Romania
Relative price	-0.08	-0.10

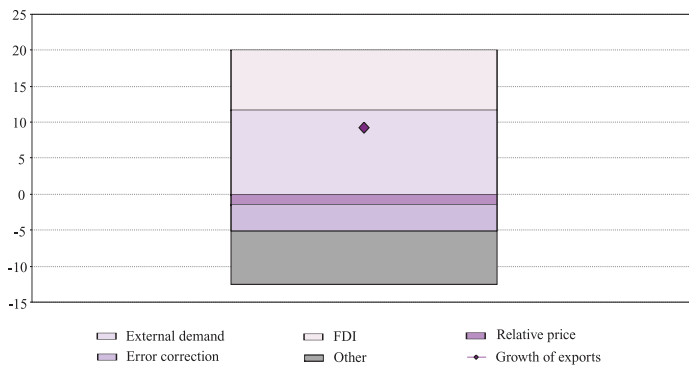
The pick up in external demand accounts for the largest part of growth of exports for Bulgaria and Romania over 2000–2008 (see Graph 7.1). This growth reflects the ability of the smaller countries to expand their market share more systematically since transition, a result evident from the relatively high elasticities to external demand (the elasticity is higher in Bulgaria than in Romania).

The accumulated FDI investment also contributed positively to export growth, more in Bulgaria than in Romania. This illustrates that the quality of physical capital and worker skills played a significant role for the export performance of the two economies. The EU accession also contributed to attract new investors leading to more export-oriented new projects.

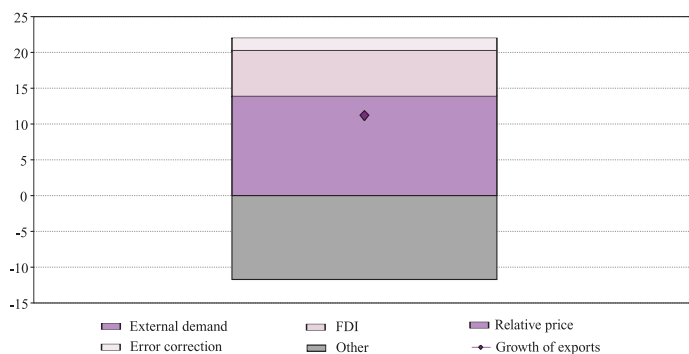
The price elasticity is low in both economies, however, it is slightly less in Bulgaria than in Romania possibly reflecting a different technology content of export goods (for example, exports of high-technology goods are less price elastic). We could conclude, that price competitiveness was not a problem for Bulgaria and Romania during the period of investigation. The relative prices had a slight negative contribution to Bulgarian exports and almost no contribution to Romanian exports (see Graph 7.1). This result suggests that most of the trend appreciation of the real exchange rate in both countries is an equilibrium development, not a loss in price competitiveness.

The contribution of others (constant, seasonals and residual) for both countries is negative, although to a lesser extent in Bulgaria (see Graph 7.1). This could include the overall business climate, the sectoral orientation of trade, or non-price competitiveness indicators that are not captured in the estimation.

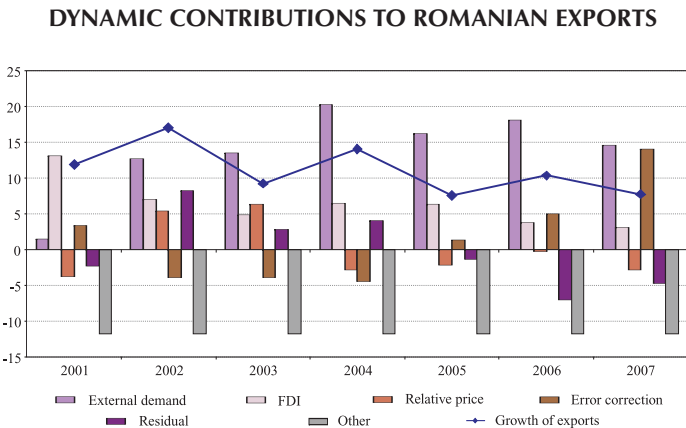
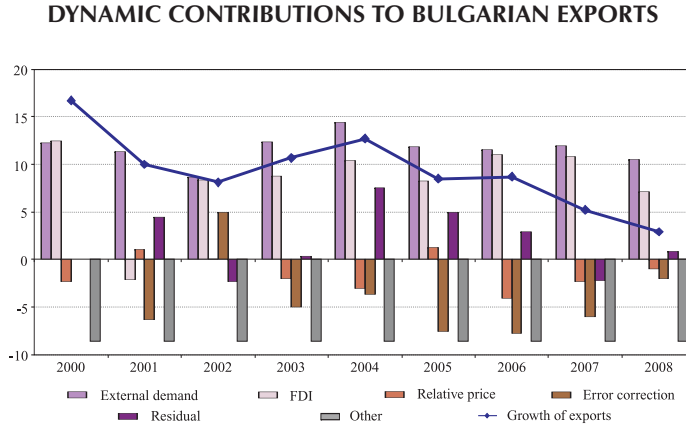
### ACCOUNTING FOR BULGARIAN AVERAGE EXPORT GROWTH, 2000–2008 (CONTRIBUTION OF DETERMINANTS)



### ACCOUNTING FOR ROMANIAN AVERAGE EXPORT GROWTH, 2000–2008 (CONTRIBUTION OF DETERMINANTS)







Concerning the imports, strong domestic demand played a key role for both countries as expected (see Graph 7.3). The elasticities of imports of both countries to domestic demand is around two, illustrating high elasticity to domestic demand. The inelasticity of import with respect to import price in Bulgaria and Romania implies that during the period of investigation, imports were largely determined by non-price factors. By contrast with the export equations, the other factors (constant, seasonals and residual) are positive which pushed up the growth rate of imports. This could include FDI, for example, which is not included in the estimation.

As import demand is income elastic in the long run, economic growth may have negative implications on the balance of payments in Bulgaria and Romania. In order to mitigate these negative effects, governments strategies should promote the development of domestic capital goods industries and also industries that produce consumption and intermediate goods that are competitive in terms of price and quality to imports.

Table 7.3

**IMPORTS LONG-TERM ELASTICITIES RELATED TO NON-PRICE COMPETITIVENESS**

	Bulgaria	Romania
Domestic demand	2.29	1.63

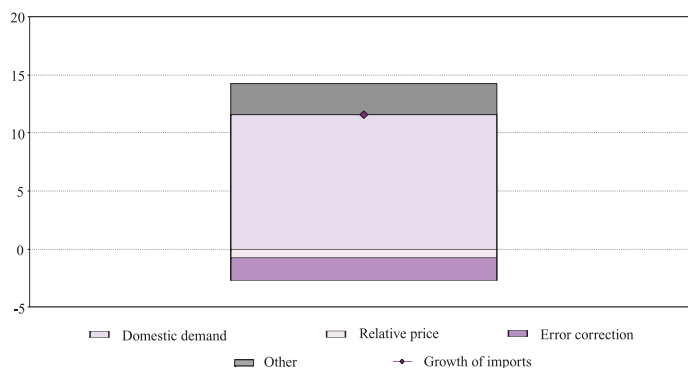
Table 7.4

**IMPORTS LONG-TERM ELASTICITIES TO PRICE COMPETITIVENESS**

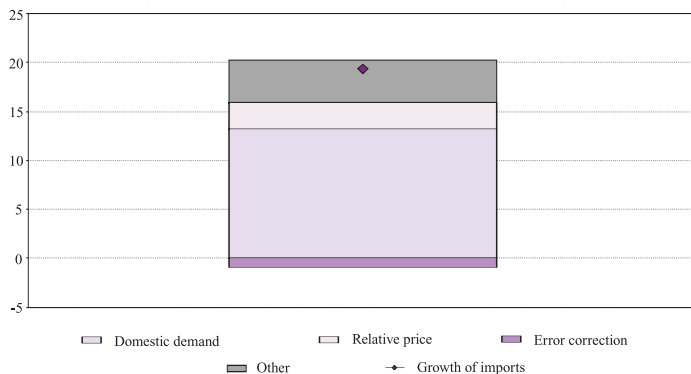
	Bulgaria	Romania
Relative price	-0.20	-0.12

Graph 7.3

**ACCOUNTING FOR AVERAGE BULGARIAN IMPORT GROWTH, 2000–2008  
(CONTRIBUTION OF DETERMINANTS)**

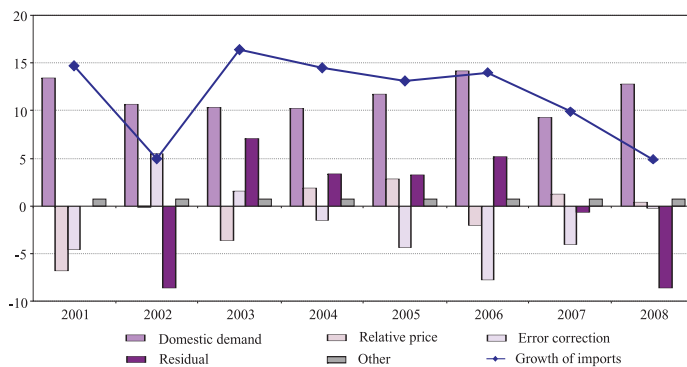


## ACCOUNTING FOR AVERAGE ROMANIAN IMPORT GROWTH, 2000–2008 (CONTRIBUTION OF DETERMINANTS)

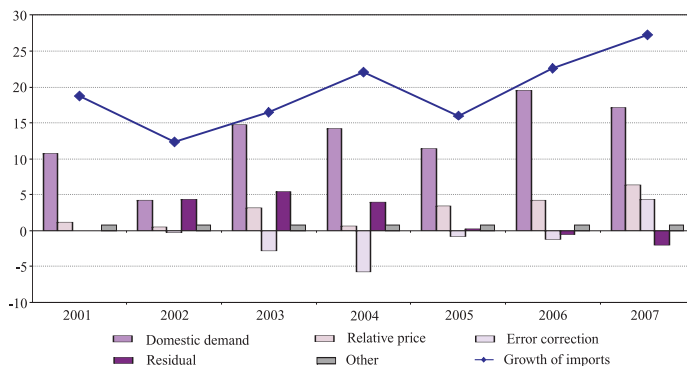


Graph 7.4

## DYNAMIC CONTRIBUTIONS TO BULGARIAN IMPORTS



## DYNAMIC CONTRIBUTIONS TO ROMANIAN IMPORTS



If we extend the sample till the fourth quarter of 2010 as the data are available to this date, a structural break occurs and the results are difficult to interpret. However, several important points could be emphasized for the period of the global economic crisis. While Bulgaria and Romania entered the period of global turmoil from a strong competitive position, their reliance on global and domestic demand had a negative impact on trade flows. The relatively high elasticities to external demand had a big impact on exports (the volume of Bulgarian exports declined by 11.2 per cent in 2009 and the volume of Romanian exports declined by 5.3 per cent, supported by the empirical results that Bulgarian exports have higher elasticity to external demand compared to Romanian exports). Also, in both countries imports declined because of the decrease in domestic demand. Furthermore, the elasticities of imports to domestic demand are higher than elasticities to external demand which explains why imports declined by more than exports in both economies (the volume of Bulgarian imports declined by 21 per cent in 2009 and the volume of Romanian imports declined by 20.9 per cent).

## VIII. Conclusions

The paper provides insights in the trade determinants of Bulgaria and Romania which recently became EU members in the context of the convergence process and also in relation to different exchange rate regimes. The global and domestic acceleration explain a significant part of export and import developments in both countries during the period 2000–2008. The pickup in growth in the EU explains to a large extent the export growth in Bulgaria and Romania. This study also shows that over the period of investigation Bulgaria and Romania were able to increase their market share, partly due to strong FDI inflows.

The key conclusion is that price competitiveness does not appear to have significant impact on trade developments in Bulgaria and Romania. Despite rapid exchange rate appreciation, which was more prominent in Romania than in Bulgaria, although the latter is with fixed exchange rate, relative prices remained muted. The evolution of relative price had a negligible negative contribution to Bulgarian exports and almost no contribution to Romanian exports. As for imports, the relative prices boosted imports for Romania and had a very small negative contribution for Bulgaria. These results suggest that most of the trend appreciation of real exchange rate reflects more a shift of an equilibrium value, not a loss in price competitiveness.

Overall, we could conclude that the convergence process in respect to trade in both economies is similar over the period of investigation irrespective of their exchange rate regime, currency board or managed float.

## Appendix I

### *Currency board arrangement in Bulgaria*

The operation of the currency board in Bulgaria is based on three major principles laid down in the Law on the BNB, namely: (1) a fixed exchange rate which as of the moment of the euro introduction is BGN 1.95583 per EUR 1; (2) the total amount of BNB monetary liabilities is fully covered by full high-liquid foreign reserves. BNB monetary liabilities consist of banknotes and coins in circulation, liabilities vis-à-vis banks, the government and budget organizations, liabilities to other depositors (see Issue Department balance sheet on the BNB website); (3) the central bank's obligation to unconditionally and irrevocably sell and purchase levs against euro at the exchange rate fixed by the Law on the BNB. These principles mean that the national currency is issued solely against providing reserve currency at the fixed exchange rate.

The currency board and the fixed exchange rate are further protected by the following provisions in the Law on the BNB:

(1) The BNB may not extend loans and guarantees in any form whatsoever, including through purchase of debt instruments, to the Council of Ministers, municipalities, as well as to other government and municipal institutions, organizations and enterprises. This provision excludes the possibility, in order to support the government in financing budget expenditure, to issue national currency beyond the limit corresponding to the currency board principles.

(2) The Bank may not provide credit to banks except in the case of liquidity risk threatening to affect the stability of the banking system. The terms and procedure for extending this credit, and criteria for identifying the existence of liquidity risk are set by an ordinance of the BNB, and the credit is to be extended up to the amount exceeding the lev equivalent of gross international reserves vis-à-vis the total amount of BNB monetary liabilities. This provision also excludes the possibility, in order to support the banks, to issue national currency beyond the limit corresponding to the currency board principles.

(3) The BNB shall invest its gross international reserves in accordance with the principles and practices of prudent investment, with investments in securities being limited to liquid debt instruments satisfying the following requirements: debt instruments issued by foreign countries, central banks, other foreign financial institutions or international financial organizations, whereof obligations are assigned one of the two highest ratings by two internationally recognized credit rating agencies, and which are payable in freely convertible foreign currency. Rules for investing gross international reserves are also intended to protect the quality of assets in which these reserves are invested.

The above principles of the currency board operation guarantee an automatic mechanism of balancing national currency demand and supply at the fixed exchange rate determined by the law. Under the currency board, it is impossible that the issue of national currency exceeds the level of the gross international foreign exchange reserves, which could, otherwise, lead to erosion of the fixed exchange rate (a key difference between a currency board and a standard fixed exchange rate regime). The change in the level of BNB gross international reserves reflects the net result of demand for national currency by economic agents, government and banks, as well as changes in the market value of gold (as part of international reserves) and financial assets in which these reserves are invested.

Under the conditions of the fixed exchange rate against the euro and a free movement of capital, the BNB has no control over the interest rates and therefore, monetary conditions in Bulgaria follow to a great extent those in the euro area. Thus, the currency board largely reproduces the conditions in which the euro area economy is functioning.

The main instrument used by the BNB to affect monetary conditions is the regulation of the minimum required reserves maintained by banks with the central bank. For example, the reduction of the minimum required reserves rate since early 2009 has boosted liquidity in the banking system and contributed to falling interest rates in the interbank money market. It is possible for the central bank to indirectly influence the monetary conditions in Bulgaria by implementing supervisory and administrative measures but their objective is mainly financial stability rather than affecting monetary conditions.

Fiscal policy also may affect money supply and liquidity in the economy through a change in the amount of the government deposit with the BNB, the net government securities issuance and their maturity or repurchases. Withdrawal of funds from the government deposit at the BNB and their depositing on other banks' accounts may boost banking system liquidity.

The implementation of these macroeconomic policy instruments affects the level of international reserves. Any change in policies that lead to an increase of the required reserves that banks have to maintain with the BNB or fiscal policies that lead to increase in the deposit of the government with the BNB also lead to an increase of the international reserves and *vice-versa*. In this respect, the fluctuations in the level of the international reserves are mainly policy driven.

## Appendix II

### Co-integration Tests

Table 1

#### TEST RESULTS FOR UNIT ROOTS FOR EXPORTS VARIABLES FOR BULGARIA

Variable	ADF level	First difference	PP level	First difference
LE_EX_R (exports)	-0.962892	-2.548061*	-2.468044	-11.02786*
LRP (relative price)	-2.344142	-4.089647*	-2.696441	-4.153125*
LE_FDI_R (FDI)	-3.048278	-7.000493*	-3.660610	-7.000493*
LA_WTV_R (ext. demand)	-2.274377	-1.777185	-1.464081	-6.218769*

\*, \*\* and \*\*\* denote rejection of a unit root hypothesis based on MacKinnon's critical value at 1 per cent, 5 per cent and 10 per cent.

Table 2

#### TEST RESULTS FOR UNIT ROOTS FOR IMPORT VARIABLES FOR BULGARIA

Variable	ADF level	First difference	PP level	First difference
LE_MP_R (imports)	-1.23821	-3.003429**	-7.016183*	-22.99910*
LRELPR (relative price)	-1.679213	-6.251493*	-1.561949	-6.243422*
LR_DD_R (dom. demand)	-0.667590	-4.110638*	-9.228513*	-16.01653*

\*, \*\* and \*\*\* denote rejection of a unit root hypothesis based on MacKinnon's critical value at 1 per cent, 5 per cent and 10 per cent.

Table 3

**TEST RESULTS FOR UNIT ROOTS FOR RESIDUALS OF EXPORT AND  
IMPORT EQUATIONS FOR BULGARIA**

Variable	ADF level	PP level
Residuals (exports)	-3.990354**	-3.943055**
Residuals (imports)	-3.347157**	-3.359132**

\*, \*\* and \*\*\* denote rejection of a unit root hypothesis based on MacKinnon's critical value at 1 per cent, 5 per cent and 10 per cent.

Table 4

**TEST RESULTS FOR UNIT ROOTS FOR EXPORTS VARIABLES FOR  
ROMANIA**

Variable	ADF level	First difference	PP level	First difference
LE_EX_R (exports)	-1.718113	-8.893079*	-4.087559**	-10.51416*
LA_REER_R (real effective ER)	-1.428654	-4.683814*	-1.512948	-4.742796*
LE_FDI_R (FDI)	-0.667553	-3.730669*	-0.635338	-3.656584**
LA_WTV_R (ext. demand)	-3.267192	-3.991536*	-3.838937**	-7.376505*

\*, \*\* and \*\*\* denote rejection of a unit root hypothesis based on MacKinnon's critical value at 1 per cent, 5 per cent and 10 per cent.



Table 5

**TEST RESULTS FOR UNIT ROOTS FOR IMPORT VARIABLES FOR ROMANIA**

Variable	ADF level	First difference	PP level	First difference
LE_MP_R (imports)	-1.586173	-3.950805*	-4.759125**	-10.94347*
LRELPR (relative price)	1.091090	-1.453922	-3.720417**	-7.452448*
LR_DD_R (dom. demand)	-2.067721	-1.938260	-7.289733*	-12.84323*

, \*\* and \*\*\* denote rejection of a unit root hypothesis based on MacKinnon's critical value at 1 per cent, 5 per cent and 10 per cent.

Table 6

**TEST RESULTS FOR UNIT ROOTS FOR RESIDUALS OF EXPORT AND IMPORT EQUATIONS FOR ROMANIA**

Variable	ADF level	PP level
Residuals (exports)	-3.271897**	-3.080868**
Residuals (imports)	-4.175699*	-4.171295*

, \*\* and \*\*\* denote rejection of a unit root hypothesis based on MacKinnon's critical value at 1 per cent, 5 per cent and 10 per cent.

## Appendix III

### *Estimated equations*

#### **Exports (Bulgaria)**

$$\ln(E\_EX\_R\_STAR)=1.64+0.96\ln(A\_WTV\_R)-0.08\ln(E\_EX\_P/(A\_MEPAE\_P*A\_ER\_PI))+0.20*\ln(E\_FDI\_N/R\_KF\_P)+seasonals$$

standard error of regression=0.05      DW=1.68      t statistics are in parentheses

$$d\ln(E\_EX\_R)=0.96 - 0.78(\ln(E\_EX\_R(-1))-\ln(E\_EX\_R\_STAR(-1)))+1.32d\ln(A\_WTV\_R)-$$

(13.62) (3.66) (1.61)

$$-0.21d\ln(E\_EX\_P/(A\_MEPAE\_P*A\_ER\_PI))+0.50d\ln(E\_FDI\_N/R\_KF\_P)+seasonals$$

(1.41) (1.97)

Adj.  $R^2=0.99$       standard error of regression=0.05

where

E\_EX\_R – real exports

A\_WTV\_R – external demand

E\_EX\_P – export deflator

A\_MEPAE\_P – competitor's price in US dollar

A\_ER\_PI – exchange rate BG currency per US dollar

E\_FDI\_N – FDI accumulated inflows without real estate (nominal value)

R\_KF\_P – Investment deflator

#### **Exports (Romania)**

$$\ln(E\_EX\_R\_STAR)=4.13+0.78\ln(A\_WTV\_R)-0.10\ln(E\_EX\_P/(A\_MEPAE\_P*A\_ER\_PI))+0.19*\ln(E\_FDI\_N/R\_KF\_P)+seasonals$$

standard error of regression=0.04      DW=0.39      t statistics are in parentheses

$$d\ln(E\_EX\_R)=0.07 - 0.18(\ln(E\_EX\_R(-1))-\ln(E\_EX\_R\_STAR(-1)))+0.70d\ln(A\_WTV\_R)-$$

(1.25) (1.39) (1.57)

$$+0.08\text{dln}(E\_EX\_P/(A\_MEPAE\_P*A\_ER\_PI))+0.17\text{dln}(E\_FDI\_N/R\_KF\_P)+\text{seasonals}$$

(1.27) (1.37)

Adj.  $R^2=0.14$  standard error of regression =0.02

where

$E\_EX\_R$  – real exports

$A\_WTV\_R$  – external demand

$E\_EX\_P$  – export deflator

$A\_MEPAE\_P$  – competitor’s price in US dollar

$A\_ER\_PI$  – exchange rate RO currency per US dollar

$E\_FDI\_N$  – FDI accumulated inflows without real estate (nominal value)

$R\_KF\_P$  – Investment deflator

### Imports (Bulgaria)

$$\ln(E\_MP\_R\_STAR)=-10.81+2.29\ln(R\_DD\_R)-0.20\ln(E\_MP\_P/R\_GDP\_P)+\text{seasonals}$$

standard error of regression=0.11 DW=1.51 t statistics are in parentheses

$$\text{dln}(E\_MP\_R)=-0.88 - 0.67(\ln(E\_MP\_R(-1) ) -\ln(E\_MP\_R\_STAR(-$$

(20.86) (3.46)

$$1))) + 4.19\text{dln}(R\_DD\_R) - 0.20\text{dln}(E\_MP\_P/R\_GDP\_P)+\text{seasonals}$$

(1.47) (1.75)

Adj.  $R^2=0.97$  standard error of regression=0.10

where

$E\_MP\_R$  – real imports

$R\_DD\_R$  – domestic demand

$E\_MP\_P$  – import deflator

$R\_GDP\_P$  – GDP deflator

## Imports (Romania)

$$\ln(E\_MP\_R\_STAR) = -7.44 + 1.63 \ln(R\_DD\_R) - 0.12 \ln(E\_MP\_P/R\_GDP\_P) + \text{seasonals}$$

standard error of regression=0.03    DW=1.96    t statistics are in parentheses

$$d\ln(E\_MP\_R) = -0.11 - 0.78(\ln(E\_MP\_R(-1)) - \ln(E\_MP\_R\_STAR(-1))) + 0.99 d\ln(R\_DD\_R) - 0.27 d\ln(E\_MP\_P/R\_GDP\_P) + \text{seasonals}$$

(1.45)    (2.53)

(2.06)                      (1.47)

Adj.  $R^2=0.92$     standard error of regression=0.03

where

E\_MP\_R – real imports

R\_DD\_R – domestic demand

E\_MP\_P – import deflator

R\_GDP\_P – GDP deflator

## Appendix IV

### ***Principle of dynamic contributions<sup>7</sup>***

Let  $Y_t$  be the endogenous variable,  $X_i$  the explanatory variables, and  $\varepsilon_t$  the econometric residual.

The ECM can be written as

$$\Delta \text{Log} Y_t = c_0 + \sum_{i=1}^n \sum_{j=1}^p b_{i,j} \Delta \text{Log} X_{i,t-j} - \lambda \text{ECM}_{-1} + \varepsilon_t \quad (1)$$

where  $\text{ECM} = \text{Log} Y_t - \sum_{i=1}^n \alpha_i \text{Log} X_{i,t}$  is determined by the co-integration relationship.

#### **Breakdown by explanatory variables**

The estimated full dynamic can be summarized as

$$A(L) \text{Log} Y_t = c_0 + \sum_{i=1}^p b_j (1-L) L^j - \lambda \alpha_i L,$$

where  $L$  is the lag operator, and  $A(L)$  and  $B_i(L)$  polynomials of this lag operator.

From (1),  $A(L) = 1 - L - \sum_{j=1}^p c_j (1-L) L^j - \lambda L$  and  $B_i(L) = \sum_{j=0}^p b_j (1-L) L^j - \lambda \alpha_i L$ .

By inverting  $A(L)$ , one gets:  $\text{Log} Y_t = \frac{c_0}{A(L)} + \sum_{i=1}^p \frac{B_i(L)}{A(L)} \Delta \text{Log} X_{it} + \frac{\varepsilon_t}{A(L)}$

The dynamic contributions of variables  $X_i$  to the growth rate of variable  $Y$  are then derived (additively) from the differentiation of (1):

$$\Delta \text{Log} Y_t = \sum_{i=1}^p \frac{B_i(L)}{A(L)} \Delta \text{Log} X_{it} + \frac{\Delta \varepsilon_t}{A(L)} \quad (2)$$

This breakdown also allows one to visualize what remains unexplained in the econometric relationship, through the contributions of the residuals.

<sup>7</sup> It follows Allard (2009).

### Breakdown between short-and long- term dynamics

Another presentation consists in distinguishing between the contribution of the short-term dynamic, through all the variables in growth rate in equation (1), and the long-term dynamic, through the impulse from the error-correcting term:

$$A^*(L)\text{Log}Y_t = c_0 + \sum_{i=1}^n \sum_{j=1}^p b_{i,j} \Delta \log X_{i,t-j} - \lambda \text{ECM}_{-1} + \varepsilon$$

where  $A^*(L) = (1-L)(1 - \sum_{j=1}^p c_j L^j)$

By inverting  $A^*(L)$ , one gets:

$$\Delta \text{Log}Y_t = \frac{c_0}{A^*(L)} + \sum_{i=1}^p \frac{B_i(L)}{A^*(L)} \Delta \text{Log}X_{it} - \frac{\lambda L}{A^*(L)} \text{ECM} + \frac{\varepsilon}{A^*(L)} \quad (3)$$

The first two elements on the right side of (3) – the constant and the terms with the growth rate of  $X_i$  variables – correspond to the contribution of the short-term dynamic, whereas the term with the error-correcting factor shows the contribution of the long-term dynamic namely, by how much the gap from the steady state equilibrium contributes to the growth rate of variable  $Y$ . Here again, the breakdown also allows one to visualize what remains unexplained in the econometric relationship, through the contribution of the residuals.

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