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2005

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CNB CZECH NATIONAL BANK

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Printed and distributed by the Czech National Bank. Available at http://www.cnb.cz.

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# Determining Factors of Czech Foreign Trade: A Cross-Section Time Series Perspective

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## Abstract

By quantifying the determining factors of Czech trade during 1993–2002, this paper enriches the empirical trade literature with evidence from an economy that has undergone intensive structural changes. Our findings lend significance to standard macroeconomic variables such as aggregate demand and the real exchange rate. Apart from these, however, liberalisation of tariffs, the evolution of unit prices of exports and imports, and economies of scale also played a significant role. An out-of-sample forecast for the trade balance was carried out for 2003–2004.

**JEL Codes:** C23, F14, F32.
**Keywords:** Dynamic estimation, export and import dynamics, trade determinants.

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This work was supported by Czech National Bank Research Project No. D4/2003.
The authors would like to thank Jan Kmenta, Vladislav Flek, Jesus Crespo Cuaresma, Josef Arlt and David Vávra for valuable comments and suggestions on previous version of this paper.

## Nontechnical Summary

We estimate the relative importance of factors central to the dynamics and structure of international trade, such as aggregate demand, factor requirements, producer prices, standards of quality, intra-industry specialisation and scale economies. We also test the significance of policy instruments (tariffs, the real exchange rate, the money supply and interest rates).

The most important determinants of Czech trade with the EU-15 are the level of aggregate demand (both domestic and in the EU-15), the real exchange rate, liberalisation of tariffs and the evolution of unit prices of exports and imports. Economies of scale also proved to be a highly significant factor, along with a sharply rising importance of intra-industry trade. These factors boosted export penetration and more than compensated for the adverse effects of the appreciated real exchange rate on the trade balance. The Czech balance of trade with the rest of the world is most explained by domestic GDP, qualitative upgrading in the unit prices of exports, domestic production prices, foreign direct investment, economies of scale and intra-industry trade.

Our estimated models showed that a real exchange rate appreciation decreases the competitiveness of both exports and domestic production replacing imports more than proportionally. The resulting loss in competitiveness, however, has apparently been compensated by additional factors: cost concessions (especially in productivity improvements); attraction of FDI, which has involved a gain in human capital and externalities of economies of scale; structural adjustments in trade; and qualitative improvements in the Czech traded commodities.

Aggregate demand is confirmed to be the most important mechanism of international shock transmission. The estimated coefficients of the income elasticity of exports in the range of 1.21–2.5 and the income elasticity of imports of 1.14–2.21 reveal the extent to which the trade balance could be hit by the hazard of an asymmetric shock at home and abroad.

The out-of-sample forecast of trade flows was performed in two scenarios. The baseline scenario assumes modest changes in exogenous variables and reveals a slight improvement in the trade balance. By contrast, the alternative scenario, assuming more dynamic development of the terms of trade, demand and the exchange rate, points to a more significant improvement in the trade balance.

# 1. Introduction

In this paper we fill the gap in the literature on the determinants of trade developments in transition countries, which undergo significant structural changes and which in this sense provide a unique basis for research. The objective of this paper is to estimate an empirical model, identify the determinants of Czech trade during 1993–2002 and derive an out-of sample forecast of trade flows for 2003–2004.

The seminal paper by Greenhalgh, Taylor and Wilson (1994) initiated a series of papers dealing with disaggregated trade data by industries and regressed against GDP per capita, domestic and foreign prices, indexes of quality and supply reliability. Later on, this approach was extended to alternative hypotheses of trade flows by, for example, Blake and Pain (1994), Pain and Wakelin (1997) and Greenaway, Souza and Wakelin (2002). By contrast, there have been few attempts to estimate the Czech trade functions in a sectoral breakdown, the exceptions being studies by Drabek (1984), Benáček (1988), Stolze (1997) and Benáček *et al.* (2003).

Similarly to the aforementioned literature, which is compatible with major economic theories of trade and trade policies, our model includes macroeconomic factors as well as the industry-specific impacts of changing factor endowments, diffusion of technologies *via* foreign direct investment, scale economies and policy variables. The identification proceeds with a random effects model and an Arellano and Bond (1991) dynamic cross-section time series estimator.

The rest of the paper is organised as follows: In Section 2 we outline basic issues regarding trade developments in the Czech Republic. Section 3 describes the model and estimation methods. The data issues and definition of variables are discussed in Section 4. Section 5 presents the results of the estimation of the export and import models. Section 6 concludes. In the Appendix we present projections for exports and imports for two years based on the estimated model and compare them with the predictions of Consensus Forecasts Eastern Europe.

# 2. Czech Foreign Trade Developments

Any evolution of exports and imports has two basic components: the common macroeconomic background (GDP at home and world-wide and the real exchange rate) and industry-specific technology, factor supply, market structure and barriers to trade. Our analysis should therefore address both the macroeconomic and the microeconomic factors of growth and quantify their general (i.e. average) impact on industries or even enterprises. While the macroeconomic variables are assumed to be the main drivers of overall trade growth, the microeconomic variables are associated with structural developments.[1]

[1] Recent literature on industrial development stresses the importance of the industrial breakdown of production because the restructuring of sectors is not symmetric, which may be associated with the disruption of historical value-added supply chains. New theories of trade and the environment of imperfect competition call for innovative explanatory variables for the analysis of sales (see Markusen and Venables, 1999, and Altomonte and Resmini, 2001).

The opening-up of the post-communist economies and the process of their integration into the EU had a big positive impact on the structure of their specialisation and external competitiveness (Pelkmans, 2002). However, the diversion of trade from the East to the West and sectoral restructuring to an extent unparalleled in European history, did not lead to high overall growth immediately. At the same time, nominal and real exchange rates remained at levels far below the benchmarks expected by purchasing power parity.

After initial losses in output, employment, the real exchange rate, unit labour costs and the terms of trade, the transition economies rallied. They were able to withstand the competition on world markets and they adjusted for EU membership. Their real exchange rates began to appreciate, real wages rose and exports increased exponentially, reflecting gains in competitiveness.

In all transition economies the highest rates of trade growth were achieved in trade with the EU. For example, during 1993–2001, Czech exports to the EU rose from EUR 6.3 billion to EUR 25.6 billion. This fourfold increase implied average annual real growth in exports to the EU of a remarkable 16.2%, while Czech exports to the rest of the world grew at a normal rate of 2% (in constant euros). At the same time, trade creation with OECD partners was accompanied by a large trade diversion from the nation's former partners grouped in COMECON. The share of trade with CEFTA and with developing countries declined only marginally, while Russia and Ukraine were the main losers.

The developments in the Czech trade deficit between 1993 and 2002 can be divided into two quite different periods. The initial one – dating from 1993 to 1996 – is connected with a huge deterioration of the trade deficit to CZK 153 billion in 1996, while the second one saw a remarkable improvement, especially with respect to trade with the EU.

During the initial period, final consumption and investments grew quickly, reflecting the recovery of economic growth. Goods imports increased rapidly to substitute for the only slight response of domestic supply to the increased demand and the changing structure of demand towards high-quality commodities.

The increased import growth was initially followed by less significant export growth. The difficulties in placing Czech goods on foreign markets were caused mainly by (i) a breakdown of the traditional COMECON market, which had absorbed the bulk of Czech exports prior to 1993; (ii) the still low competitiveness of Czech production; and (iii) changing ownership relations in firms and as yet unfinished company restructuring.

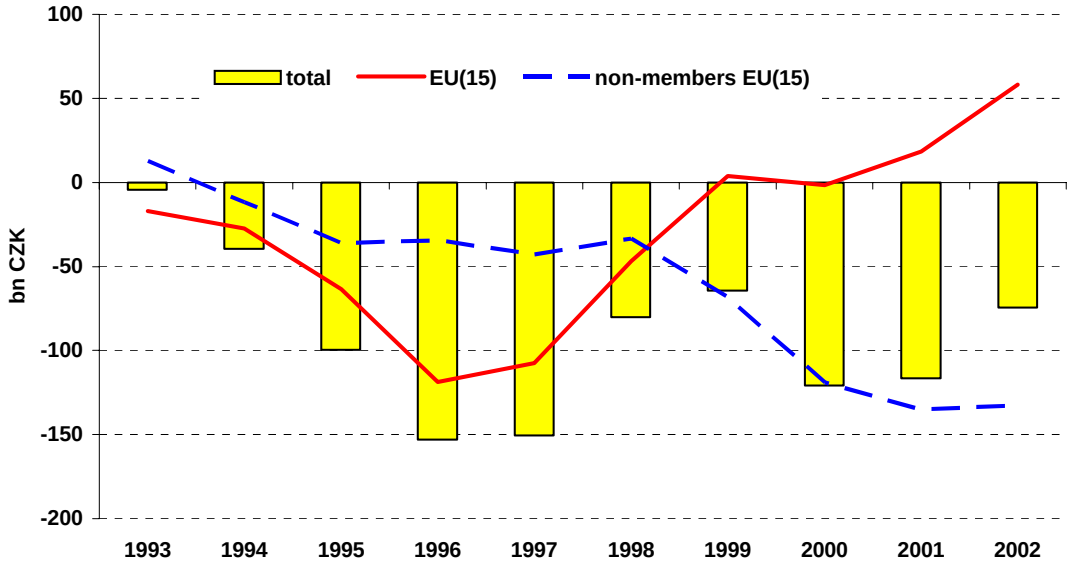
By contrast, the period of 1997–2002 is associated with a gradually improving trade balance trend. In 2002, the trade deficit reached only CZK 71.3 billion, more than 50% lower than in 1997. In that year, the implementation of restrictive macroeconomic policies (responding to increasingly imbalanced developments in the balance of payments) had contributed to a significant reversal of the sizable trade deficit trend.

In addition, following 1997 the inflow of foreign direct investment connected with the privatisation of Czech state enterprises to foreign owners (more precisely, the sale of controlling shares to foreign owners) was the most favourable influence, causing in effect strong export growth.

Nevertheless, the downward trend in the trade deficit was not continuous. In 2000 and 2001, the deficit temporarily increased again compared to the previous two years. This deterioration was due mainly to a rapid increase – compared to previous years – in import prices of fuels (especially crude oil and natural gas) and also to higher investment imports of engineering commodities as a consequence of major restructuring and modernisation.

Even though the level of import prices of fuels remained very high in 2002, the higher value of fuel imports was offset by additional exports as a result of the positive effects of FDI inflows, leading to a moderate improvement in the trade deficit.

***Figure 1: Trade Balance of the Czech Republic in 1993–2002; by Group of Countries***




***Source:*** Ministry of Finance of the Czech Republic – Directorate General of Customs; own calculations.

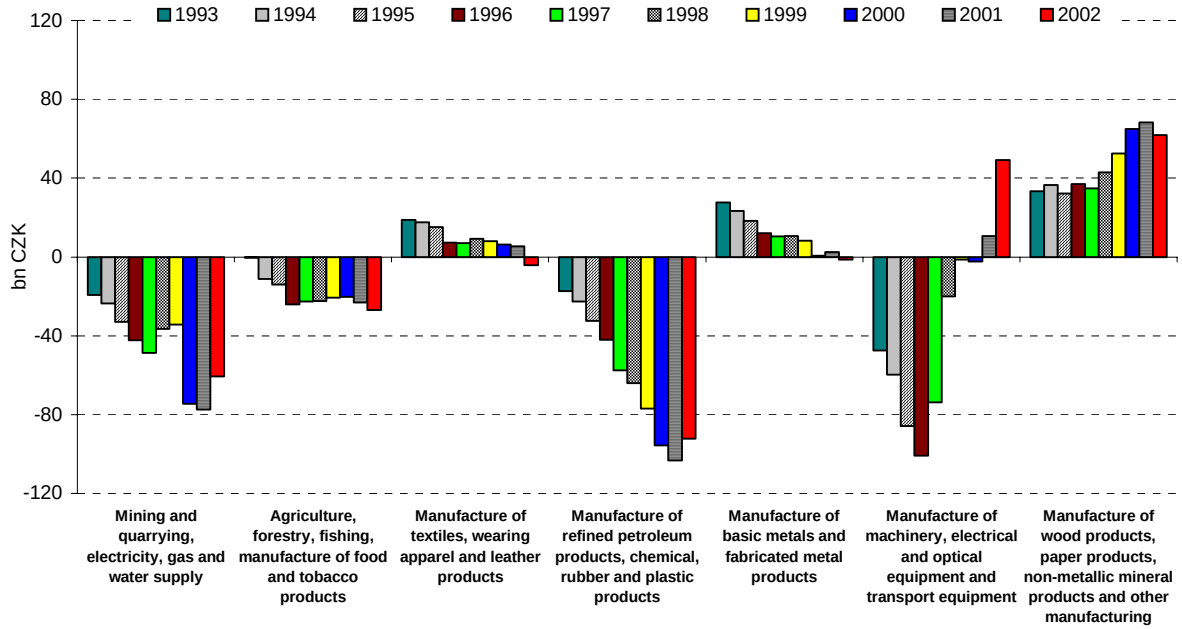
Observed empirically, the evolution in the tradable sector can be quantified as the change in the composition of exports or imports over time, which can be related to two structural aspects: the geographical (territorial) breakdown and the commodity breakdown.

The territorial breakdown of the Czech trade balance clearly reveals both the improvement in trade with the EU-15 and the worsening deficit with the rest of the world (Figure 1). The improvement in trade with the EU-15 starting in 1997 was a consequence of progressive structural changes implemented on the supply side. The pronounced growth in the deficit with the rest of world beginning in 1999 was a result of imports of more expensive energy commodities and growing imports for intermediate consumption, above all electrical components from the Asian region.

The breakdown of the trade balance into seven partial aggregates according to the NACE code (Industrial Classification of Economic Activities; see Figure 2) reveals a strong negative trend for the analysed period of 1993–2002. This is especially apparent in the manufacture of refined

petroleum, chemical, rubber and plastic products, chiefly because of rapid growth of the deficit in the manufacture of chemical products.

***Figure 2: Trade Balance of the Czech Republic in 1993–2002 by NACE Categories***




***Source:*** Ministry of Finance of the Czech Republic – Directorate General of Customs; own calculations.

Furthermore, the deficit in the mining and quarrying and electricity supply category was predominantly a consequence of rapid growth of the deficit in mining and quarrying of energy producing materials. A trend of deterioration in partial balance was also apparent in the manufacture of metals and fabricated metal products, the manufacture of textiles and wearing apparel and in agriculture and the manufacture of food products.

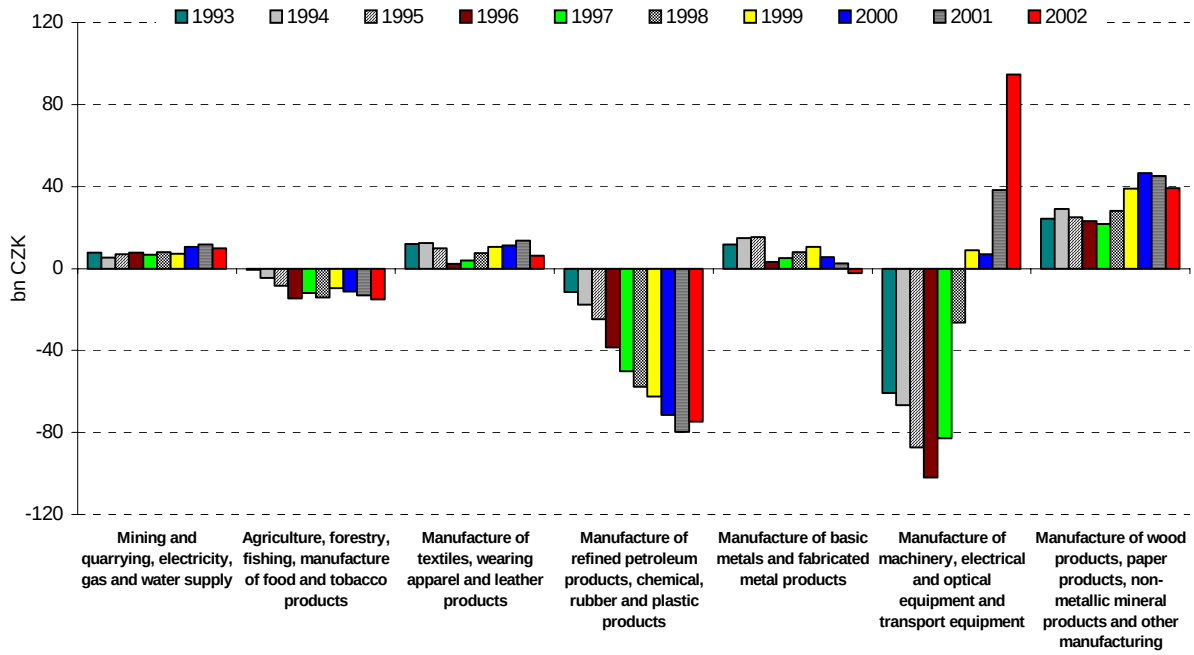
On the contrary, an apparent improvement was exhibited by the manufacture of wood, paper and mineral products and other manufacturing (mainly as a consequence of an increasing surplus in the manufacture of furniture and other manufacturing).

The only partial balance to record a substantial turnaround in the analysed period was the manufacture of machinery and electrical, optical and transport equipment. Engineering branches had the highest share in the total foreign trade turnover throughout the period (41% on average). The balance for engineering branches was *de facto* the sole determinant of the overall trade balance.

After initial rapid growth in deficit in the engineering branches (up to 1996, when it reached CZK 100.9 billion), their balance significantly improved during 1997–2002 and in the final year reached a surplus of CZK 49.2 billion. This favourable development was mainly due to a rapid increase in surplus in the manufacture of transport equipment.

The engineering branches balance was by far the dominant item in foreign trade with the EU-15 (see Figure 3). The share of engineering branches in total annual trade turnover with the EU was 62% on average in the analysed period. After having fallen to a deficit of CZK -101.9 billion in 1996, the engineering branches balance closed with a surplus of CZK 94.7 billion in 2002. An improving balance trend was also apparent in the case of the manufacture of wood, paper and mineral products and other manufacturing.

***Figure 3: Trade Balance of the Czech Republic with the EU-15 in 1993–2002 by NACE Categories***




***Source:*** Ministry of Finance of the Czech Republic – Directorate General of Customs; own calculations.

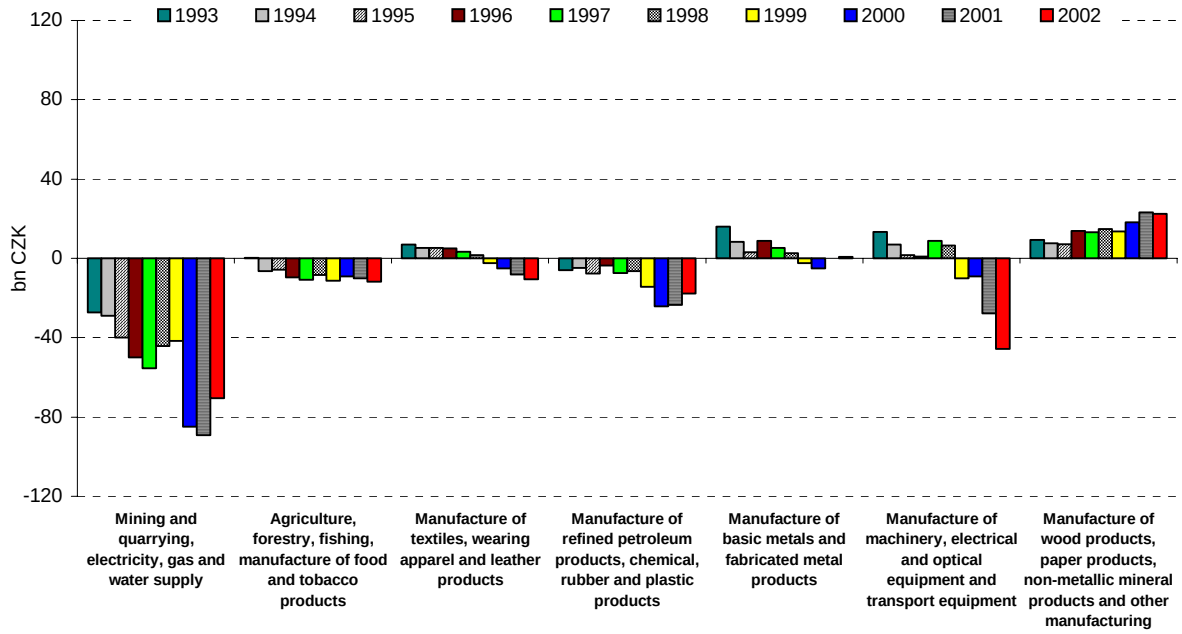
By contrast, a quite unfavourable trend was again identified in the manufacture of refined petroleum, chemical, rubber and plastic products. The shifts in the balances of the other four partial aggregates were minor and, from the point of view of the total trade balance, immaterial. Nevertheless, their impact on the total trade balance was generally negative.

As for trade with the rest of the world (i.e. non-members of the EU-15; see Figure 4), the trends of all the partial balances were negative with the sole exception of an improving balance in the manufacture of wood, paper and mineral products and other manufacturing. The engineering branches balance showed the most significant deterioration, which suggests that the growing deficit with the rest of the world identified from 1999 is related to increasing imports for intermediate consumption, especially in electrical branches, production of which is in turn exported to the EU-15.

Similarly, mining and quarrying and electricity supply indicated a substantial deterioration in deficit. While in trade with the EU-15 this partial balance recorded relatively stable and moderate

surpluses throughout period, with the rest of the world it was significantly affected by increasing prices of energy producing materials.

***Figure 4: Trade Balance of the Czech Republic with Non-members of the EU-15 in 1993–2002 by NACE Categories***




***Source:*** Ministry of Finance of the Czech Republic – Directorate General of Customs; own calculations.

## 3. The model and estimation methods

As for the economic literature dealing with a similar approach to the estimation of trade flows as that used in this study, the closest reference is the study by Xiaohui and Chang Shu (2003), where the trade volumes and patterns are regressed on cross-sectional data, all of them representing the industrial supply side. This is the train of thought originally proposed by Balassa (1963).

Another seminal paper mentioned is by Greenhalgh, Taylor and Wilson (1994), in which the trade data is disaggregated by industries and regressed against GDP per capita, domestic and foreign prices, indexes of quality and supply reliability. Later this was extended to a myriad of alternative hypotheses of trade flows, as used in Blake and Pain (1994), Pain and Wakelin (1997) and Greenaway, Souza and Wakelin (2002). There have been only a few attempts to estimate the Czech trade functions in a sectoral breakdown; these include Drabek (1984), Benáček (1988) and Benáček *et al.* (2003).

Let us stress that the choice of the model and its variables was constrained by the existence of several parallel and often complementary economic theories of trade. According to Fontagne and Freudenberg (1997, p. 17), there are eight basic economic theories of international trade. For example, even though the Heckscher–Ohlin comparative advantages in factors (capital, labour and

human capital) and Ricardian comparative advantages in costs are traditionally treated as alternative theories of comparative advantage, the more recent empirical studies test them simultaneously and there have been calls for an amalgamated theory to explain their simultaneous functioning (Leamer, 1995b).

It has therefore become a standard for econometric testing to work with variables pertaining to different economic theories. However, it is not our interest to test and discriminate between the relevance of particular theories. Rather, we aim primarily to find a mechanism explaining the structural dynamics of Czech trade.

Based on these views on the theoretical explanation of trade, our empirical trade model hinges on the macroeconomic concepts of open economy absorption, the real exchange rate and the elasticities approach to the balance of trade. The dynamics of trade is thought to be driven by structural changes and specialisation patterns (Pain and Wakelin, 1997; Aturupane *et al.*, 1997; Greenaway *et al.*, 2002), as well as by the domestic and foreign demand conditions.

Controlling for macroeconomic and policy developments – demand conditions in the form of GDP, the real exchange rate, the monetary policy interest rate and fiscal policy (tariffs) – in a dynamic cross-section, we investigate the empirical significance of variables representing the technological requirements of factors (subject to given factor endowments)[2], domestic producer prices, prices of exports and imports[3], economies of scale[4] and change in productivity.

The design of the model of trade dynamics breaks down into two export and import functions. We follow the class of trade models of Greenhalgh, Taylor and Wilson (1994) and developed further by Blake and Pain (1994), Pain and Wakelin (1997) and Greenaway, Souza and Wakelin (2002), in which trade data are disaggregated by industries. In formal terms, the export and import function distinguished by industries can be represented as:

$$lnX_{ijt} = \varphi_1 (lnX_{ijt-1}, lnYe_{jt}) \qquad (1)$$
$$lnM_{ijt} = \varphi_2 (lnM_{ijt-1}, lnYm_{it}),$$

where *j* denotes the trading partner, *i* stands for industry and *t* denotes time. Y*e* and Y*m* denote the specific determinants of exports and imports respectively. The choice of estimation technique for the model identification is suggested by the structure of the data, i.e. 29 sectors observed over

[2] The relative factor inputs to the production of exports and domestic import replacements reflect the country's relative position in endowments (capital and labour). Thus the factor requirements and FDI stocks (the latter as a proxy for human capital subject to changes in time – see Markusen and Venables, 1998 and 1999) are our core variables, defining the structural, supply-side based constraint of the trade potential.

[3] The reason for using prices of exports and imports in the trade model is that they indicate the sectoral terms of trade and impact on the volume of exports.

[4] Another supply-side based factor shaping the intensity of exports and imports is economies of scale – see Krugman and Obstfeld (2003, pp. 120–159). We can therefore test the hypothesis whether the elasticity of trade caused by a change in *the size of domestic industry* is higher or lower than unity. This concept can be approximated by material inputs.

1993–2002 – cross-sectional time series. The data structure offers the potential for investigation of both the structural aspects of specialisation (a cross-section set-up)[5] and the determinants of the dynamic behaviour of trade (a dynamic cross-section time series).

This study has two complementary aspects in its empirical aims: a) to provide an explanatory framework for the estimation of which determining factors moulded the trade structure in the relevant past – which is a problem of specialisation and cross-section analysis of the data; b) to estimate what kind of common forces have potentially been driving the trade flows (in the given structure) into their near future – which is a problem of trade dynamics and time series analysis. Since the primary objective of the paper is to find the determinants of the dynamics of trade, we opt for analysis of the cross-section time series, including, however, macroeconomic variables as well as the determinants of specialisation.[6]

Models of trade are known to be past-dependent (significant autocorrelation). As long as the autoregressive process (measured by the coefficient of autocorrelation) is relatively low (minimal dynamics in the data), it is advantageous to perform the data transformation using a DW-iterative procedure and convert the dynamic model into a static one (because by estimating the model in differences one imposes a coefficient of autocorrelation of unity) and to proceed with the estimation of the static specification instead.

However, in cases where we observe the autoregressive process at a higher magnitude, we would prefer to specify a dynamic process in cross-section time series (at least for cross-checking the efficiency of the estimation results of the transformed data). Thus we opt to work with the static specification and transform the data where necessary (i.e. when significant autocorrelation is lower than 0.5), but in cases where the interdependency is higher, we complement with the dynamic model with lagged dependent variables.

Using a method with autoregressive adjustment in cross-section time series, we estimate a *within* estimator for fixed-effects models and a GLS estimator for random-effects models and discriminate between them using the Hausman test. Let us consider the following model:

$$ln\ Y_{it} = \alpha + \beta\ lnX_{it} + \upsilon_i + \varepsilon_{it} \qquad (2)$$

where $\varepsilon_{it} = \rho\ \varepsilon_{it-1} + \omega_{it}$

and where $|\rho|<1$ and $\omega_{it}$ is independent and identically distributed (*iid*) with zero mean and variance $\sigma^2$. If $\upsilon_i$ are assumed to be fixed parameters defined on industries, then the model is a fixed-effects model. If $\upsilon_i$ are assumed to be realisations of an *iid* process with zero mean and variance $\sigma_\upsilon^2$, then we speak about a random-effects model. If the fixed-effects model applies, the

[5] This is a similar issue to that discussed by Friedman (1957) when he was analysing the structure of consumption and its dynamics. He demonstrated how the interplay between theoretical ideas and data analysis could lead to major policy implications.

[6] However, there might occur structural change even without any trade growth, while there may be trade growth even without any structural adjustments, i.e. no specialisation.

$\upsilon_i$ may be correlated with the covariates $x_{it}$. However, the random-effects model maintains the assumption that the $\upsilon_i$ are independent of the $x_{it}$.

The discrimination between the method of fixed-effects and random-effects models will be subject to the information about the independence between $\upsilon_i$ and $x_{it}$. Employing a Hausman test for comparing asymptotic consistency and efficiency, we decide on the choice of appropriate method.

As mentioned above, if $|\rho|$ is relatively high (i.e. exceeds 0.5), we specify a dynamic process for the dependent variable to account for the autoregressive part. We follow the specification by Arellano and Bond (1991), i.e.

$$ln\ Y_{it} = \alpha\ ln\ Y_{it-1} + \beta\ lnX_{it} + \upsilon_i + \eta_{it.} \qquad (3)$$

In this specification, the industry-specific effect is removed by first differencing and the estimation proceeds with the GMM method.

The dynamic and the static cross-section time series specifications estimated by the random/fixed effects model and by GMM, respectively, differ in exclusion or inclusion of a lagged dependent variable and in the treatment of industry-specific effects. Whereas the former works with the specific effects in the form of random realisation from a distribution, the latter approach uses first differences to remove these industry-specific effects. However, since the models are specified in logarithmic terms, the first differences in the case of the dynamic model cause the coefficients to be closer approximations of the true elasticity than the estimates based on the purely static *ln-ln* model.

## 3. Data issues and definition of variables

The definitions of the variables are presented in Table 1. The source of the data and thus the construction of the majority of the variables are based on official data as published by the Czech Statistical Office and the Czech National Bank. These are data on GDP, the PPI, enterprise statistical data, the exchange rate, interest rates and M2.

The rest of the data is based on our own databases, as some of the statistical time series needed for the intended analysis were missing. Either they were absent completely, or they were available only in some shorter time series, or they were reported only in a more aggregated classification than our analysis required. Therefore, they had to be either partly or completely reconstructed on the basis of other more subtle available data. These additional statistical calculations were above all connected with basic time series of exports and imports and duty rates by NACE. In addition, the series of positions of foreign direct investment in the Czech Republic were completed.

The time series of exports and imports of goods in NACE (Industrial Classification of Economic Activities) between 1993 and 2002 are not part of the official statistics. However, in autumn 2002 revised time series of exports and imports of goods for 1996–2000 were published (in CZK)

broken down by the Classification by Products by Activity (CPA), which is very similar to the NACE classification and in principle could have been used.

But owing in particular to (1) expected revisions to the foreign trade data in the recent period and the necessity of prompt treatment in an appropriate structure, (2) missing data at the beginning of the period and (3) the fact that these series were crucial to our analysis, we decided to construct our own original consistent series. The core of their construction consists in the creation of an accurate, yet relatively simple procedure for converting statistical data in the widely used SITC, Rev. 3 classification into the NACE classification.

Annual statistical data by SITC, Rev. 3 broken down into 5 levels of numerical codes were publicly accessible on the web sites of the Directorate General of Customs of the Ministry of Finance of the Czech Republic. The level 2 and 3 classifications were the basis for our conversion. Nevertheless, it was advisable in many cases to use the 4-digit code to ensure that the conversion was accurate enough. In addition, the 5-digit code was generally used to confirm the correctness of placement in NACE. The Harmonised System and Combined Nomenclature classifications were also used to verify the conversion.

The NACE classification of commodity flows follows the methodology of "net branches". This indicates what volume (value) of production which, from the point of view of its origin, belongs to the relevant NACE branch was exported or imported. However, the total amount of this production was not necessarily produced (in the case of exports) or consumed (in the case of imports) directly in this branch. Therefore, the data in our analysis do not measure the total export (import) flow from (to) each NACE branch, but measure trade from the point of view of the origin of the commodities with regard to the various NACE branches.[7]

The breakdown of representatives for the conversion into NACE was constant during 1993–2002. Verification and careful specification of the commodity flows were very important, especially in the second half of the analysed period, when significant structural changes and accelerated international cooperation took place in manufacturing industry and when exports and imports of some commodities, the share of which in total flows were still fairly irrelevant (especially in electrical branches), rocketed by hundreds of per cent.

But above all, the construction of time series of duty rates on imports by NACE was a rather complicated process. The customs tariffs from 1993–2002 and data concerning the structure of imports by SITC and the Harmonised System were the bases for this.

The construction of the branch duty rate first required knowledge of the average shares of the most significant import commodities (in the most detailed 5-digit SITC classification) in the total imports of each branch. These were calculated as the average of the shares for 1994, 1997 and 2000. The shares of the most important import items were calculated directly in branches with fewer commodities involved. The share of the least important representative among those short-listed was 5% (the threshold for consideration of the representative).

[7] The enterprise statistics are based on the methodology of the "prevailing economic activity of the branch".

If the branch involved a higher number of commodities which were, in addition, rather heterogeneous, the shares of the partial commodity groups in total branch imports were calculated separately and afterwards the shares of the most significant import items in these partial groups were constructed. This more complicated approach had to be used especially in the categories of agriculture, manufacture of food products and beverages, manufacture of chemical products and manufacture of machinery and equipment.

Given the time-consuming nature of the calculations, the branch duty rates were set for selected years only, and their levels in three years (1995, 1997 and 1999) were estimated on the basis of their declining trend.

Time series of foreign direct investment positions in the Czech Republic in the breakdown suitable for our analysis have been published by the CNB since 1997. Therefore, the data for the starting period 1993–1996 had to be reconstructed in the necessary aggregation by NACE and content definition on the basis of available published data. Series of equity capital inward flows into the Czech Republic, as the main part of the total FDI inflows in a limited breakdown, and data concerning equity capital total positions as of 31 December of the corresponding years constituted the available data source.

The series of equity capital positions and the total FDI positions in the Czech Republic as of 31 December 1997 in the necessary NACE classification were the starting level bases for the calculations. In addition, data concerning the total foreign direct investment positions at the end of 2002 had to be estimated on the basis of accessible data (preliminary data of FDI inward flows classified by NACE and the preliminary datum of the FDI total positions in the Czech Republic at the end of 2002), as they had yet to be published at the time the econometric calculations were performed.

***Table 1: Definition of Variables***

| Variable | Definition |
|---|---|
| $M_{it}^{w}$ | Czech imports from *w* (in current CZK); |
| $X_{it}^{w}$ | Czech exports to *w* (in current CZK); |
| $GDP_{t}$ | Czech GDP in CZK at constant prices, measuring the real aggregate demand absorption capacity; |
| $GDP_{t}^{w}$ | Aggregated GDP in EUR for countries *w* importing Czech products, measuring their aggregate demand absorption capacity; |
| $RER_{t}^{w}$ | The real effective exchange rate index based on the CPI and related to the currencies of the given trade partners (an increase means appreciation); |
| $PC_{it}$ | Czech price changes in industries i (producer price deflators, where the base year of 2000 has the index 1.00), measuring the intensity of nominal convergence; |
| $PM_{it}^{w}$ | Unit prices in EUR per tonne, measuring the type of competition (in prices or in quality). In the import equation it is the strategy used by foreign penetration onto Czech markets. In the export equation it is a proxy variable for foreign competition to Czech exports abroad; |
| $PX_{it}^{w}$ | Unit prices in EUR per tonne, measuring the type of competition (in prices or in quality). In the export equation it is the strategy used by Czech exporters abroad. In the import equation it is a proxy variable for Czech domestic competition to foreign imports; |
| $K_{it}/L_{it}$ | Capital (at constant prices) per unit of labour, characterising the domestic technologies and their relative factor requirements; |
| $Y_{it}/L_{it}$ | Productivity of labour (at constant prices); |
| $FDI_{it}$ | Foreign direct investment stocks (in CZK), serving as a proxy variable for human capital; |
| $MAT_{it}$ | Material input values adjusted for price changes; |
| $TM_{it}^{w}$ | Tariff rates levied at home on Czech imports from w; |
| $TX_{it}^{w}$ | Tariff rates levied abroad on Czech exports to w; |
| $MP_{t}$ | Monetary policy (stock of real M2); |
| $PRI_{t}$ | Money market rate PRIBOR – 3 months (as an alternative to the MPt variable); |
| $X_{it}^{EU}$ | Exports to the EU, indicating the potential for intra-industry trade (present in the import function only); |
| $\varepsilon_{\tau t}^{\omega}$ | Random term. |

## 5. Results of estimating the export and import functions

The report of the results of the estimation consists of two tables. Table 2 presents the estimates of the Czech export functions for exports to the EU-15 countries and the RW (rest of the world). In parallel, Table 3 describes the estimates of the Czech import functions for imports from both the EU-15 and the RW.

The section of Table 2 devoted to exports to the EU-15 contains estimation results for both the static estimation (estimated by the random effects model) and the dynamic estimation, i.e. the two-step Arellano and Bond (1991) procedure. Both specifications are estimated in unrestricted and restricted form. The restrictions made to derive the most parsimonious model are based on the Hausman test, which compares the consistency and efficiency of the estimates. For instance, in the case of exports to the EU-15, the probability of not rejecting the hypothesis of the validity of the restrictions is 0.78, which justifies the restrictions. We complement the statistics of the estimation by presenting $R^2$, the Sargan test of overidentifying restriction, the coefficient of autocorrelation, within and across variability and the Wald test – testing the existence of a regression relation.

As can be seen, the results confirm the existence of a regression relation in all the regressions, with the probability of rejecting the existence of regression near zero. Furthermore, we report the correlation between $v_i$ and the covariates $x_{it}$. Its value is 0.075 in the case of the export function to the EU countries and 0.14 in the case of the export function to the rest of the world. Both give us confirmation that the data support the application of the random effects model instead of the fixed effects model.[8]

As can be seen from Table 2, five key determining factors of Czech exports to the EU-15 have been identified: the GDP of the EU-15, the CZK/EUR *RER*, unit prices of Czech exports to the EU-15, material inputs, and export tariffs. With respect to the rest of the world, we see an explanatory power of the following variables: unit prices of exports to the RW, the level of domestic production prices and the intensity of material inputs, suggesting the presence of economies of scale.

The explained variation ($R^2$) in the export models is 0.69 in the case of the EU-15 and 0.64 in the case of the RW. We can conclude that the models explain the dependent variable quite well. But, evidently, our model of exports to the EU has much higher economic explanatory power. The RW is too heterogeneous and for better results it would be necessary to split it into more sub-regions.

[8] The Hausman test was applied, the results of which favoured the random effects model over the fixed effects model.

***Table 2: Results of estimating the export function***

| | Exports to EU-15 | | | | | Exports to RW | |
|---|---|---|---|---|---|---|---|
| | transformed static estimation | | dynamic estimation – Arellano and Bond (1991) | | | transformed static estimation | |
| | unrestricted | restricted a) | unrestricted two-step | unrestricted one-step | restricted one-step; a) | unrestricted | restricted a) |
| Intercept | -5.88(4.1) | -7.38(2.7) | - | - | - | -0.71(3.3) | 1.51(0.57)*** |
| lnEXPORT(t-1) | - | - | 0.56(13.8)*** | 0.52(4.81)*** | 0.56(4.88)*** | - | - |
| lnGDPeu (lnGDPrw) | 2.29(0.63)*** | 2.5(0.37)*** | 1.55(5.75)*** | 1.64(2.55)*** | 1.45(2.96)*** | 0.72(0.51) | - |
| lnREReur (lnRERusd) | -1.08(0.44)*** | -1.19(0.42)*** | -1.16(-9.2)*** | -1.18(-4.64)*** | -1.15(-4.67)*** | -0.22(0.18) | - |
| lnM2real | 0.04(0.49) | - | -1.02(-6.8)*** | -0.73(-1.14) | -0.83(-1.64) | 0.08(0.05) | - |
| lnPC | 0.28(0.27) | - | 0. 29(2.1)** | 0.24(0.68) | 0.32(0.93) | 0.39(0.25) | 0.67(0.17)*** |
| lnPXeu (lnPXrw) | 0.19(0.05)*** | 0.17(0.04)*** | 0.14(3.63)*** | 0.17(1.08) | 0.15(1.1) | 0.23(0.05)*** | 0.23(0.05)*** |
| lnPMeu (lnPMrw) | -0.05(0.06) | -0.072(-0.36) | -0.03(-0.7) | -0.07(-0.36) | - | -0.03(0.05) | - |
| lnKLcp | -0.1(0.07) | -0.09(0.07) | 0. 13(2.53)** | 0.19(2.58)*** | 0.19(3.1)** | 0.07(0.07) | - |
| lnFDI | -0.01(0.02) | - | 0.01(0.92) | 0.01(0.23) | - | 0.01(0.02) | 0.004(0.01) |
| lnMAT | 0.7(0.06)*** | 0.69(0.05)*** | 0.52(10.6)*** | 0.57(5.76)*** | 0.57(6.02)*** | 0.66(0.06)*** | 0.66(0.05)*** |
| lnEXtariff | -1.54(-0.33)*** | -1.59(0.31)*** | -0.14(-0.7) | -0.24(-1.13) | -0.14(-0.6) | -0.08(0.5) | - |
| lnY/L | -0.09(0.08) | - | -0.16(-4.8)*** | -0.19(-1.51) | -0.16(-1.71) | -0.05(0.1) | - |
| PRIBOR 3M | -0.002(0.01) | - | 0.001(0.1) | 0.003(0.57) | - | 0.01(0.01) | - |
| 1st order autocorr. | - | - | -2.07(0.03)** | -2.17(0.03)** | -1.8(0.07)* | | |
| 2nd order autocorr. | - | - | -0.85(0.39) | -1.01(0.31) | -1.03(0.31) | | |
| Sargan test | - | - | 16.94(0.9) | - | 19.05(0.9); b) | | |
| $\rho$ | 0.69 | 0.69 | - | - | - | 0.56 | 0.56 |
| $\sigma_e$ | 0.23 | 0.23 | - | - | - | 0.24 | 0.24 |
| $\sigma_u$ | 0.52 | 0.53 | - | - | - | 0.67 | 0.74 |
| Wald test | 443(0.00) | 443(0.00) | - | - | 0.44(0.93) | 257(0.00) | 261(0.00) |
| Hausman test | - | 3.17(0.78) | - | - | 1.74(0.99) | - | 7.75(0.11) |
| Corr($v_i$,Xb)/assumed | 0.075/0 | - | - | - | - | 0.14/0 | - |
| $R^2$/nob | 0.70/290 | 0.69/290 | - | - | - | 0.64/290 | 0.63/290 |

***Note:*** standard errors are in parenthesis; asterisks denote significance level: *** 1%, ** 5%, * 10%.

a) Estimates after excluding variables that do not interfere with consistency as tested by the Hausman test.

b) The Sargan test is reported from the two-step estimation.

***Table 3: Results of estimating the import function***

| | Imports from EU-15 | | Imports from RW | |
|---|---|---|---|---|
| | transformed static estimation | | transformed static estimation | |
| | unrestricted | restricted a) | unrestricted | restricted a) |
| Intercept | -30.5(13.2)** | -11.8(4.6)*** | 8.4(9.5) | 0.08(2.6) |
| lnGDPeu (lnGDPrw) | 3.08(1.8)* | 2.21(0.67)*** | 0.78(1.14) | 1.14(0.63)* |
| lnREReur (lnRERusd) | -0.51(0.94) | - | -0.21(0.31) | -0.32(0.28) |
| lnM2real | -0.78(1.78) | - | 0.5(1.11) | - |
| lnPC | 0.65(0.6) | - | 0.54(0.33)* | 0.67(0.33)** |
| lnPXeu (lnPXrw) | -0.01(0.13) | - | -0.13(0.07)* | -0.13(0.07)* |
| lnPMeu (lnPMrw) | 0.23(0.14)* | 0.27(0.08)*** | 0.17(0.07)** | 0.17(0.07)** |
| lnKLcp | -0.27(0.16) | - | -0.04(0.10) | -0.05(0.99) |
| lnFDI | 0.03(0.03) | - | 0.07(0.02)*** | 0.07(0.02)*** |
| lnMAT | 0.7(0.06)*** | - | 0.12(0.08) | 0.12(0.09) |
| lnEXtariff | 3.3(2.0) | - | -1.73(1.9) | - |
| lnY/L | 0.05(0.19) | - | -0.17(0.11) | - |
| ln(export into EU) | 0.48(0.12)*** | 0.48(0.08)*** | 0.34(0.08)*** | 0.34(0.08)*** |
| $\rho$ | 0.33 | 0.34 | 0.51 | 0.53 |
| $\sigma_e$ | 0.62 | 0.61 | 0.35 | 0.35 |
| $\sigma_u$ | 0.74 | 0.91 | 0.73 | 0.75 |
| Wald test | 150(0.00) | 110(0.00) | 219(0.00) | 211(0.00) |
| Hausman test | - | 0.25(0.97) | - | 5.78(0.68) |
| Corr($v_i$,Xb)/assumed | 0.06/0 | - | -0.12/0 | - |
| $R^2$/nob | 0.68/290 | 0.59/290 | 0.56/290 | 0.53/290 |

***Note***: a) Estimates after excluding variables that do not interfere with consistency as tested by the Hausman test.
Standard errors are in parenthesis; asterisks denote significance level: *** 1%, ** 5%, * 10%.

The coefficient of unit export prices has a positive sign in both cases, which suggests that Czech export penetration is based on gains in quality and a growing importance of exports of products with higher value added per unit. This is a rather positive finding that is supported by a high statistical significance of material inputs in both models. We interpret this as the presence of economies of scale and evidence documenting the importance of long supply chains of value added for Czech export penetration. The role of product quality for export and domestic import replacements was also found to be crucial in a recent paper by Egert and Lommatzsch (2003), who found it to be important for exchange rate sustainability, while Dulleck *et al*. (2003) explored quality issues in transition countries.

Czech exports to the EU-15 proved to be very sensitive to changes in aggregate demand. Also, the *RER* exhibits the expected negative relationship with exports, meaning that exports are adversely affected by appreciation of the Koruna. However, this does not seem to have particularly devastating effects, because of the presence of the compensating factors mentioned above. Neither the key monetary policy rate, nor real M2 growth has any statistically significant autonomous impact on exports. This influence was intermediated only indirectly by the developments of GDP, *RER* or prices.

Since the autoregressive process in the residuals reaches a correlation coefficient higher than 0.5 in the case of Czech exports to the EU-15 (0.69), we employ a dynamic estimation in order to check the significance of the results derived by the random effects model.[9]

The crucial relationship between foreign income and Czech exports remains at a firm level: the estimate of the coefficient of GDP in the case of the EU-15 ranges between 1.21 and 1.64. The role of the *RER* remains similarly strong, retaining an elasticity only slightly above unity. Tariffs appear significant only in the case of the EU-15, but in the remaining regressions they preserve the intuitive sign. Export unit prices exhibit similarly unstable significance when estimated in different specifications, but the sign remains intuitive and the insignificance could be considered marginal. Last but not least, we found an influence of factor requirements (capital-per-labour intensities) on exports in the dynamic specification only. Nevertheless, the inflow of direct investment does not seem to contribute to the development of exports, as it is rather equally distributed among industries. Out of the total FDI over 1993–2002, only about 35% was directed to manufacturing; the rest went into non-manufacturing. Thus, the broad impact of FDI on trade across industries was not expected to be significant (see Table C in Appendix II).

Analogously to the export function, the parsimonious specification was found by employing Hausman test for imports as well. For instance, we see that in the case of imports from the EU-15 the probability of not rejecting the restrictions is 0.97, which confirms the validity of the parsimonious model specification. Also, the Wald test proves the existence of a regression relation, and the correlation between $\upsilon_i$ and the covariates $x_{it}$ (0.06 and -0.12 for imports from the EU-15 and the RW respectively) show that the random effects model applies.

[9] Based on the results, the two-step statistics for autocorrelation inference show that the probability of having first order autocorrelation is very low (at 3%). At the same time, we cannot reject the hypothesis of having second order autocorrelation at the 10% significance level. Although the Sargan test shows that there might be a problem with over-identifying restrictions, we conclude that the model is reasonably identified.

As far as imports are concerned (Table 3), the key determinants include Czech GDP (aggregate demand import absorption) and unit import prices. In addition, one should stress the high export content of imports (around 35–50 per cent of EU-15 imports; a significant explanatory power of exports for imports) and the significant role of FDI inflow for imports. As the positive sign of *PM* reveals, the import penetration strategies of OECD exporters are based on competition in product quality.

The estimated high implicit income elasticity of imports – varying between 2% and 3% – is compatible with other estimates, for instance by Tomšík (2000). This documents a high degree of Czech domestic substitution for import products in the studied period. As a result, nearly all gains in exports achieved during the last ten years have been neutralised by contractions in some segments of domestic production for domestic consumption and replaced by imports.[10] The correlation between imports and exports itself is another crucial characteristic of the functioning of Czech international trade. The correlation between exports and imports within the same sectors documents intra-industry trade (Rosen, 2002). The widening of the potential for intra-industry trade makes the balance of trade less prone to adverse consequences from an exchange rate shock.

Furthermore, imports from the RW are determined by the stock of foreign direct investment and the evolution of nominal domestic prices. In addition, the negative coefficient of *PX* confirms that the Czech production competing with imports is very weak. Imports from the RW are challenged by only weak (or non-existent) domestic competition, which concentrates mainly in vertically differentiated products of lower quality. This is confirmed by the positive coefficient of *PC*, which implies that a domestic price increase supports imports from the RW.

## 6. Conclusion

The analysis focuses on the determinants of external trade in the Czech economy, which underwent significant structural changes during 1993–2002. The results confirm the importance of the level of aggregate demand (measured by GDP) at home and in the EU-15, the real exchange rate, liberalisation of tariffs and the evolution of unit prices of exports and imports for the development of bilateral trade with the EU-15. The quality of Czech exports was on a steadily improving trajectory throughout 1993–2002, which boosted export penetration and compensated for the appreciated real exchange rate. Also, economies of scale proved to be a highly significant factor, along with the sharply rising importance of intra-industry trade.

In the case of the Czech trade balance with the rest of the world, the key determinants are domestic GDP, qualitative upgrading in the unit prices of exports, Czech domestic production prices, the stock of foreign direct investment and economies of scale. Intra-industry trade has also been deepening outside the EU-15. But the involvement of Czech partners in vertical

[10] Altomonte and Resmini (2001) found that the developments in transition countries driven by expanding multinationals may be checked by disruption in the ties between domestic firms, forcing them to go through costly restructuring and downsizing and causing them to be superseded by imports. The processes of creative destruction can last a long time and preclude growth.

differentiation of products (exporting lower quality for products with higher quality) incapacitated the efficiency of domestic producers in such exchanges. Finally, we did not find any statistically strong influence of the real exchange rate on the intensity of trade with the non-EU-15 countries.

Taken from the government perspective, the fact that the estimates of the elasticity of exports to the EU-15 to the real exchange rate only slightly exceed unity implies that a *RER* appreciation of 10% will decrease the competitiveness of both exports and domestic production replacing imports more than proportionally. The resulting fall in exports is estimated to be more than 12%. On the other hand, imports do not seem to receive any significant incentive for expansion by an *RER* appreciation. On the other side, the structural adjustments in trade imply gains from a deepening of intra-industry trade, and the reallocation of production to industries that use higher capital per labour leads to an increase in exports.

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## Appendix I: Out-of-Sample Forecast of Czech Foreign Trade

The estimated model (a restricted model estimated using a random effect estimator) has been used to construct a forecast of export and import developments in Czech foreign trade in a two-year period, i.e. 2003–2004, at a level of disaggregation of 29 industries. To carry out the forecast, a detailed reference scenario (preserving the assumption that exogenous changes are common to all 29 sectors) of the determinants in the model of exports and imports (to both the EU-15 and the RW) is needed. However, the scenarios remain very simplistic, reflecting the uncertainty about the future evolution of exogenous variables. An overview of the two scenarios (baseline and alternative) is presented in Table A; the results of the simulations are given in Table B.

***Table A: Baseline scenario*** ***Alternative scenario***

| | exports | | imports | | exports | | imports | |
|---|---|---|---|---|---|---|---|---|
| | EU-15 | RW | EU-15 | RW | EU-15 | RW | EU-15 | RW |
| lnGDPeu (lnGDPrw) | 2.50% | - | - | - | 2.50% | - | - | - |
| lnGDPczech | - | - | 3.00% | 3.00% | - | - | 3.00% | 3.00% |
| lnREReur (lnERusd) | 2002 level | - | 2002 level | - | 4.00% | - | 4.00% | - |
| lnPC | 1.00% | 1.00% | 1.00% | 1.00% | 3.00% | 3.00% | 3.00% | 3.00% |
| lnPXeu (lnPXrw) | 2002 level | 2002 level | - | - | 10.00% | 10.00% | - | - |
| lnPMeu (lnPMrw) | - | - | 2002 level | 1.50% | - | - | 2.00% | 2.00% |
| lnFDI | - | - | - | 7.00% | - | - | - | 7.00% |
| lnMAT | 2002 level | 2002 level | 2002 level | - | 4.00% | 4.00% | 4.00% | - |
| EXtariff | no tariffs | - | no tariffs | - | no tariffs | - | no tariffs | - |

***Note:*** percentage values are annual growth rates unless stated otherwise.

The baseline scenario preserves the majority of the determinants at the levels of 2002, whereas the alternative scenario assumes more dynamic development in the terms of trade, demand, the exchange rate, etc. As a result, the trade balance of the baseline forecast continues to be rather stable (slightly improving). On the contrary, the forecast based on the alternative scenario points to a more significant improvement in the trade balance in 2004.

As can be seen from the comparison of our forecast with the predictions published by Consensus Forecasts Eastern Europe (CFEE) in 01-2005, the CFEE trade balance predicts a worsening of the trade deficit of CZK 116 billion for both years of the prediction. The difference from our forecast stems mainly from the overstating of imports by the CFEE. Both forecasts exhibit approximately the same margin of forecast error.

***Table B***

| **Baseline scenario simulation** | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | **2003** | **2004** | **std.*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exports to the EU-15 | 222 | 269 | 343 | 352 | 424 | 534 | 629 | 769 | 875 | 856 | **962** | **1063** | **42** |
| Imports from the EU-15 | 239 | 297 | 406 | 471 | 531 | 581 | 625 | 771 | 857 | 798 | **828** | **948** | **45** |
| Exports to the RW | 199 | 190 | 224 | 249 | 285 | 300 | 280 | 352 | 394 | 396 | **476** | **523** | **23** |
| Imports from the RW | 187 | 202 | 260 | 284 | 328 | 334 | 348 | 471 | 530 | 528 | **679** | **698** | **28** |
| Balance X-M | -5 | -40 | -99 | -154 | -150 | -81 | -64 | -121 | -118 | -74 | **-70** | **-61** | |
| **Alternative scenario simulation** | | | | | | | | | | | | | |
| Exports to the EU-15 | 222 | 269 | 343 | 352 | 424 | 534 | 629 | 769 | 875 | 856 | **975** | **1141** | **42** |
| Imports from the EU-15 | 239 | 297 | 406 | 471 | 531 | 581 | 625 | 771 | 857 | 798 | **845** | **1009** | **45** |
| Exports to the RW | 199 | 190 | 224 | 249 | 285 | 300 | 280 | 352 | 394 | 396 | **476** | **519** | **23** |
| Imports from the RW | 187 | 202 | 260 | 284 | 328 | 334 | 348 | 471 | 530 | 528 | **679** | **704** | **28** |
| Balance X-M | -5 | -40 | -99 | -154 | -150 | -81 | -64 | -121 | -118 | -74 | **-73** | **-53** | |
| **Consensus Forecasts EE prediction**** | | | | | | | | | | | | | |
| Exports | 421 | 459 | 567 | 601 | 709 | 834 | 909 | 1121 | 1269 | 1252 | **1498** | **1680** | **88** |
| Imports | 426 | 499 | 666 | 755 | 859 | 915 | 973 | 1242 | 1387 | 1326 | **1614** | **1796** | **105** |
| Balance X-M | -5 | -40 | -99 | -154 | -150 | -81 | -64 | -121 | -118 | -74 | **-116** | **-116** | |

***Note:*** *std. denotes the average over two years of the standard error of the respective forecast. ** Consensus Forecasts EE 01-2003
CZK billion (FOB foreign prices multiplied by the actual exchange rate)

# Appendix II

***Table C: Czech Inward Foreign Direct Investment by Industry, 1993–2002***

(in millions of EUR)

| | **1993** | **1994** | **1995** | **1996** | **1997** | **1998*** | **1999*** | **2000*** | **2001*** | **2002*** | **SUM** | **%** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Non-manufacturing** | | | | | | | | | | | | |
| Agriculture, hunting, and forestry | 2 | 1 | 6 | 0 | 6 | 7 | 6 | 9 | 32 | 12 | **81** | 0.2 |
| Mining and quarrying | 12 | 18 | 18 | 6 | 0 | 15 | 234 | 83 | 41 | -261 | **165** | 0.5 |
| Electricity, gas, and water supply | 20 | 73 | 31 | 128 | 332 | 211 | 313 | 223 | 301 | 365 | **1998** | 5.5 |
| Construction | 56 | 91 | 53 | 97 | 34 | 43 | 14 | 109 | 87 | 95 | **677** | 1.9 |
| Trade, hotels and restaurants | 34 | 30 | 114 | 226 | 110 | 745 | 1378 | 595 | 786 | 466 | **4483** | 12.3 |
| Transport, storage and communications | 3 | 8 | 1044 | 147 | 1 | 313 | 185 | 276 | 921 | 4,832 | **7730** | 21.2 |
| Financial intermediation | 120 | 117 | 53 | 26 | 264 | 497 | 1412 | 1012 | 1,767 | 1,956 | **7226** | 19.9 |
| Real estate and business activities | 0 | 0 | 0 | 0 | 37 | 303 | 395 | 812 | 509 | 580 | **2636** | 7.2 |
| Education | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | **2** | 0.0 |
| Health and social work | 0 | 0 | 0 | 0 | 6 | 19 | 3 | 18 | 2 | 15 | **63** | 0.2 |
| Other social and personal services | 0 | 0 | 0 | 0 | 0 | 18 | 110 | 44 | 4 | 26 | **202** | 0.6 |
| **Total non-manufacturing** | **247** | **339** | **1319** | **629** | **791** | **2172** | **4049** | **3182** | **4,451** | **8,085** | **25263** | 69.4 |
| **Manufacturing** | | | | | | | | | | | | |
| Food and tobacco | 196 | 60 | 94 | 58 | 83 | 113 | 337 | 191 | 275 | 289 | **1697** | 4.7 |
| Textiles, wearing apparel and leather | 1 | 1 | 2 | 18 | 13 | 88 | 43 | 74 | 115 | 63 | **419** | 1.1 |
| Wood, paper and publishing | 0 | 0 | 0 | 65 | 90 | 76 | 195 | 56 | 167 | 163 | **812** | 2.2 |
| Refined petroleum and chemicals | 16 | 37 | 70 | 267 | 45 | 53 | 370 | 323 | 122 | 200 | **1502** | 4.1 |
| Non-metallic products | 42 | 51 | 137 | 49 | 15 | 156 | 296 | 125 | 171 | 102 | **1143** | 3.1 |
| Basic metals and metal products | 0 | 0 | 0 | 0 | 70 | 284 | 173 | 271 | 96 | 286 | **1181** | 3.2 |
| Machinery and equipment | 57 | 247 | 360 | 54 | 14 | 300 | 424 | 1140 | 900 | 682 | **4179** | 11.5 |
| Recycling and other manufacturing | 0 | 0 | 0 | 0 | 30 | 76 | 46 | 42 | -2 | 15 | **207** | 0.6 |
| **Total manufacturing** | **312** | **395** | **663** | **511** | **362** | **1146** | **1884** | **2222** | **1,845** | **1,801** | **11139** | 30.6 |
| **All FDI** | **559** | **734** | **1982** | **1140** | **1152** | **3317** | **5933** | **5404** | **6296** | **9886** | **36402** | **100.0** |

***Source:*** Data provided by the Czech National Bank, October 2003

* Until 1997 the data included FDI in equity capital; since 1998 data on reinvested earnings and other capital have been included in FDI flows.

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