COMMAND ECONOMY AFTER THE SHOCKS OF OPENING UP: THE FACTORS OF ADJUSTMENT AND SPECIALISATION IN THE CZECH TRADE

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ABSTRACT

By quantifying the determining factors of Czech exports and imports 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 the variables of aggregate demand and the real exchange rate, in addition to liberalisation of tariffs, evolution of unit prices of exports and imports, changes in quality, diversion in factor usage and economies of scale. Unimpeded opening-up can be a crucial driver of an in-depth restructuring, which brings positive results from the very start, even though its spillovers into an overall fast growth can be delayed.

1. INTRODUCTION

The from the World Bank (Broadman 2006) opened several innovative questions about trade and economic growth in the post-communist countries. For example, it concluded with consequential statements based on empirical evidence:

- Some transition countries made enormous progress in catching up with the EU average, meanwhile some others failed.
- The most reliable leading indicator for progress can be found in the degree of reintegration with the world economy.
- The underlying success in international trade must be conditioned by a series of domestic market-compatible reforms.

Although Broadman's most extensive analysis of international trade in transition countries offers a new outlook at the processes of their growth, it still left some salient aspects of success in trade unanswered. In particular these are the behavioural responses of the supply side to the reforms and the way how the changing patterns of specialisation have been associated with the processes of reallocation.

As the theory of international trade posits, one cannot explain such changes without considering cross-industrial adjustments. This study aims at filling this gap by analysing the structural factors of development in one concrete transition country, in which the difference between the pre-transition and the post-transition stance of the supply side in the traded sector was one of the most profound. The unique Czech experience of the opening-up also offers implications to policy-making and the behaviour of agents of more general validity.

The pure theories of international trade and specialisation are based on the comparison of the structure of production under autarchy with the situation after the perfect free trade is opened up. Although the theories may differ in their stress on the factors determining specialisation, the processes of adjustment unfettered by past impediments must erupt. If the potential for comparative advantages is exceptionally high, the ensuing changes must be very intensive. Whatever interesting it could be to know, the empirical testing of such situations of break-through has been rarely documented in the economic literature. The cases of "Dutch disease" were some of the exceptions (Gylfason et al. 1999). The reason was simple: structural transitions required a lot of data and sophisticated statistics, meanwhile there were only few cases in the modern history, which could be called a transition from autarchy to free trade.

Nevertheless, some of the recent transitions of post-communist economies could fit into such a category of fundamental break-through. Even though they were far from being completely autarchic, their openness was rather low and, what is crucial, their international trade could not be formed by market signals and efficiency criteria. To the contrary, their structure of production was biased by the criteria of self-sufficiency, leading to import substitution policies and to a sort of a random structure of specialization.

Czech transition can be studied as an exeplary case of drastic liberal policies, when foreign exchange rationing was phased out by the end of 1990, quotas were dramatically scratched and the average tariff incidence on imports from the OECD countries fell below 4%. This move was in sharp contrast with the Czechoslovak "leadership" prior to 1990 when Czechoslovakia had resisted the introduction of market exchange rate and both exports and imports were regulated by a bureaucratic system of implicit taxes and subsidies specific to each commodity, which equalised the receivables from trade with the level of planned internal prices based on cost mark-up. Thus trade represented no competition to domestic sales. These were actually the principles of pricing and international competition under autarchy, which led to wide import substitution and inefficient division of labour.

After 1989 Czechoslovakia became a leader in liberalisation, which resulted in deep strains of several rounds of restructuring, as the market conditions altered the short-run conditions for resource allocation. Even though it was visible from the very start that international trade became the leading sector of Czech transformation, the burdens of intensive restructuring and enterprise bankruptcies brought their fruits of growth only after 1999, after the long-run reallocations were settled.

In this paper we are attempting to fill the gap in the literature on the determinants of trade developments in transition countries, which received first a large demand shock followed soon by implementing intensive pro-market policies, resulting subsequently in significant structural changes. Czech economy provides in this sense a unique basis for research. If we consider the period of 1993-2003, the overall trade in goods and services expanded by 160% in exports and 194% in imports (i.e. 9.6% and 10.8% annually in average). An even more remarkable change was achieved in visible trade with the EU-15 where exports shot up by 281% and imports by 215%. The export gain with the EU was reached mainly by an average annual improvement in the euro unit prices by 11,7%, that implies an overall qualitative improvement for 1993-2003 by 222%. Such dramatic favourable changes in the Czech trade must be contrasted with a very modest overall increase in the real GDP that was by mere 24,5%. We should keep in mind that the Czech economy was highly opened, where the share of imports on GDP increased from 49% in 1993 to nearly 74% in 2001.

The diverse development between the highly contestable traded sector and the protected non-traded sector can be taken for the main paradox of Czech restructuring. It opens similar questions like those tested by Crespo-Cuaresma and Wörz (2005): trade has a specific role in promoting growth, and it is its composition and bias towards technologically more sophisticated industries, which matter. So, our aim at estimating the factors behind the pushing up of trade is gaining on relevance for better understanding how the exposition to markets and competition boost the economy of a transition country. The objective of this paper is to estimate an empirical model, identify the determinants of Czech trade during 1993–2002 and assess the statistical properties of such factors of changes.

Seminal studies by Levine and Renelt (1992) and Greenhalgh et al. (1994) initiated a series of papers dealing with disaggregated trade data by industries and regressed against GDP per capita, domestic and foreign prices, indices of quality and supply reliability. Later on, this methodology of regressions was extended to testing of alternative hypotheses of trade flows by, for example, Blake and Pain 1994; Pain and Wakelin 1997; Aturupane et al. (1997); Greenaway et al. 2002. At the same time there have been attempts to estimate the Czech trade functions in a sectoral breakdown, e.g. by Drabek 1984; Benáček 1988; Stolze 1997; 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 a dynamic cross-section time series estimator.

2. CZECH INTERNATIONAL 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 the industry-specific factors, such as technology, factor endowments, market structure and barriers to trade. Our analysis should therefore address both the macroeconomic and the microeconomic factors of growth and quantify their general impact on industries.

While the macroeconomic variables are assumed to be the main drivers of overall trade growth, the microeconomic variables are associated with structural developments. Recent literature on industrial development stresses the importance of the industrial breakdown of production because the restructuring of sectors is not symmetric, which has further repercussions in the disruption of historical value-added supply chains. New theories of trade based on economic geography and the environment of imperfect competition call therefore for innovative explanatory variables for the analysis of sales (see Markusen and Venables 1999; 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 the beginning at levels far below the benchmarks expected by purchasing power parity. (For example, in the Czech case Koruna depreciated nominally by 113% in 1990 to 29,5 CZK/USD. In 2005 the exchange rate stood firm at 25 CZK/USD, meanwhile the CPI increased 3.8-fold.)

After initial losses in output, employment, the real exchange rate, unit labour costs and the terms of trade, the transition economies in Central and Baltic Europe rallied within 2-4 years. Their real exchange rates began to appreciate, real wages rose and exports increased exponentially, reflecting gains in competitiveness. In the early stages of transition it was imports that became the main drivers of restructuring. Therefore import growth was initially followed by less significant gains in exports. 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 changing ownership relations in firms and as yet unfinished governance issues;
(iii) the still low competitiveness of Czech production due to low degree of technological and product restructuring.

By contrast, the period of the second wave of stabilisation (1997–2002) was associated with a gradually improving trade balance. The influx of foreign direct investment since 1997, boosted by the privatisation of Czech state enterprises to foreign owners, was a substantial influence, causing in effect a new wave of strong export growth. Observed empirically, the evolution in the tradable sector can be quantified as a change in the composition of both exports and imports over time, which can be related to two structural aspects: the geographical breakdown by countries and the commodity breakdown. In addition, there are also two spillovers of international trade – into the domestic production of import substitutes and into the domestic sales of exported commodities.

As in all transition economies, the highest rates of growth in the Czech trade were achieved with the EU. For example, during 1993–2001, Czech merchandise exports to the EU rose nominally from EUR 6.4 billion to EUR 25.7 billion. This fourfold nominal increase implied average annual real growth in exports to the EU of a remarkable 14.8%, if the prices were adjusted by the internal EU deflator. At the same time Czech exports to the rest of the world grew at a normal real rate of 2%. What deserves a special attention is that the increase in the value of exports to the EU was caused by 87% by the improvements in unit (kilogram) prices and only by 13% by augmented physical volumes. Thus the annual

improvement in average real unit prices was 13,2%, as is shown in Figure 1. That was in sharp contrast to the evolution in the prices of imports. As a result, trade creation with the OECD partners followed immediately after the large trade diversion from the former partners grouped in COMECON (1990-94).

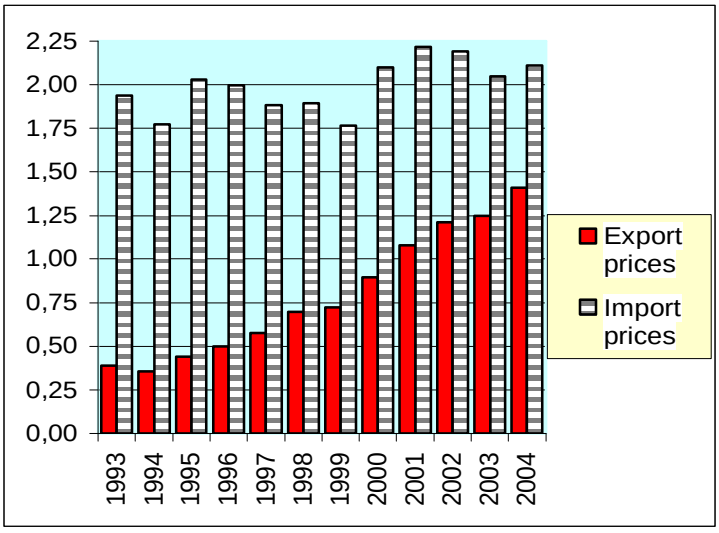

Figure 1. Unit (kilogram) prices of Czech exports and imports with the EU-15 in real EUR
Source: Trade Statistics of the Czech Customs, 2004

The developments in the Czech trade deficit between 1993 and 2002 can be divided into two different periods. The initial period characterized by deep inter-industrial retrenchment – dating from 1993 to 1996 – was subject to a growing trade deficit reaching 26% of merchandise exports in 1996, while later there was a remarkable improvement. During 1992-96 final consumption and investments grew quickly, reflecting the recovery of economic growth. But merchandise imports increased even more rapidly – substituting for the highly inelastic response of domestic supply and serving the changing structure of demand towards high-quality commodities.

As the latter part of this study reveals, the improvement in trade with the EU-15 starting in 1997 was a consequence of previous 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 a new territorial structure of specialization: the imports of energy and material for intermediate consumption concentrated in the East, meanwhile the exports of components, machines and some other merchandise goods (wood, paper and mineral products) were subject to a rapid trade creation in the Western markets. The other trend in specialization of trade with the OECD countries was a deepening of deficit in chemical, metal, textile and food products. The reversal in the specialisation pattern and the improving balance for engineering commodities (machinery, electronic, electrical, optical and transport equipment) became *de facto* the sole determinant of the overall trade balance, which turned into a surplus in 2005.

Engineering branches had the highest share in the foreign trade turnover throughout the period, reaching 62% for the EU. They were often supported by the development in their servicing sectors, which brought higher value added to the final exports. Similar trend could be observed among other new EU members, e.g. in Hungary or Slovakia. Such sharp recent turns in the pattern of specialisation have been most pronounced in the trade with the EU-15, meanwhile the trade with the rest of the world was subject to more inertia. What were the factors behind such an unprecedented restructuring?

3. THE MODEL AND ESTIMATION METHODS

As for the economic literature dealing with the estimation of trade flows and determining factors of specialization, as that used in this study, there have not been many attempts at using industrial cross-sectional decomposition for such tests. 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). Propelled by advances in the econometric techniques of panel data in the early 1990s, structural analyses explaining the asymmetry in the patterns of specialisation or efficiency at the level of industries or enterprises became more common. Except for the studies already mentioned in the introduction, there were more recent papers by Medvedev and Zemplinerova (2005), and Hashi et al. (2006).

Let us stress that the choice of our model and its variables was constrained by the existence of several parallel and often complementary economic theories of trade. According to Fontagné and Freudenberg (1997: 17), there are eight basic economic theories of international trade. However, it is difficult to treat all of them as disjunctive. For example, even though the Heckscher–Ohlin comparative advantages in factors (capital, labour and human capital) and Ricardian comparative advantages in costs are traditionally explained as alternative theories of comparative advantage, the more recent empirical studies test them simultaneously and there were calls for an amalgamated theory to explain their conjoint functioning (Leamer 1995).

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 trade in a concrete country subjected to a unique task of restructuring. Based on these views on the theoretical explanation of trade, our empirical trade model hinges on a combination of both the macroeconomic and the microeconomic concepts of an open economy. Our explanation of overall dynamics of trade starts with the factors used in the theory of international finance: demand absorption, real exchange rate and money supply. However, the dynamics of specialization is thought to be driven by factors underpinning the patterns of structural changes, some of which were used in the studies mentioned above. Therefore we had to rely more on the microeconomic theories of trade, such as the elasticities approach to the balance of trade, evolution of prices, product qualities, factor requirements, productivities and tariffs.

Viewed from another point, controlling for macroeconomic and policy developments – such as the aggregate demand, real exchange rate, monetary policy (interest rates) and

fiscal policy (tariffs) – should be combined with variables capturing the cross-sectional (structural) dynamics. Therefore we have also investigated the empirical significance of variables representing the technological requirements of factors (subject to given factor endowments), domestic producer prices, prices of exports and imports, economies of scale and changes in productivity. 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, following the Heckscher-Ohlin model of trade, 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. The reason for using prices of exports and imports in the trade model is that they indicate the sectoral terms of trade and their impact on the volume of exports. The theoretical underpinnings of our models are discussed in more detail in Benáček et al. 2003.

The design of the model of trade dynamics breaks down into two export and import functions. We followed the class of trade models of Greenhalgh et al. (1994), in which trade data were disaggregated by industries. In formal terms, the export and import function distinguished by destinations and industries can be represented as:

$$ln\ X_{ijt} = \varphi_x\ (ln\ X_{ijt-1},\ ln\ Vx_{it}) \qquad (1)$$
$$ln\ M_{ijt} = \varphi_m\ (ln\ M_{ijt-1},\ ln\ Vm_{it}),$$

where ***i*** stands for industry, ***j*** denotes the trading partner (e.g. the EU) and ***t*** denotes time. ***Vx*** and **V*m*** denote the specific (theoretical) variables determining 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 1993–2002, forming cross-sectional time series. The data structure offers the potential for investigation of both the structural aspects of specialisation (a cross-section set-up) and the determinants of the dynamic behaviour of trade (a dynamic cross-section time series). 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 in time series versus in cross-sections could lead to alternative analytical views on a seemingly identical problem and to alternative aspects of policy implications.

This study has two complementary aspects in its empirical aims:

a) To provide an explanatory framework for the estimation of determining factors relevant for shaping a concrete structure of trade in the recent past. This is a problem of economic hypotheses about specialisation defined on cross-sectional data and analysed by static methods.

b) To estimate what kind of common forces have potentially been driving the trade flows (in the given structure) into their present state – which is a problem of trade dynamics and time series analysis.

Therefore we should capture both cases of development in trade: where there might occur structural changes even without any trade growth and where there may be trade growth even without any structural adjustments, i.e. without shifts in the specialisation pattern. Models of trade are known to be time-dependent, reflected by a significant autocorrelation. As long as the autoregressive process 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. This is because by estimating

the model in differences one imposes a coefficient of autocorrelation of unity. Then the tests can be simplified by proceeding with the estimation of a 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 where the interdependency is higher, we complement the previous estimation with a 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 for exports by industries **i** to given region **j**:

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

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

and where $|\rho|<1$ and $\boldsymbol{\omega_{it}}$ is independent and identically distributed (*iid*) with zero mean and variance σ^2. If $\boldsymbol{\upsilon_i}$ are assumed to be fixed parameters defined on industries ***i***, then the model is a fixed-effects model. If $\boldsymbol{\upsilon_i}$ are assumed to be realisations of an *iid* process with zero mean and variance σ_υ^2, then we interpret it as a random-effects model. If the fixed-effects model applies, the υ_i may be correlated with the covariates $Cov(x_{it})$. However, the random-effects model maintains the assumption that the $\boldsymbol{\upsilon_i}$ are independent of the $Cov(x_{it})$. The discrimination between the method of fixed-effects and random-effects models will be subject to the information about the independence between υ_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.

$$ln\ X_{it} = \alpha\ ln\ X_{i\ t-1} + \beta\ ln\ V_{it} + \upsilon_i + \eta_{it.} \qquad (3)$$

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.

4. DATA ISSUES, VARIABLES USED AND THE RESULTS OF ESTIMATIONS

The choice of the time period analysed (i.e. 1993-2002) had the following constraints: it had to be compatible with our main objective – to reveal the mechanisms, which were

instrumental for economic adjustments when the industrial sector had to respond to a series of severe exogenous shocks, such as trade destruction, trade diversion, trade creation, as well as changes in prices of currencies, commodities and factors, taxes, ownership, institutions and tariffs. The separation of Czechoslovakia (January 1, 1993) and the currency split were a watershed, which stabilised the institutional setup and accelerated the privatisation. It was since 1993 only when the statistical data lost the bias of institutions of central planning and reflected more the market pressures for restructuring, such as bankruptcies, labour layoffs and strategic marketing. The period after 2002 was also specific: with the institutional transition prior to the EU entry in 2004 being close to be complete, the country was more prone to behave like a standard market economy. Therefore we have decided to analyse only the period of 1993-2002 when the systemic change from autarchic to market economy occurred.

The definitions of the variables are presented in Table 1 (at the end of paper). 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, prices, exchange rate, interest rates, M2 and enterprise output. 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 partially, or in a different classification. Therefore, some of the data had to be reconstructed on the basis of other data. These additional statistical calculations were above all connected with basic time series of exports, imports and tariff rates before 1997, which had to be converted into the NACE classification.

Given the time-consuming nature of the calculations, the average tariff rates by industries 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 breakdown suitable for our analysis have been published in sufficient breakdown since 1997 only. Therefore, the data for the period 1993–1996 had to be reconstructed in the necessary aggregation and content definition on the basis of alternative published data.

The report of the results of estimations consists of two tables. Table 2 (in appendix) presents the estimates of the Czech export functions for the EU-15 countries and the rest of the world (RW). In parallel, Table 3 describes the estimates of the Czech import functions for the EU-15 and the RW. The section of Table 2, dedicated to exports to the EU-15, contains estimation results for both the static estimation (estimated by the random effects model) and the dynamic estimation by the two-step GMM procedure (Arellano and Bond 1991). Both specifications are estimated in unrestricted and restricted forms. 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 over-identifying restriction, the coefficient of autocorrelation within and across variability and the Wald test – testing the existence of a regression relation.

Our 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 $\boldsymbol{v_i}$ and the cov (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. Also the Hausman test was applied, the results of which favoured the random effects model over the fixed effects model.

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 real exchange rate of CZK/EUR, unit prices of Czech exports to the EU-15, material inputs, and export tariffs. With respect to the rest of the world, we see that the explanatory power was assigned to unit prices of exports to the RW, the level of domestic production prices and the intensity of material inputs, the latter suggesting the presence of the economies of scale.

The explained variation in dependent variable (measured by 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 if compared with the results for the RW. The RW is too heterogeneous, consisting of developed non-EU countries, transition countries and developing countries. For better results it would be necessary to split it into more sub-regions.

5. ECONOMIC INTERPRETATION OF THE RESULTS

Let us begin with the Czech visible exports to the EU-15. This region is of crucial importance because its exports (including services) represent 70% of Czech exports and a sales equivalent to a half of the GDP. Since the autoregressive process in the residuals for this region reached a correlation coefficient higher than 0.5 (i.e. 0.69), we have employed a dynamic estimation in two steps in order to check the significance of the results derived by the random effects model. 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. Thus we have received three basic unrestricted estimations, where the differences between static and dynamic estimations are apparent, even though in the majority of cases the differences are not large.

We should be aware that both estimations have their own meaning and therefore they cannot be treated as one being automatically superior to the other. The static estimation is based on the relationships between variables in space – i.e. in the cross-sectional differences among industries. For example, it quantifies how the relative differences in unit export prices among industries are related to their export performance in given years. In contrast, the dynamic estimation deals with the relationships between variables and given industries in time – i.e. the stress is on the changes in the time-series. Their coefficients depict, for example, how a percentage increase in a unit export price in particular industry within a year is related to an increase in its exports (in percentages). Therefore only the GMM estimation offers true elasticities, which are of particular importance for variables without an industrial dimension, such as GDP, RER or M2.

A special attention should be given to the lagged variable of exports, which was present only in the dynamic estimation. It offered a momentous observation that the intense path-dependent evolution in the structure of Czech exports was being incremntally modified in its pattern, which was subject to the changing intensities of fundamental structural variables, such as export prices (PX), supply chains (MAT) or factor endowments (K/L). It signals that evolving transformations were based on long-sustainable funadamentals and the convergence to new structure of trade was sustainable. Even though the lagged variable of exports captured a great deal of "explanatory power", it did not crowd-out the space for the significance of other structural variables.

Going concretely into these results, we can see that the coefficients of unit export prices (PX) are highly statistically significant and have a positive sign in all three cases. This suggests that Czech export penetration was based on gains in quality and on a growing importance of exports of products with higher value added per unit. It is valid not only among industries (i.e. where industries with higher price per tonne have higher exports) but also in time (i.e. an increase in such price tends to enhance export gains). This is a highly positive finding, pointing to comparative advantages in products with high contents of value added. It also implies that the incentives for restructuring were very efficient – the primary static incentive (i.e. a competitive advantage of an industry with higher unit prices) was co-acting with the incentive to gain even more by increasing these prices. That would be possible only if an increase in price could be associated with a gain in the quality of products.

Thus we have unvailed that processes of catching-up in the Czech traded sector commenced already in the early stages of transition and they were uniquely associated with the EU-15. The crucial role of product quality upgrading in exports and domestic import replacements in all transition countries was also reported by Landesmann and Stehrer (2002), Dulleck *et al.* (2003) and Égert and Lommatzsch (2005). The latter study linked the improvements in export quality with exchange rate sustainability, superseding the weak influence of the Balassa-Samuelson effect.

Czech exports to the EU-15 proved to be very sensitive to changes in foreign aggregate demand (GDP^{EU}). This crucial elasticity of exports to the EU incomes ranged between 1.45 and 1.64. In this particular case the elasticities estimated by GMM can be presumed to be more precise than those of the static estimation. Although the effects of growth by "path dependency", which were captured by the lagged export variable, caused a decrease in income elasticity (e.g. to 1.55 from 2.29, as estimated by static methods), its intensity remained still credible. Also, the real exchange rate (RER*)* exhibits the expected negative relationship with exports, meaning that exports have been adversely affected by appreciating Koruna. The influence of RER was harmful to domestic competitiveness, retaining elasticity above unity. Nevertheless, it did not seem to have particularly devastating effects, because of the presence of strong compensating factors in remaining variables. The estimate of the negative sign is, however, surprising technically: practically throughout all period of 1993-2002 the RER was rising (i.e. appreciating altogether by 38%), meanwhile practically all exports in industries were rising (though not uniformly rising), too.

No key monetary instrument we tested, such as the real money supply (M2) growth or the PRIBOR interest rate, had any statistically significant autonomous impact on exports. Their influence, however, could be intermediated only indirectly, as it is signalled by the

significance of the real M2 in the two-step dynamic estimation. Its negative sign could imply that monetary policies were not causes but effects of growth and their role was more accommodating. Once the growth improved, the monetary expansion relaxed.

A similar conclusion can be drawn from the limited explanatory power of the variable of labour productivity, crucial for the Ricardian hypothesis of comparative advantage, which was found significant again only in the two-step GMM estimation, having a problematic negative sign. We could conclude that the pattern of specialisation and the dynamics of trade in the Czech case were not determined by the Ricardian type of comparative advantages, but by factors which were associated with labour indirectly. E.g. exports from labour-intensive industries have lower labour productivity than capital-intensive industries.

A surprising finding concerned the non-significance of FDI as a determining factor of export expansion. When comparing the pair-wise correlations, the structure of FDI was the most highly correlated exogenous variable with exports (0.512). Also some previous partial studies concluded that FDI was one of the most important determining factors of Czech exports (Benáček et al. 2003). However, this study reveals that the highly sector-specific FDI allocations were following the true determining factors present in other variables only, once the elements of relevant causal chain were specified in the model. Also only about 35% of total FDI was directed to manufacturing; the rest went into services. There is a consensus among economists that FDI was crucially associated with the competitiveness in Czech exports. Nevertheless, the true role of FDI, as it seems, was rather intermediary. It seems that incoming FDI just reaped the advantages of effects of other more fundamental causes.

The growth of exports and their competitiveness is supported by a high statistical significance of material inputs (MAT) in all export models. We interpret this as the link to highly upgraded supply chains and the rising presence of economies of scale. It is an evidence documenting the crucial importance of input optimisation for an export penetration. The key for success rests in supporting domestic value added by high absorption of material inputs coming especially from imports (Benáček et al. 2003). The universal significance of this variable suggests that exports were more competitive in industries with higher degree of material processing. Its typical representative is the production of automobiles.

The finding about relative factor requirements (K/L) has serious implications. Its role in determining the pattern of specialisation was revealed in the dynamic estimation only, pointing to a growing role of capital-intensive production in exports to the EU. That was not the case in the early stages of transition when labour-intensive exports dominated (Stolze 1997 or Benáček et al. 2003). The reversal occurred gradually at the end of millennium, as the FDI and new investments (over 30% on GDP throughout the transition period) were replacing the accumulated stocks of antiquated physical capital. High rates of capitalisation and its sharply rising efficiency in tradables can be considered the crucial success of transition. Unfortunately, the latter cannot be generalised for the non-traded sectors, the growth of which was very low, causing a low overall GDP growth. This is in line with the hypothesis of Crespo Cuaresma and Wörz (2006:34-35) saying that a qualitative distinction should be made between export sectors and domestic production.

Tariffs appear significant only in the case of static estimation. Contrary to intuitive judgments, our results do not pose the EU tariff concessions into the role of drivers of

exports. Relative to other more robust changes, such as the quality upgrading or structural reallocations, the small size of the average EU tariff and a relatively long period for gradual tariff dismantling (8 years), the tariff concessions seems to be an auxiliary instrument of trade creation only.

What concerns the regression function for exports to the rest of the world (RW – see the last two columns in Table 2), we have found that its properties support the static estimation with random effects. Even though we have found only three statistically significant exogenous variables, its coefficient of determination was only slightly lower than that one for exports to the EU. As in the previous case, the structural characteristics of specialisation have been determined by improving unit prices (PX) and the supply chains (MAT) pointing to rising importance of the value of inputs. The significance of the variable of internal price changes (PC), in parallel with rising unit export prices, signals that the pattern of domestic inflation was correlated with the success in exports to this region. A similar but less pronounced tendency was also found with exports to the EU.

The findings about nominal convergence raise a question whether such price changes should be considered a true inflation reflected also in the GDP deflators. Terms of trade improvements via exports should not be considered an inflation of the same standing like price hikes in the non-traded products lacking a concurrent quality upgrading. It would also imply that the real growth in transition countries, where intensive quality upgrades in exports are interpreted as "inflation", could be systematically under-estimated. As Kohli (2004) has shown, a higher GDP growth can be estimated if more concern is given to the terms of trade improvements and if the statisticians would accept a more broad-minded approach to deflators.

As far as the analyses of import functions are concerned (see Table 3), analogously to the export function, the parsimonious specification was found by employing Hausman test 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 υ_i and the covariates x_{it} (0.06 and -0.12 for imports from the EU-15 and the RW respectively) show that only the static random effects model applies.

The key determinants of imports from the EU include Czech GDP, reflecting an intensive import absorption of the aggregate demand. In addition, we should stress the high interdependence of imports and exports (X^{eu}) within the same industry, as is confirmed by the last explanatory variable on the list. Partially it reveals a high re-export destination of imports. Until 1997 the inward processing traffic in some highly labour intensive industries was an important driver of trade creation. Later, when the Czech wages were losing on their competitiveness, it was replaced by a general tendency to substitute domestic material inputs by imports.

At the same time a high correlation between exports and imports within the same sectors documents the intra-industry trade (Rosen, 2002). Its sharp increase, forming approximately 70 % of the EU-15 imports in 2002, is a positive signal, even though it is still dominated by vertical differentiation (Horáková 2005), i.e. by exporting commodities of lower quality in exchange for similar products with higher quality. Intra-industry trade supports the immitation spillovers, makes the balance of trade also less prone to adverse consequences of the exchange rate appreciation and deepens the importance of supply

chains – a feature that was also captured by the statistical significance of material inputs (MAT).

As the positive sign of unit import prices (PM) signals, the import penetration strategies of the EU exporters are based on competition in product quality. Thus the transition in the whole trade with the EU (i.e. in both imports and exports) was marked by a restructuring based on sharply improving standards in quality. This tendency was even more pronounced than the changes in the industrial structure of specialisation.

The estimated high income elasticity of imports – its index for the EU-15 varying between 2 and 3 – is compatible with other estimates, for instance by Tomšík (2000). It 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 analysed period have been neutralised by contractions in some segments of domestic production for domestic consumption and replaced by imports. For example, Altomonte and Resmini (2001) found that developments in transition countries driven by expanding multinationals may be checked by disruptions in the ties between domestic firms, forcing them to go through costly restructuring and downsizing and causing their output to be superseded by imports. The processes of creative destruction can last a long time and preclude growth.

Concerning imports from the RW, they were closely associated with the stock of foreign direct investment and the evolution of nominal domestic prices. The former hints at a fact that a part of the FDI capacities were built for processing the material imports from the East – a continuation in the traditional division of labour from the times of COMECON. In addition, the negative coefficient of PX^{rw} confirms that the Czech production for exports to the RW competed with its imports. Imports from the RW are challenged by domestic competition that concentrates mainly in vertically differentiated products of lower quality, which, however, improve in time. This is in line with the positive coefficient of PC, which implies that domestic price increases were not in conflict with rising imports from the RW.

6. CONCLUSIONS

This analysis focuses on factors determining the transition of international trade in the Czech economy. Its story reminds of the fairy tale of Cinderella. Even though the Czech economy was exposed to several structural shocks during 1993–2002 and grew at a very low rate, its external exchanges still sustained an annual growth around 10%. The restructuring in the pattern of specialisation with the EU-15 was exceptionally intensive and our results confirm that its progress can be explained by the variables used in the theories of open economies. The undergoing changes were profound and painful, but their positive final outcome was undisputable.

What concerns exports and imports with the EU-15, the level of aggregate demand at home and in the EU-15 and the appreciating real exchange rate were the leading explanatory factors on the side of macroeconomics. In addition, there were several factors acting at the level of commodities or industries. The development of trade with the EU-15 was particularly shaped by the evolution in unit prices of exports and imports, and partially by the liberalisation of tariffs. The product quality of Czech exports was on a sharply improving trajectory throughout 1993–2002, which boosted export penetration and

compensated for the appreciated real exchange rate. The adjustment proceeded not only by rising unit prices but mainly by reallocating exports to commodities with already high unit prices.

Economies of scale (or the extent of supply chains, respectively) proved to be a highly significant factor determining the specialisation of both exports and imports, along with the rising importance of intra-industry trade. We have also found that the dynamics of exports to the EU were subject to adjustments in the factor requirements. That means the producers had to react to the changing endowments of capital and had to seek the optimal capital per labour mix, once the obsolete and sunk physical capital stock was gradually replaced by very high new investments.

Concerning the Czech trade with the rest of the world, the key determinants were domestic GDP, qualitative upgrading in the unit prices of exports, Czech domestic production prices, stock of foreign direct investment and economies of scale. Intra-industry trade has been also deepening outside the EU-15, although the vertical differentiation of products prevailed. That burden of the past could be soon reversed, though, if the process of quality upgrading would continue. Finally, we did not find any statistically strong influence of the real exchange rate on the intensity of trade with the non-EU countries.

By quantifying the determining factors of Czech exports and imports during 1993–2002, this paper enriches the empirical trade literature with evidence from an economy that has undergone intensive structural changes. As it is evident from the Czech case, deep restructuring on the supply side can proceed very fast from the beginning of transition, being driven by replacing the sagging domestic part of demand by foreign demand. However, such developments cannot proceed without intensive restructuring and adjusting to highly competitive world markets – i.e. without process of creative destruction, which imply high social costs. In the Czech case the unimpeded exposure to international competition resulted in a trade-off between accelerated exports and a subdued growth in GDP that was restrained by burgeoning imports.

An analysis of the open part of a transforming economy, which evolves in a very different environment from the non-traded or the government sectors, can serve as a leading indicator for the future developments. Notwithstanding the low overall GDP growth, the Czech economy was unveiling a sharply rising progress in the hard core of its emerging market economy. In this case the pattern of observed changes was not in conflict with the standard theories of modern open economies, such as Heckscher-Ohlin factor proportions, economic geography or intra-industry trade. It also helps explaining why the net effects of such fundamental reallocations and trade-offs could bring fruits in the long-run only.

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Table 1. Definition of variables

Variable	Definition
X_{it}^{w}	Czech exports to region *w* (in current CZK) by industry *i* in year *t*; (dependent variable)
M_{it}^{w}	Czech imports from region *w* (in current CZK) by industry *i* in year *t*; (dependent variable)
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 domestic 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. It is assumed that catching up with the EU price level is faster in industries, which adjust quicker to the world market requirements;
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 describing the type of foreign competition the Czech exports are confronted with 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 the 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). It is assumed that gains in productivity in time increase the competitiveness of given industry;
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, reflecting the dependence of industry on the supply chain and its impact on the economies of scale;
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 assessed by the stock of real M2 (as an alternative to the PRI_t variable);
PRI_t	Money market interest rate of PRIBOR – 3 months (as an alternative to the MP_t variable);
X_{it}^{EU}	Exports to the EU, indicating the potential for intra-industry trade (present in the import function only);
e_{ti}^{w}	Random term.

Table 2. Results of estimating the export function

	Exports to the EU-15					**Exports to the RW**	
	Transformed static estimation		Dynamic estimation – GMM method 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)***
ln EXPORT (t-1)	-	-	**0.56 (13.8)*** **	**0.52 (4.81)*** **	**0.56 (4.88)*** **	-	-
ln GDP^{eu} (ln GDP^{rw})	**2.29 (0.63)*** **	**2.50 (0.37)*** **	**1.55 (5.75)*** **	**1.64 (2.55)*** **	**1.45 (2.96)*** **	0.72 (0.51)	-
ln RER^{eur} (ln RER^{usd})	**-1.08 (0.44)*** **	**-1.19 (0.42)*** **	**-1.16 (-9.2)*** **	**-1.18 (-4.64)*** **	**-1.15 (-4.67)*** **	-0.22 (0.18)	-
ln M2real	0.04 (0.49)	-	-1.02 (-6.8)***	-0.73 (-1.14)	-0.83 (-1.64)	0.08 (0.05)	-
ln PC inflation	0.28 (0.27)	-	0. 29 (2.1)**	0.24 (0.68)	0.32 (0.93)	0.39 (0.25)	0.67 (0.17)***
ln PX^{eu} (ln PX^{rw})	**0.19 (0.05)*** **	**0.17 (0.04)*** **	**0.14 (3.63)*** **	0.17 (1.08)	0.15 (1.10)	**0.23 (0.05)*** **	**0.23 (0.05)*** **
ln PM^{eu} (ln PM^{rw})	-0.05 (0.06)	-0.07 (-0.36)	-0.03 (-0.7)	-0.07 (-0.36)	-	-0.03 (0.05)	-
ln K/L	-0.1 (0.07)	-0.09 (0.07)	**0. 13 (2.53)** **	**0.19 (2.58)*** **	**0.19 (3.10)** **	0.07 (0.07)	-
ln FDI	-0.01 (0.02)	-	0.01 (0.92)	0.01 (0.23)	-	0.01 (0.02)	0.004 (0.01)
ln MAT	**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)*** **
ln TX^{EU} tariff	**-1.54 (-0.33)*** **	**-1.59 (0.31)*** **	-0.14 (-0.7)	-0.24 (-1.13)	-0.14 (-0.6)	-0.08 (0.5)	-
ln Y/L productivity	-0.09 (0.08)	-	-0.16 (-4.8)***	-0.19 (-1.51)	-0.16 (-1.71)	-0.05 (0.1)	-
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]		
ρ	0.69	0.69	-	-	-	0.56	0.56
σe	0.23	0.23	-	-	-	0.24	0.24
σu	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 (probab.)	-	3.17 (0.78)	-	-	1.74 (0.99)	-	7.75 (0.11)
Corr (vi,Xb) / assumed	0.075 / 0	-	-	-	-	0.14 / 0	-
R^2 / no. of observ.	0.70 / 290	0.69 / 290	-	-	-	0.64 / 290	0.63 / 290

Notes: 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 only.

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	-30.50 (13.2)**	-11.8 (4.60)***	8.40 (9.5)	0.08 (2.60)
ln GDP^{eu} (ln GDP^{rw})	**3.08 (1.8)***	**2.21 (0.67)*****	**0.78 (1.14)**	**1.14 (0.63)***
ln RER^{eur} (ln RER^{usd})	-0.51 (0.94)	-	-0.21 (0.31)	-0.32 (0.28)
ln M2real	-0.78 (1.78)	-	0.50 (1.11)	-
ln PC inflation	0.65 (0.6)	-	0.54 (0.33)*	0.67 (0.33)**
ln PX^{eu} (ln PX^{rw})	-0.01 (0.13)	-	-0.13 (0.07)*	-0.13 (0.07)*
ln PM^{eu} (ln PM^{rw})	**0.23 (0.14)***	**0.27 (0.08)*****	**0.17 (0.07)****	**0.17 (0.07)****
ln K/L	-0.27 (0.16)	-	-0.04 (0.10)	-0.05 (0.99)
ln FDI	0.03 (0.03)	-	**0.07 (0.02)*****	**0.07 (0.02)*****
ln MAT	**0.70 (0.06)*****	-	0.12 (0.08)	0.12 (0.09)
ln TM^{CZ} tariff	3.30 (2.0)	-	-1.73 (1.9)	-
ln Y/L productivity	0.05 (0.19)	-	-0.17 (0.11)	-
ln X^{eu} exports into EU	**0.48 (0.12)*****	**0.48 (0.08)*****	**0.34 (0.08)*****	**0.34 (0.08)*****
ρ	0.33	0.34	0.51	0.53
σe	0.62	0.61	0.35	0.35
σu	0.74	0.91	0.73	0.75
Wald test	150 (0.00)	110 (0.00)	219 (0.00)	211 (0.00)
Hausman test (probab.)	-	0.25 (0.97)	-	5.78 (0.68)
Corr(vi,Xb) /assumed	0.06 / 0	-	-0.12 / 0	-
R^2 / no. of observ.	0.68 / 290	0.59 /290	0.56 /290	0.53/290

Notes: 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.