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WHAT PATTERNS DOES HUNGARY'S REAL INTEGRATION INTO THE EU SHOW? A 'HECKSCHER-OHLIN' MODEL AND SOME TIME-SERIES ANALYSES

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SUMMARY

Exports from Hungary to Germany are sensitive to the trend of industrial output there, in a way contrary to the explanation projected. However, this is not the case with exports to Austria. It should also be noted that Hungarian exports are insensitive to short-term variation of industrial output abroad, but interestingly, short-term variation of the real exchange rate and FDI affect them.

Hungary can be said to show strong real integration with some EU countries. The findings relating to Germany are important, since Germany is commonly seen as the driving force behind the demand condition of the EU core, against which real integration can be judged. It has been shown that there is a long-term structural link between Hungary and two of the three countries analysed: Germany and Austria. However, the short-term variation of foreign demand, unlike real exchange rates and FDI, does not have any explanatory power over the cyclical variation of Hungary's exports.

This suggests that more direct measures may yield more 'optimistic' results, in terms of the real integration of CEE countries, than simple industrial output. Unfortunately, the authors of this study lacked data to carry out the same investigation for other pre-accession countries. Although the results are promisingly clear for Hungary, but they need to be qualified by international comparisons.

An interesting side product of the empirical exercise is that it suggests that FDI inflow is probably associated with good times in the foreign countries. This makes it more probable that foreign investment flows in Hungary are complementary rather than substitutes with investments taking place abroad. This has the implication FDI inflows to Hungary are not replacing capacities abroad, rather they are set up jointly with those.

SOME REMARKS ON THE ROLE OF FOREIGN DEMAND

It is often suggested that foreign demand is crucial to the growth of developing countries. The typical transmission mechanism that mediates between foreign demand and domestic supply is foreign trade. If foreign demand is important to the growth of the domestic economy, this must show itself in rising trade (and exports) as well. The other determinant of how desirable domestic products are, besides foreign demand, is the relative product price between foreign and domestic markets. Using a common currency to compare the price levels, this is often called the absolute real exchange rate and commonly used to check for differing price behaviours of domestic and foreign production in export equations. Discounting transport costs and trade restrictions, small price differences can cause big swings in who is exporting.

The most interesting applied research usually has some simple, disturbingly everyday 'political- economic' motivation. The political slogan that goaded the authors into collecting data and sketching a model for checking by simple econometrics was the assertion that the EU slow-down may impede the dynamic growth in the more successful transition countries. To put this another way, it is being assumed that EU demand drives the economic progress of these countries, through their dynamic exports to the EU. This argument often appears in the popular press and it has featured in official statements by Central and Eastern European (CEE) government bodies and by international organisations (*e.g.* in EBRD, 2000, p 50). Without denying that foreign demand plays a role, the authors would like to point out that there are other important factors present. The research aimed to discover whether the use of 'supply-based' language about exports was more justified than language related to foreign demand. However, this paper goes on to say more than that. After looking at the data of the past ten years in Hungary, the authors conclude that demand conditions in the main exports markets are far from enough to explain exports and this is particularly so in the short run.

Another relevant line of argument in the research concerns the level of integration between CEE countries and the EU. Boone *et al.* (1998) found that sufficient real convergence has taken place between the EU and the CEE countries. Buch et al (1999) found that monetary integration was ahead of real integration, and it seemed as if neither had managed to proceed very far. This paper deals only with real integration, not with monetary integration. This is more important on the way to EU accession, as membership of the CEE countries in EMU will probably come only later in the process, and not immediately upon accession. Buch *et al.* (1999) uses empirical models to check for real convergence. We have tried to supplement their work, at least in the Hungarian case, and found that there are long-run co-integrating relations between German and Hungarian economic activity. Clearly and unsurprisingly, the driving force behind these derives from real variables, one of which is FDI. The case is similar for Austria, but the link is missing with Italy.

1) A PARTIAL MODEL

A simple model is proposed in Appendices A and B to illustrate this point. The assumptions of the model are quite standard. Assume there are two economies and two products. One economy (the foreign country) produces a final product, while the other (the home country) produces only an intermediate product. The former country can represent an EU country (in particular Germany) and the latter a CEE country (in particular Hungary).

There are fixed amounts of capital and labour, which are assumed to flow freely between sectors and countries. To come nearer to reality, labour movements can be restricted, but that does not change in the least the qualitative results in which we are interested. (Dixit *et al.*, 1980 and Pfaffmayr, 2001 present models of a similar nature.) The flow of goods between the countries is completely free. Whit industrial goods (apart from some sensitive products), trade restrictions with the EU were dismantled under the Europe Agreements for the early 1990s. The final product is used in the foreign country only and the intermediate-goods sectors of the two countries produce identical inputs for the final-product sector. This assumption is not completely outlandish, as in Hungary's case, the main export producers (FDI firms in the automotive and electronics industries) brought in the most advanced production technologies. So there was no difference in the production technologies used in much of the export sector of the home country and in the intermediate-goods sector of the foreign country. In the home country, there is only one type of production and the output is entirely exported to the foreign country. The fact that there is only one sector in the home country means simply that the rest of the economy is insulated from the high-technology export sector of the economy. With little interaction, there is no need to represent the rest of the economy in the model.

Only a negligible part of Hungary's high-technology production is sold on the home market and so it is not unrealistic to assume that the foreign and the home production are driven entirely by the foreign needs. Foreign demand for the final product has been treated as one of the exogenous variables, as the demand side has not been introduced yet in other ways. There are two other exogenous variables: the total stocks of capital and labour. Input prices are assumed to be flexible, so that there is no idle labour or capital. The adjustment mechanism that corrects for the disturbances of foreign demand derives from price changes and factor movements. These are standard Heckscher-Ohlin assumptions, except that in one of the countries in the model there is only one product and the production of one of the products requires some of the other product as input.

The intention has been to show that an exogenous shift in the foreign demand for final products can have an ambiguous impact on home production.

The model we recommended has been summarised formally in Appendices A. We wanted to see how exports from the home country responded to disturbances in foreign demand.

Appendix sums up the comparative static results of interest here. By considering a simple model, it can be shown that the behaviour of exports from the CEE countries to the EU will be involved than a simple demand equation, and EU demand conditions are crucial only under certain conditions. Exports are determined by the behaviour of input costs as well, and depend on the factor flows from the EU. In reality, capital flows are the only permitted factor flows between these two groups of countries, so we prohibited changes in labour stock across countries in the model.

2) Why FDI was chosen

Foreign direct investment was taken as a measure of capital flows because it is more directly related than other capital-flow forms to the production pattern abroad and to home exports. It was assumed in the model that the capital flow to the home country results quickly in a rise in output and exports. This assumption is best fulfilled by FDI flows.

In the traditional export-demand equation, the two main determinants of exports are real exchange rate and foreign demand. The presence of the latter distinguishes the export-demand equation from the export-supply equation. A usual policy with these data is to calculate the price elasticities of export demand and import demand. This line represents a popular route of research and new methodologies help to reinterpret old data and rewrite old topics.

A significant convergence of price levels is required between Hungary and the EU before accession takes place. This means that Hungarian prices will have to rise faster and the real exchange rate worsen as well. One cannot expect that price competitiveness will be an important source of exports. Halpern-Wyplosz (1996) summarise the reasons behind the long-term appreciation of real exchange rate. Sustaining export growth (and growth in the required imports) will call either for favourable demand conditions in the importing country, to compensate for the loss of competitiveness, or for other factors to drive up exports as well.

The experiences of Japan and other Asian countries show that relative price and demand conditions can be unimportant as long-run determinants of exports success (Goldstein and Khan, 1985). It has been extensively shown that exports from East Asia to the United States have been independent of cyclical demand conditions on the US market. Researchers were already pointing out in the 1970s that the export success of these countries depended far more on supply factors (new technology, capacities and FDI). Pure time-series testing of supply factors is scarce, due to the short period for which data on FDI has been available. The importance of FDI was not recognized until the mid-1980s, and systematic international data collection only started after FDI flows had begun to replace bank credits as the main channel of international capital flows.

FDI time series are even shorter in transition countries than they are in developing countries. It is not surprising, therefore, that economists modelling exports and trade in transition countries have used panel models with large country cross-section data (Jakab *et al.*, 2000) instead of analysis of non-stationary time-series data. The fixed-effects specification of the gravity model by Mátyás (1997) and its application to the Asian-Pacific countries resulted in interesting sign shifts in the other variables. However, for a panel with long cross section, these results did not prove robust (Jakab *et al.*, 2000). The other interesting feature of the panel was that the authors managed to include FDI flows for a large sub-sample of countries and these proved highly significant – in fact, much more significant than real exchange rate or foreign income. Hence, as Hooper observed in his early works, supply-side factors are important determinants of export behaviour. In this early work Hooper (1978) surmised that the high-income elasticities observed in the exports of Asia-Pacific countries to the US must be due to supply elasticities, rather than income sensitivity.

Interestingly, only ten years after Hooper's hypotheses came new studies that tried to explore this hypothesis expansively (*e.g.* Riedel, 1988 and Muscatelli *et al.*, 1995). In our research, the initial explanation for the expected high degree of supply responsiveness and low responsiveness to income is simply replacing capital abroad with inputs from the home country. Capital intensity increases in the home country while intensity in the product f the home country increases abroad. This is a traditional story. For instance, Muscatelli *et al.* (1995) explained the elasticities they found by the new growth theory and thence, the increase in varieties and quality for South-East Asian countries with annual data. They identified both long and short-term elasticities using an auto-regressive distributed lag (ADL) model, where they estimated simultaneous reduced-form equations for supply and demand. In this framework, they used not only prices, but capital stock as a factor of the export-supply function. Demand function was formulated in the usual manner (Goldstein and Khan, 1985). Next, they used a similar equation to the one used in this study. They estimated a demand equation with the price and demand variables and capital stock. However, capital stock represented a demand factor in their story, as it proxied either increasing variety (horizontal diversification) or better quality (vertical diversification). It could therefore be seen as a demand factor and included in a demand equation. They estimated an equation with similar variables to the one used here (prices, demand and capital stock). Here foreign capital stock has been used instead of capital stock. For this, they also used co-integration technique and arrived at similar results to the ADL method. In the simultaneous ADL framework, capital entered the regression as a supply factor in the reduced-form equation, while it was estimated by co-integration when it was a demand factor.

Similar equations to those of the latter method (prices, demand and capital) have been used here, with a wider range of methods for co-integration. The co-integrating relation for this equation can be regarded as a long-term demand equation, where quality improvement and product variety are proxied by FDI stock. Alternatively, they can be seen as reduced-form equations, if we are only interested in the reduced-form parameters.

The main findings of Muscatelli *et al.* (1995) were that capital stock proved significant in almost all South-East Asian countries, regardless of whether it was treated as a supply or a demand factor. At the same time, they differed from some earlier literature (Riedel, 1988) in finding both price and demand elasticities quite high in most countries.

In panel estimations, on the other hand, foreign demand was significant along with the factor representing the supply side (FDI) as well (Jakab *et al.*, 2000). In successfully exporting countries of East and South-East Asia, the most important determinants of exports were supply-side factors (investment, total capacities) (Hooper, 1978), the supply side being proxied with some measure of investment, rather than input and output prices. This was because the use of some average measure of prices was strongly questionable at aggregate level (Goldstein and Khan, 1985).

In transition countries, and in Hungary as well researchers face the problem of lacking capital stock data at the aggregate level. Some attempts to obtain it have been made to by aggregating investments over time, but the time span of aggregation extends to the pre-transition period questioning the validity of adding investments up in a single number. In lack of anything better we proposed using FDI stock to proxy for the supply side transformation of the economy. Naturally, it has limited validity in general, but in the Hungarian context and the time period covered (privatisation dominated by foreigners), it may be a good proxy for supply side effects. It is thought to capture a wider range of supply effects than physical capital stock.

3) Some methodological issues of time-series analysis

The most authoritative review of trade elasticities is Goldstein and Khan (1985), who cover empirical studies that use time-series regressions, reflecting the econometric practice of the time. Hence, they do not cover either the use of panel models, as recommended by Mátyás (1997), or the new methods of time-series analysis. The one technique of new time-series methodology touched upon at the end of the review is the Granger causality test.

This new methodology is not new any more (Granger and Newbold, 1984, Engle and Granger, 1987, and Johansen, 1988, to name just a few studies). It is only new relative to the time-series articles that essentially established the trade-elasticities literature up to the early 1980s. Re-evaluation of that literature and the elasticities with the new methods is still going on. We would like to add a modicum of new information from one transition country.

Without going into the techniques of the new time-series methodology, it is worth pointing out here the main intuitions behind it. It was very difficult to distinguish casual relations from spurious regressions using the old methodology, as most time series in economics contain a trend. This almost certainly makes parameter estimates with time series significant. Researchers controlled for this problem by including a time trend in the regression. This was found to be insufficient, as not all time series revert to a deterministic trend and turn out to be trend stationary. It was found that many non-stationary time series could be better described with a unit root, as they need to be differenced to render them stationary. The practical importance of finding unit roots is that they are long-memory processes, unlike trend-stationary processes. So the impact of a disturbance disappears very slowly. Theoretically, a check for the presence of a unit root should be made on the individual non-stationary time series that may appear later in the regressions, before deciding how to render the data stationary – by differencing or with a trend variable.

The other problem with non-stationary time is causality. It is not simple to distinguish significant parameters found according to whether they are due to an underlying trend in the series or whether there really exists an economic equilibrium relation between the variables of the model. That is when a search for a co-integrating relation can be of help. If all the series are integrated in the same order and they make up an economically reasonable system, the set of non-stationary variable is going to result in 'equilibrium errors' from the regressions. Equilibrium errors are a stationary set of regression residuals that signal there is no underlying tendency for the system to explode. This implies that the set variables in the systematic part provide a proper approach to the economic problem. If the errors are not satisfactory, the system is not co-integrated and the underlying theory may be a flawed description of the real world.

It is possible to choose the wrong set of non-stationary variables to explain the behaviour of a non-stationary variable. A co-integrated system means that the variables on the right-hand side are really the 'cause' and the possibility of a spurious regression diminishes. In this case, simple OLS provides true parameter values in what is known as super-consistency. This implies that simple OLS regressions converge to the true value of the underlying equilibrium parameters, in an order faster than with stationary data. However, there has to be enough evidence that the system is co-integrated. Another way of checking the causality of the variables of the system is by VARs. The intuition is simple: past values of the cause must predict the current values of the consequence well, and the reverse should not be true. This is usually used as a supplement to simpler versions of co-integration tests.

If there is a system of co-integrated variables, this implies that they have a common long-run trend. The system, then, can be described as a combination of long-run behaviour and behaviour that corrects for short-term deviations from the long-term stochastic trend. This short-term component of the error-correction model (ECM) consists of the 'equilibrium errors' of the system and its parameter value in a short-term equation. It should be negative if the system is truly co-integrated. Thus ECM too can be used as a kind of co-integration test.

4) The structure of the empirical investigation

The above multivariate, non-stationary time-series methodology is followed here. In the 1960s and 1970s, trade elasticities were estimated with simple 'spurious' OLS regression, without checking for the presence of equilibrium errors. Studies that were more thorough might include a time trend, to control for trends in the series.

If the variables are unit root, the differences can be used to gain some idea of what impact on short-term exports can be expected from short-term real exchange rates, foreign demand and FDI. Particularly interesting is the role of foreign demand in the short-term equation, as shocks in short-term, cyclical foreign demand influence exports. It may happen that foreign demand does not play a role in the long-term structural relation of Hungarian exports to the main EU partner countries, but in the short term they matter a lot. According to this scenario, the hypothesis is that foreign demand plays no role in the co-integrated relation, but in a differenced equation, it proves significant.

The order of computation is as follows:

1. The series is seasonally corrected using a 12-month moving average when needed
2. Graphs of the individual series are presented and tested for the presence of unit root.
3. Before accepting the right-hand regression variables as explanatory variables, a test is made for Granger causality.
4. If all the series to be included in the model are unit root and the Granger cause of the explained variable, the Engle-Granger method is used to test for co-integration (Engle and Granger, 1987). Then, Johansen's vector error correction formulation is utilised for a similar purpose. (Johansen, 1988).
5. Short-term regressions are run to see how the cyclical components relate to each other.

5) THE DATA

The input data for the calculations appear in *Figures 1* to *5*. Modelling exports involved collecting data for exports, nominal exchange rates, inflation for domestic and foreign prices, and FDI. The export data were obtained from the Hungarian Ministry of Economic Affairs, and the data for exchange rates, Hungarian prices and FDI from the National Bank of Hungary. Monthly data were used in the modelling exercise. Foreign demand was represented by the level of industrial output in the foreign country concerned, but attempts to obtain this from national statistical offices were unsuccessful. For want of anything better, cumulative indices of the volume of industrial production were used instead. The whole modelling exercise was based on calculations in foreign currencies.

The export data were available in US dollars, which had to be converted into national currency of the importing country. Calculations were made for Hungary's three most important EU trading partners: Germany, Austria and Italy. Real exchange rates were based on production-price indices for each pair of countries. Apart from industrial price data, industrial-output figures were also useful in our investigation. Most of the international trade between the EU and the CEE countries consists of industrial, intermediate and capital goods, not consumer goods, and so it was sensible to use industrial output as a measure of foreign demand.

The FDI data originate from the National Bank of Hungary's monthly current-account balance. The authors would have liked to test for the bilateral impact of demand shifts and supply-side impacts, but unfortunately, there were no bilateral FDI flows available on a monthly basis that were long enough. It therefore had to be assumed that FDI flows generate similar patterns of new exports to all three countries. If this is not so, it should show up as a lack of a co-integration relationship explaining exports. As much of the FDI inflow and much of the exports are related to Germany we can expect to find a cointegrating link more than in other trade relations. Monthly net FDI data by countries have been only available only since January 2000. All variables are expressed in the constant national currency of the EU country in question (calculating all values in terms of the prices in January 1992). Where level data could not be obtained, cumulative indices were used. The two leaps in the FDI data (two large privatisation deals) made no significant change in the results of later estimations. One problem with the FDI data is that they contain inflows in both export and non-export sectors.

Hence, some of the FDI recorded only influences exports indirectly and slowly.

6) Improving on other explanations of real convergence by time-series methods

Buch *et al.* (1999) make bilateral comparisons between the monthly industrial output of Germany and the pre-accession countries without finding a long-term linear relationship. This supports their conclusion that the real integration of these countries is insufficient. There are some problems with their procedure, which the present study tries to correct, while using only a Hungarian data set. In some respects, they picked the wrong variables, as real convergence is better measured by directly observable trade data. They write, 'After the break-down of trade links among the members of the Council of Mutual Economic Assistance (CMEA) in the early 1990s, the EU and particularly Germany have become major trading partners for the accession states. These figures suggest that real linkages of the countries with Germany and other EU countries can be expected to have tightened considerably during the past decade.' They argue that international trade should communicate real convergence. The *ad hoc* model that was recommended in the appendix of this paper has incorporated exactly that point. Furthermore, this kind of story should be tested on directly observable trade data, instead of the industrial data what they had used. Their work relies on the two ends of the rope, so to speak, the German and Hungarian indices of industrial production, but hardly examines the rope itself: trade. So a regression with exports explained by 'international' real variables such as foreign demand (industrial output) and FDI stock will be founded no less well than their model. Comparing simply the two industrial output indices ignores the channels by which economic integration is taking place (trade and factor flows). Real integration must show itself in the trade data.

Our study therefore chose exports instead of industrial production as a dependent variable. If integration is close then variation in trade data should be well explained with real foreign variables like foreign demand behaviour or foreign direct investment. This exercise needed more than two variables in the system. The real exchange rate is an important control variable and it is common practice to include it in trade equations, and so we do not dispense with it here. Foreign demand is represented by foreign industrial output and FDI appears in the system to represent the creation of capacities. This is done to arrive at a more complete system.

For all the CEE countries, Buch *et al.* (1999) reject co-integration and 'tight' real convergence with the EU core. They also tried to test for common cyclical behaviour of the two industrial indices, in cases where they found no co-integration or common trend with the EU (all CEE countries except Slovenia). It was found that except for Poland and Hungary, the presence of a common industrial cycle could also be rejected for all the pre-accession countries. They concluded that there is some real integration in the cases of Hungary and Poland, but it is weaker than for the countries in the EU core and Slovenia where strictly co-integrated industrial production indices are common.

7) Findings

The equations estimated in this study have two possible interpretations. First, they can be regarded as long-term export-demand equations (Goldsting-Khan, 1985), and one can also look at them as a reduced form of the simultaneous system. (Muscatelli *et al.*, 1995).

The calculations were done with the logs of the data, so that the estimated parameters can be regarded as elasticities. The relations estimated were meant to describe the last ten years. No observations were set aside to check the predictive accuracy of the models. Forecasting was not a purpose of the exercise. The findings were quite in line with expectations. After the data had been cleared of seasonal influences, the series consisted of the cyclical component and the trend component. The standard unit-root tests conducted suggested that all our series are unit roots (For the Phillips-Perron results, see *Table 1*.) The Granger causality tests then confirmed that real exchange rate, foreign industrial output and FDI are causes rather than consequences of exporting, so they should be on the right-hand side of the co-integrating relations. Up to this point, the results had arrived very 'smoothly'.

The Engle-Granger single-equation method then showed there was no co-integration vector for any of the countries. However, the more flexible Johansen test suggested otherwise and the presence of one co-integrating vector in the German and Austrian case was accepted, although none could be found in the Italian case. With the exception of Italy, the ECM specification confirmed co-integration with all the co-integration vectors found. In other words, all the parameters belonging to the ECM component proved significantly negative. The co-integrating relationship always disappeared when one of the explanatory variables was excluded from the system. This means that all of them are necessary for a satisfactory description of the long-run export behaviour.

It becomes apparent that the long-run export behaviour in national currencies is the most sensitive to foreign demand. (See *Table 2* for the co-integrating vectors.) A 1 per cent change in the volume of German industrial output involves an almost 4 per cent increase in the constant DEM value of Hungary's exports to Germany. To some extent, this is complemented by the impact of the FDI stock. When there is a 1 per cent increase in the volume of FDI, a 1 per cent increase of exports to Germany can be expected. The Austrian results differ from the German pattern only in the role of foreign demand. It is much smaller than for Germany, while the real exchange and FDI parameters are quite similar. Hence, it can be said that there is no truth in the expectation that foreign demand plays an unimportant role and exports are driven by FDI. What appears is that the in the long term exports to Germany are sensitive to demand conditions there, but less to FDI. However, it must be noted that the opposite holds for Austria. Hence, the validity of the initial assumption about the importance of FDI ("supply impact") for exports relative to foreign demand depends on which trading partner is analysed.

The only non-usual pattern noticed was that the sign of the price parameter was positive in the German and in the Austrian co-integration vectors. This result is often recorded in the literature (Goldstein and Khan, 1985) and often explained by nominal rigidities. It can be argued that the firms generating most of Hungary's exports fix the volume and nominal price of their exports month by month. Even if they experience negative input price shocks, they can only adjust output price the year after. Hence growing exports may be observed alongside an appreciating currency in the short run. In line with the literature, the estimated elasticity changed sign when lagged prices entered the equation instead of current ones. *Figure 6* shows that this model provides a pretty good fit for both countries, except in the first two years (1992–3), when predicted exports even went opposite to the actual ones. These were years in which disturbances related to the transition still played a major role in export behaviour. Such factors might include high inventories inherited from state-owned enterprises and the supply effect of the bankruptcy law of that period. Some argue (Kovács, 1999) that other factors contributed to the weak performance of the exports sector, such as excess public spending and the low credibility of monetary policy. Homogeneity is clearly lacking in the sample and this may invalidate the results. However, it was surprising to find that omitting this period did not change the results in qualitative terms. The price elasticity halved in Germany's case, while the rest of the parameter estimates remained essentially unchanged.

After robust long-term linear relations with the German and Austrian economies had been established, attention turned to short-term links. All the variables are unit roots, so that the differenced equations should be helpful, because they only contain the cyclical components of the variables. We started with a long lag (18), and checked for the correct lag length by various methods (AIC, Schwarz criterion). In most cases they all suggested a zero lag as optimal in others a lag length of one or two was chosen as optimal. There is unresolved controversy in the literature as to how to choose the leg length optimally. The reason for this is that there is a trade off between a well-behaved error structure and how economical the empirical model is. Adjusted R^2 recommended maximum lag length as optimal. In the estimates with short lags we have of course low adj. R^2 while with long lag structure we have high (70–72%) adj. R^2. A middle of the way approach between the very strict Schwartz criterion and the lax adj. R^2 criterion is a series of LR-tests whether it is acceptable to further reduce the length of the model. However, this method did not help up us much. The economic content of the export equations with a zero lag is questionable, and so we presented the lagged short-term results with up to three lags as well. (See *Tables 3* and *4* for Germany and Austria.) However, the qualitative results were the same with all lag length: it turns out that of the three explanatory variables, only FDI and the real exchange rate show up as significant, while the proxy for foreign demand is always insignificant, whichever lag length is chosen. Omitting the first two years of the sample did not change the short-term results in any meaningful way, except that the ECM term became –0.2 instead of –0.4. This signals that in the German case, the co-integrating relation is probably even tighter than suggested by the estimate based on the whole sample. If disturbance occurs, actual exports return to the predicted level even twice as fast as than before.

It is not obvious why a change in the real exchange and the FDI inflow should already cause a change in exports so promptly. One obvious reason, relevant to the real exchange rate, has already been mentioned – nominal rigidities – but other reasons for that can be envisaged. It can happen (not considering exchange rate and foreign price disturbances) that firms systematically produce more than the amount for which they have a long-term contract with their buyers, because they can sell it abroad at a discount, albeit still profitably. When such possibilities arise, firms with an unchanging capital stock are better off if their workers do overtime or they employ extra labour to produce the extra amount. Because the discounted goods are exported, the effect is an increase in exports coupled with a decreasing real exchange rate. This may happen in the same month, the adjustment for some products may require a very little time. Surprisingly, FDI too can influence exports, even in the same month. The FDI used as an input series is FDI inflow collected by the central bank. It may only mean that an ownership stake in some company has been bought and the proceeds are in the previous owner's account. But, it may be that the company's exports were sluggish only for want of a financially stable owner and the banks become happy to provide credit once a creditworthy owner appears. With some products, the availability of finance may improve the exports of a firm very quickly. Furthermore, banks are often well aware of a change in ownership before the proceeds appear in the seller's account (as FDI). This is truer still if the banks are the sellers of the firm. That explains how a positive link between exports and FDI can be observed even before the inflow. The observed current-time correlation may result from something invisible to us that has taken place before we realise it. However, this hypothesis can be confirmed conclusively only at the micro level.

INTERPRETATION OF THE ELASTICITIES FROM A REDUCED FORM

Up to now we have interpreted the trade elasticities as if they were a result of estimating an export demand equation. However, they can be interpreted as reduced form parameters as well, where the elasticities represent the long-term multipliers of a structural system. We set up a system like that (See Appendix) under a number of simplifying assumption, and tried to draw conclusions about the structural parameters of the economy.

It turns out that the price elasticities Hungary has in the observed relations are such that

1. The price elasticity of demand for the foreign product by Hungarian producers is small compared to the supply elasticity of the foreign product.
2. The foreign price elasticity of the demand for Hungarian products are high compared to the Hungarian supply elasticity.
3. Importantly, we found that under the model, investments in the partner countries and Hungary are complementary and not substituting each other. This weakens the argument that if capital stock declines in the foreign country, it is due other countries attracting investments. In fact, investments tend to take place jointly. This is a result supported by the vector error correction specification as well.

One can estimate the structural parameters using econometric methods directly as well, but this is an issue we are going to take up in a subsequent paper.

* * * * *

TABLES AND FIGURES

Table 1
The p-values of Phillips-Perron tests for various specifications of the regression equation

	LEXPORTS	LFDISA	LRARFMOD	LINDPRMO
DEM CT	0.15664	0.88546	0.80366	0.38926
DEM C	0.97505	0.78907	0.49291	0.94267
DEM	0.73280	0.74703	0.52396	0.43246
DEMDIFI CT	1.38361D-14	1.74880D-09	6.58697D-08	3.27449D-14
DEMDIFI C	2.74323D-16	6.23101D-10	2.37014D-09	4.64929D-16
DEMDIFI	3.35782D-16	1.70337D-08	6.69546D-10	2.49899D-16
AUT CT	0.0053684	0.87855	0.80196	0.0076795
AUT C	0.82761	0.79489	0.51664	0.92019
AUT	0.71769	0.73805	0.43698	0.95039
AUTDIFI CT	2.13875D-11	2.67962D-09	6.14678D-09	6.22957D-09
AUTDIFI C	5.04275D-13	8.30306D-11	1.02858D-10	9.38279D-11
AUTDIFI	2.75348D-13	2.00379D-08	3.27069D-11	1.59373D-12
ITA CT	0.0093834	0.92965	0.37272	0.010237
ITA C	0.73761	0.78665	0.60068	0.72446
ITA	0.71618	0.75036	0.21965	0.70542
ITADIFI CT	9.79105D-13	4.65330D-09	2.63565D-06	3.06586D-12
ITADIFI C	2.11179D-14	1.72682D-09	1.28142D-07	7.35662D-14
ITADIFI	2.47330D-14	2.20569D-08	2.24623D-08	7.02853D-14

Note: DEM, AUT and ITA in the equation names indicate German, Austrian, and Italian input data respectively. The suffix DIFI at the end of the equation name denotes test statistics from a differenced, short-term equation (with error-correction specification). The others are long-term equations. Explanation of the signs after the name of the equation: CT = There was both a constant and a trend in the equation. C = There was only a constant in the equation. ␣ = Neither a constant nor a trend was present in the equation.

Table 2
Co-integrating vectors in Hungary's three main trade relations

	Germany	Austria	Italy*
LEXPORTS	1,00000	1,00000	1,00000
LFDISA	-0,95599	-0,84457	-1,11663
LRARFMOD	2,66082	2,82463	-30,40924
LINDPRMO	-3,96301	-0,45996	68,89504
Variables			
LEXPORTS	Log of Hungarian exports to the foreign country		
LFDISA	Log of FDI		
LRARFMOD	Log of real exchange rate		
LINDPRMO	Log of industrial production abroad		
ECM	Error correction component		
C	Constant		

Note: * In the Italian case, the vector is not valid.

Table 3
Short-term regression results with differenced variables in various lag structures, in the German export equation

Lag = 3 Explanatory variables	Adjusted R^{**} = 0.229422 Coefficient	Schwarz B.I.C. = -4.37885 p-value
C	0.010322	0.474
ECM	-0.209046	0.003
DFDISA	1.1267	0
DFDISA(-1)	0.119075	0.7
DFDISA(-2)	-0.467962	0.127
DFDISA(-3)	0.098371	0.735
DRARFMOD	-1.00534	0.066
DRARFMOD(-1)	-0.427042	0.428
DRARFMOD(-2)	1.62537	0.003
DRARFMOD(-3)	-0.824082	0.112
DINDPRMO	0.544815	0.436
DINDPRMO(-1)	-1.23049	0.148
DINDPRMO(-2)	0.237388	0.778
DINDPRMO(-3)	-1.05094	0.138
Lag = 2 Explanatory variables	Adjusted R^{**} = 0.211854 Coefficient	Schwarz B.I.C. = -4.46586 p-value
C	0.007352	0.557
ECM	-0.207735	0.002
DFDISA	1.15509	0
DFDISA(-1)	0.034042	0.912
DFDISA(-2)	-0.30606	0.295
DRARFMOD	-1.06342	0.05
DRARFMOD(-1)	-0.21841	0.682
DRARFMOD(-2)	1.32851	0.011
DINDPRMO	0.4371	0.533
DINDPRMO(-1)	-0.950905	0.251
DINDPRMO(-2)	0.523162	0.47
Lag = 1 Explanatory variables	Adjusted R^{**} = 0.175989 Coefficient	Schwarz B.I.C. = -4.53432 p-value
C	0.006859	0.573
ECM	-0.224629	0
DFDISA	1.24365	0
DFDISA(-1)	-0.193687	0.519
DRARFMOD	-1.25989	0.019
DRARFMOD(-1)	0.196533	0.703
DINDPRMO	0.193028	0.778
DINDPRMO(-1)	-0.94513	0.179
Lag = 0 Explanatory variables	Adjusted R^{**} = 0.183634 Coefficient	Schwarz B.I.C. = -4.65364 p-value
C	0.001401	0.896
ECM	-0.204121	0
DFDISA	1.19134	0
DRARFMOD	-1.17204	0.022
DINDPRMO	0.674057	0.263

Table 4
Short-term regression results with differenced variables in various lag structures, in the Austrian export equation

Lag = 3 Explanatory variables	Adjusted R** = 0.13029 Coefficient	Schwarz B.I.C. = -3.75477 p-value
C	0.016283	0.401
ECM	-0.317758	0
DFDISA	0.628008	0.13
DFDISA(-1)	0.115204	0.779
DFDISA(-2)	0.209334	0.61
DFDISA(-3)	-0.051987	0.896
DRARFMOD	-1.24634	0.104
DRARFMOD(-1)	0.711925	0.349
DRARFMOD(-2)	0.70422	0.346
DRARFMOD(-3)	-0.761597	0.301
DINDPRMO	-0.396043	0.237
DINDPRMO(-1)	-0.358648	0.332
DINDPRMO(-2)	-0.28485	0.429
DINDPRMO(-3)	-0.393921	0.239
Lag = 2 Explanatory variables	Adjusted R** = 0.137754 Coefficient	Schwarz B.I.C. = -3.87226 p-value
C	0.008031	0.65
ECM	-0.29641	0
DFDISA	0.668155	0.098
DFDISA(-1)	0.117769	0.771
DFDISA(-2)	0.313579	0.418
DRARFMOD	-1.25146	0.091
DRARFMOD(-1)	0.610942	0.406
DRARFMOD(-2)	0.61537	0.397
DINDPRMO	-0.352926	0.282
DINDPRMO(-1)	-0.144988	0.663
DINDPRMO(-2)	-0.110237	0.739
Lag = 1 Explanatory variables	Adjusted R** = 0.128201 Coefficient	Schwarz B.I.C. = -3.96712 p-value
C	0.01167	0.476
ECM	-0.255502	0
DFDISA	0.794375	0.048
DFDISA(-1)	0.1204	0.755
DRARFMOD	-1.56495	0.032
DRARFMOD(-1)	0.693873	0.337
DINDPRMO	-0.413243	0.163
DINDPRMO(-1)	-0.077719	0.798
Lag = 0 Explanatory variables	Adjusted R** = 0.12346 Coefficient	Schwarz B.I.C. = -4.07001 p-value
C	0.014581	0.327
ECM	-0.223898	0
DFDISA	0.766907	0.044
DRARFMOD	-1.48776	0.037
DINDPRMO	-0.377903	0.184

Figure 1
Monthly, seasonally unadjusted behaviour of aggregate stock of FDI (FDI), and exports to Germany (EXPORTDE), Austria (EXPORTAUT), and Italy (EXPORTITA) in national foreign currencies (mn DEM, 10 mn ATS, 100 mn ITL respectively)

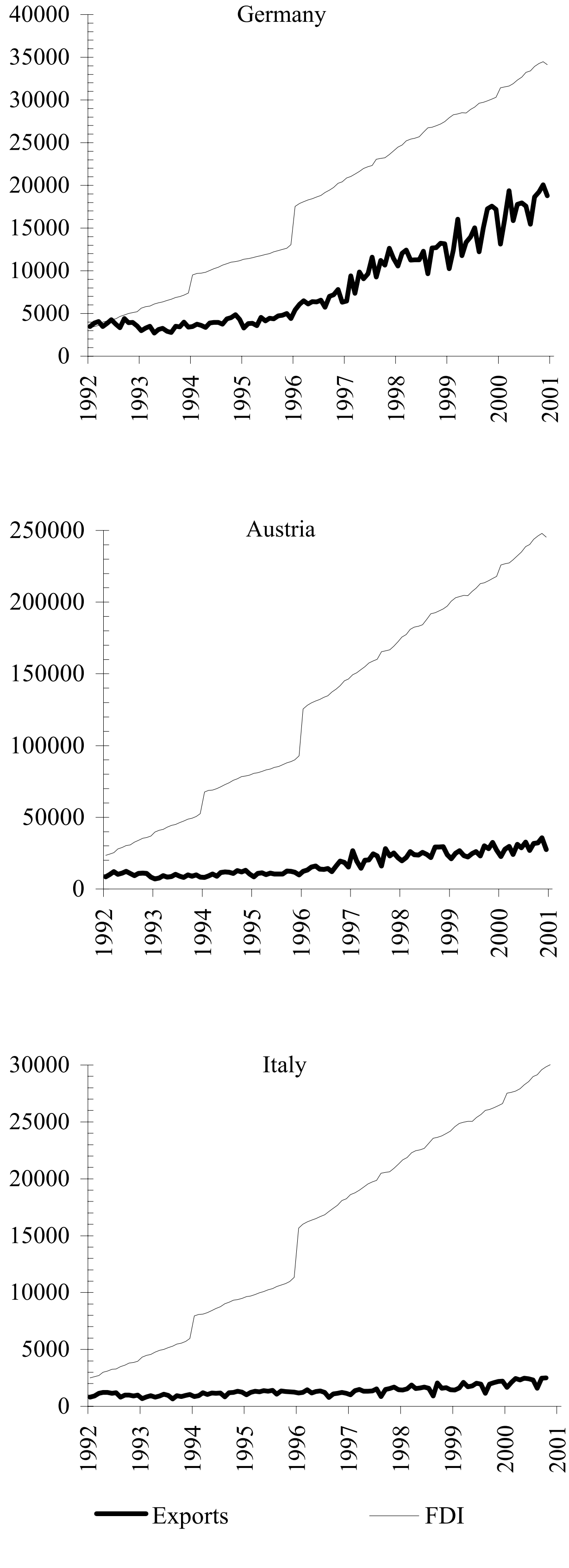


Figure 2
Monthly, unadjusted exchange rates per unit of Austrian, German and Italian currency (AUT/HUF, DEM/HUF and ITL/HUF respectively),

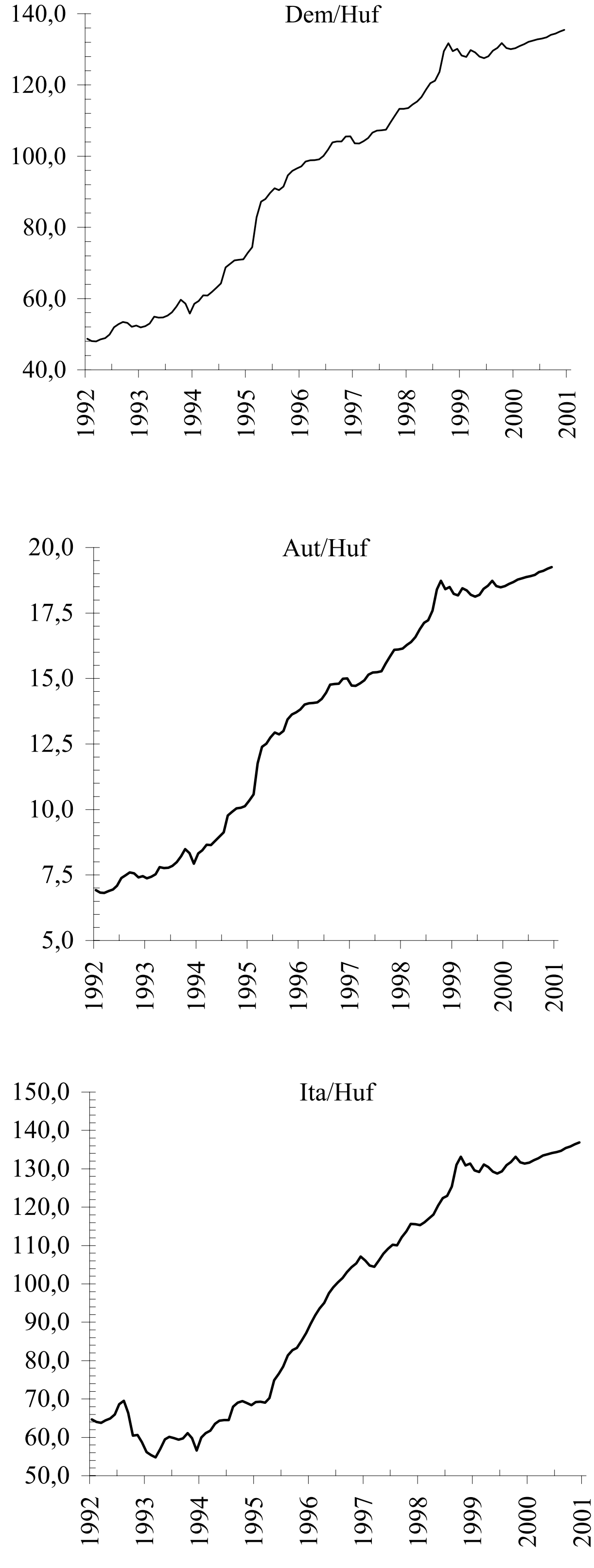


Figure 3
Monthly, seasonally adjusted cumulative industrial production indices
for Germany (Deindpr), Austria (Autindpr), and Italy (Itaindpr)

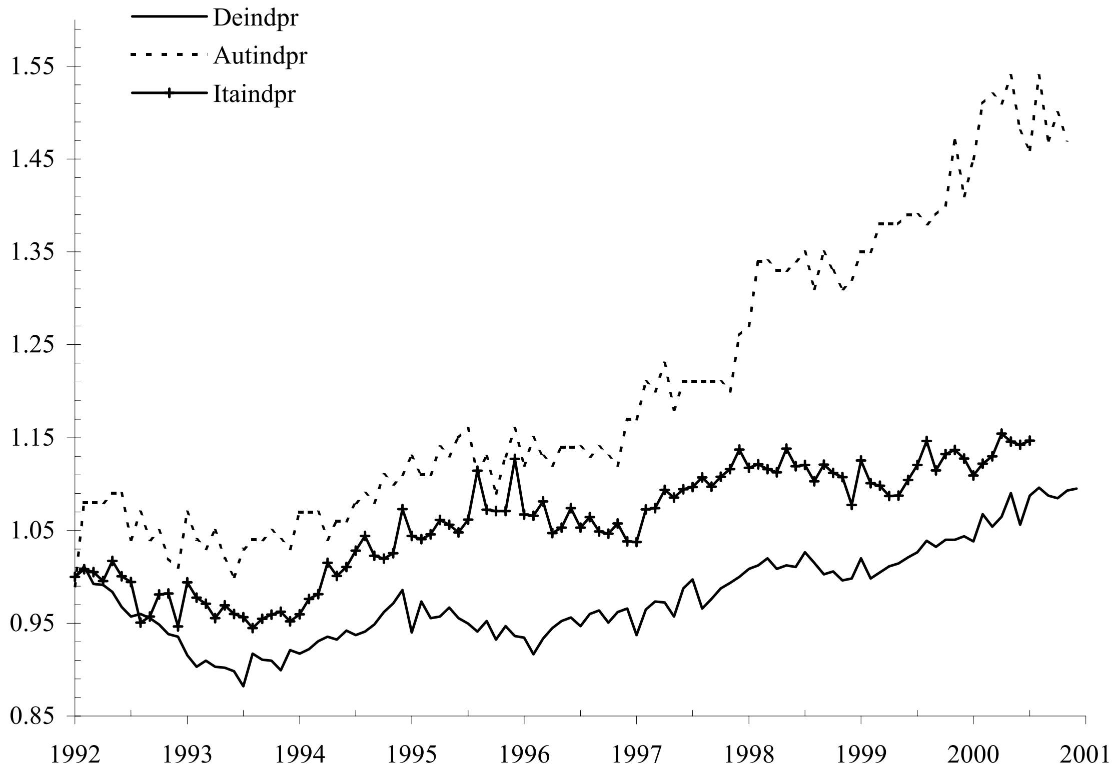


Figure 4
Monthly, and seasonally adjusted cumulative production price indices
for Hungary (Hun/ppi), Austria (Aut/ppi), Germany (Dem/ppi) and Italy (Ita/ppi)

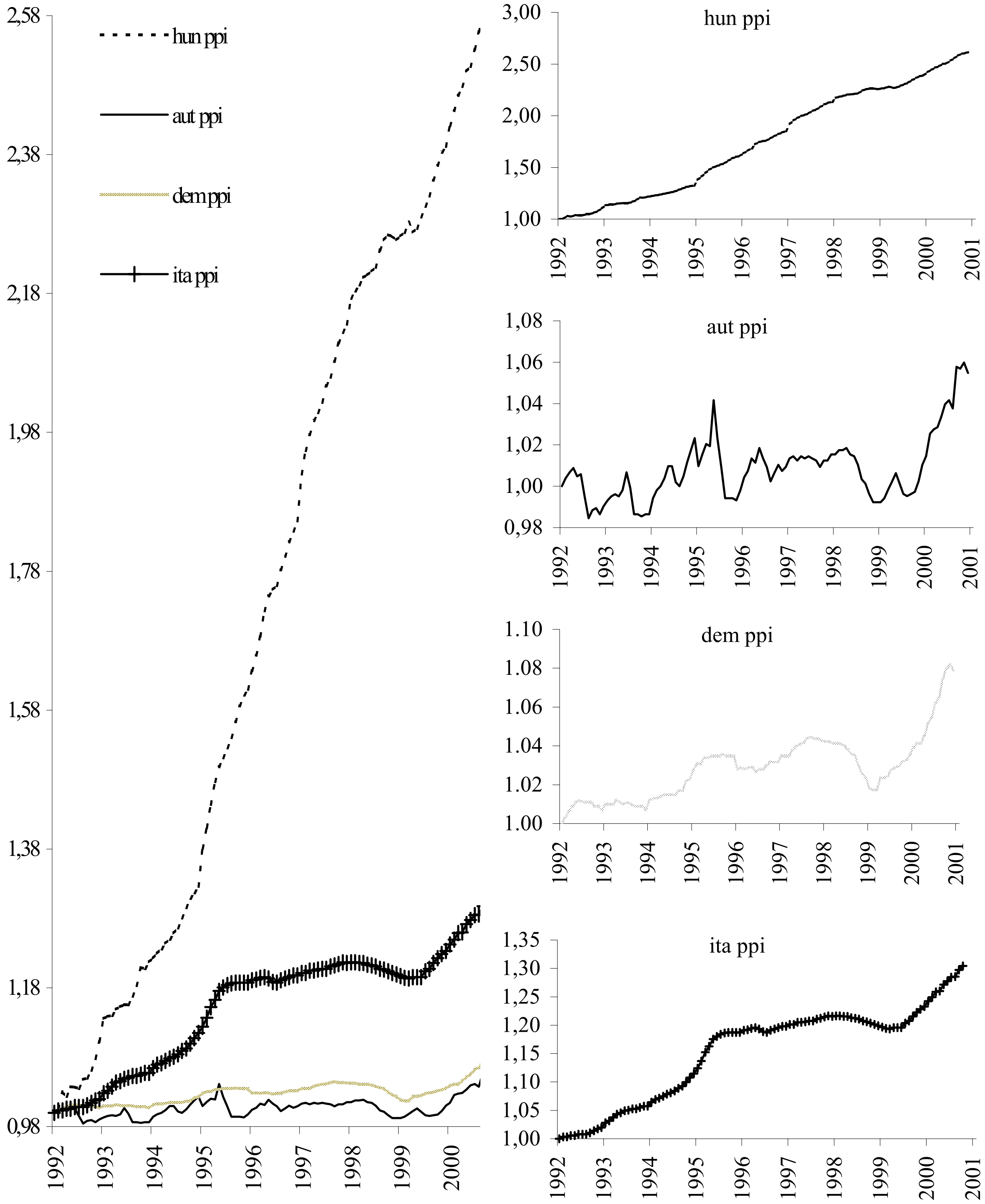


Figure 5
Stochastic trend and log of exports for Austria (AUT) and Germany (DE)

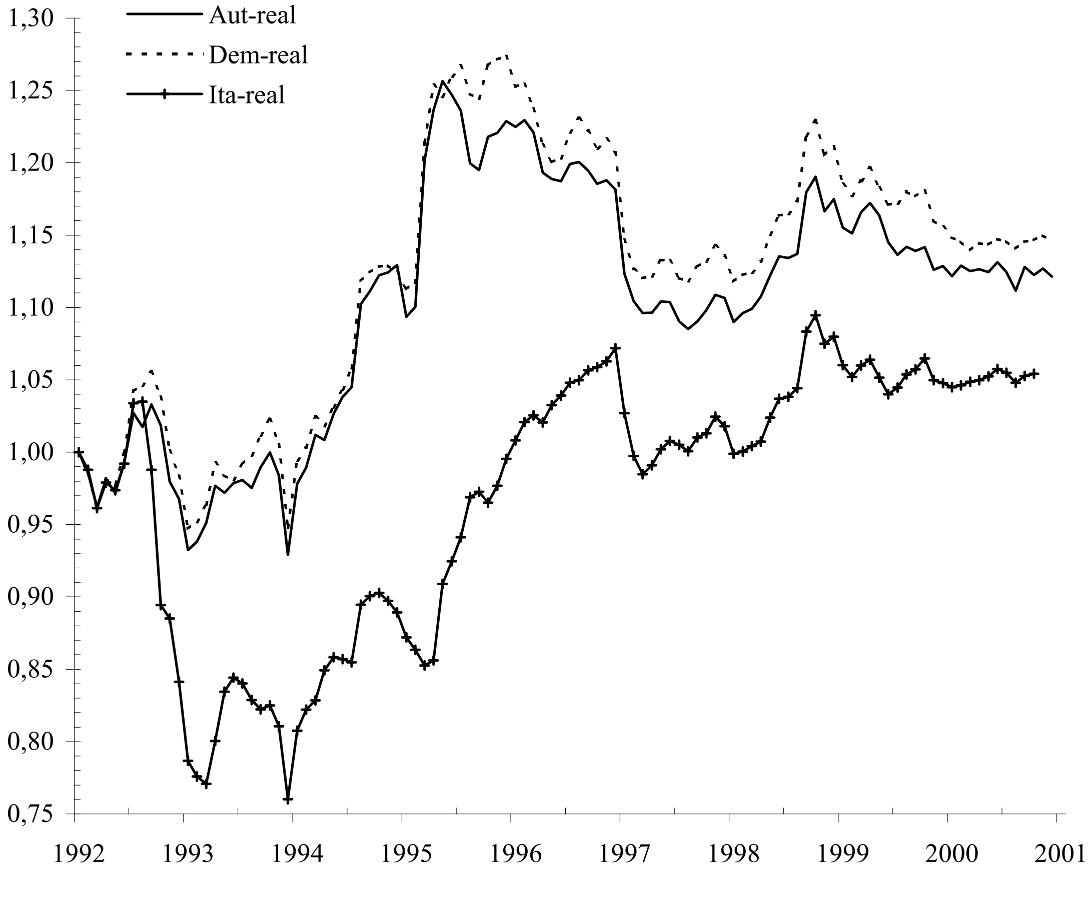
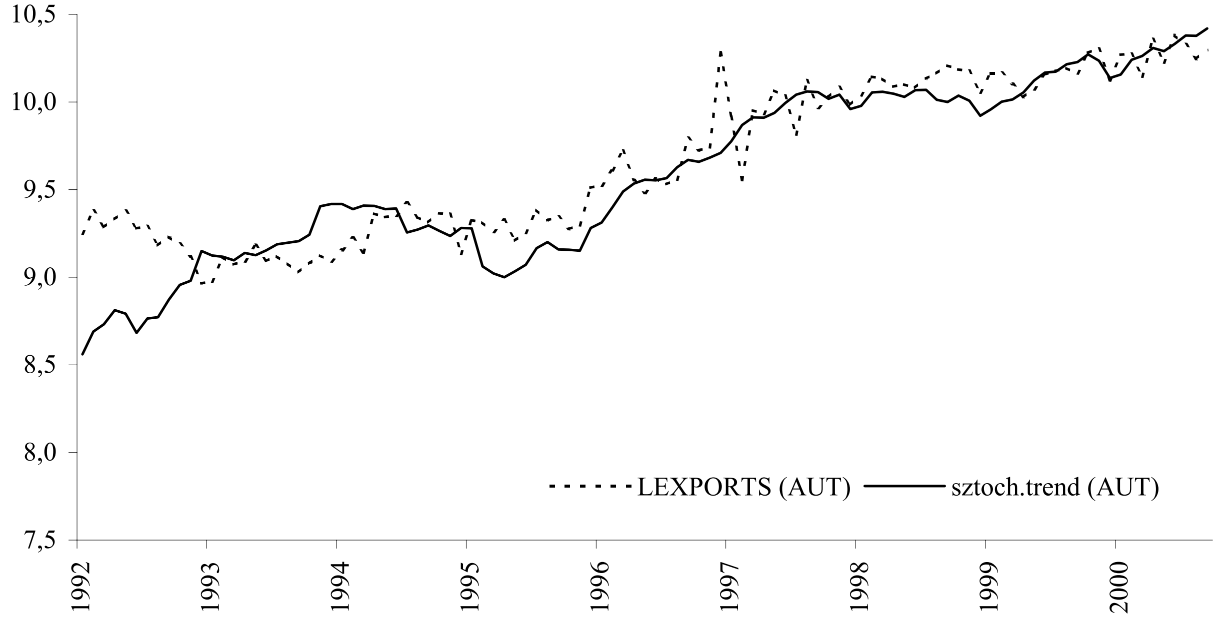
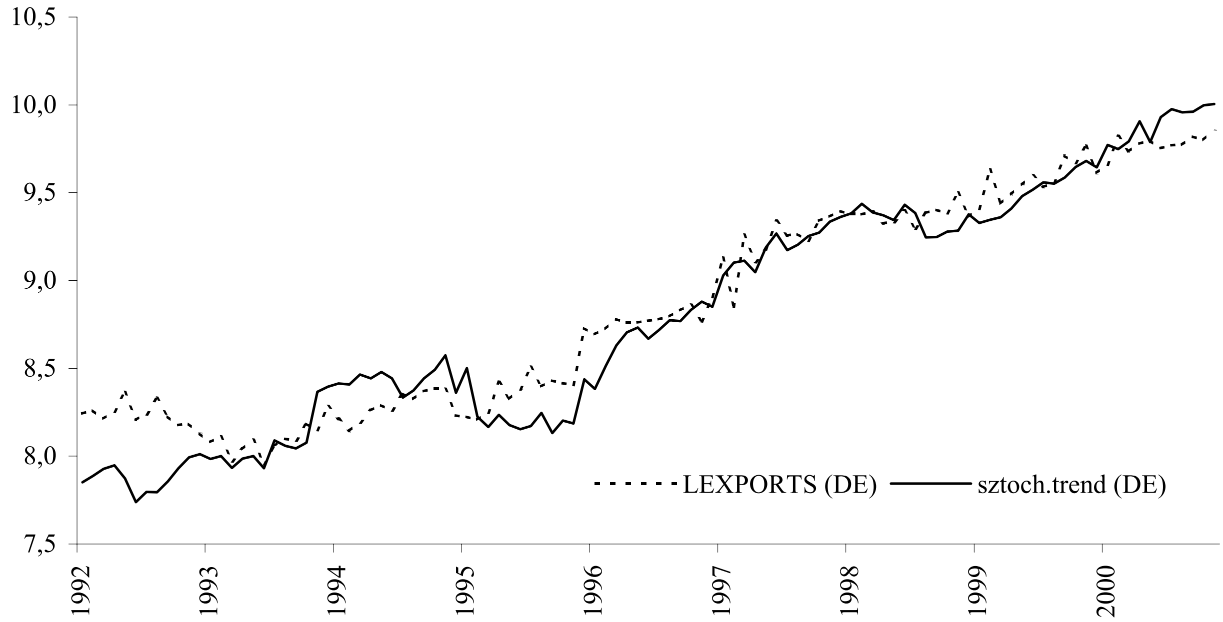


Figure 6
The stochastic trend and the log of exports for Austria (AUT) and Germany (DE)





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APPENDIX

A structural partial equilibrium model to explain exports from the home country

Notation:

p_Y Price of the output sector Y in the foreign country.

p_Z Price of the output sector Z in the foreign and the home country.

Y_D, Y_S Demand for and supply of final products in the foreign country, respectively.

Z_D, Z_S Demand for and supply of product Z produced in the home country, respectively.

K_Y, K_Z The use of capital in sector in the home country and in Y in the foreign country.

K The use of total capital in the foreign country.

Y, Z Products in the foreign country and in the home country, respectively.

Π_Y Profit in the foreign countries Y sector.

X Exports from the home country.

1. The equations

We present the equations we are going to use to draw conclusions regarding the structural parameters of the economy. The signs of the partial for those variables that have one are indicated with a plus or minus sign at the right hand top of a variable. Labour stock is not entering the model. Hence, when we talk about capital it should rather be understood as capital intensity later on.

We assumed two types of activities. One is only producing final goods and it taking place in the foreign country in the model. While the other activity is to produce intermediate goods used in the production process of the foreign country firm. The structural link between an economy like this is going to be analysed below. Demand for the final product is determined by the total profit economy in the foreign country. Total profits however, are not going to be determined by the profits of the sector the home country is producing for, as they only represent a very small part of the total profit-generating sector of the foreign country – this is partly why our system is partial. This is a kind of small country assumption. The input and output decision of the firms influence the profits of the individual Y firm, but not the overall profit of the income generating sector of the economy.

Total profits in the foreign country are going to influence the total level of capital in use there. In turn, the use of capital stock in the home country is going to be determined by the income and profit conditions in the foreign country, that is, the supply of capital from the foreign country. Thereby, we assume that the home country firms are capital constrained, which is not an unrealistic assumption. They are keen to take in capital inflow at the ongoing cost.

The home country uses the foreign final good as input. This is not far-fetched an assumption as Hungary's imports from Germany and the EU in general are investment goods, or highly processed intermediate goods. Furthermore, it is also well known that intermediate goods dominate Hungary's exports to the EU as well.

Equation 1. Equilibrium in the foreign market for final product Y

We assumed that the final good is demanded in the world in the foreign country, and in the home country as well. The latter reflects the fact that the largest part of the imports from Germany to Hungary is investment goods and highly processed intermediate goods. We expect that this should not be an important determinant of total demand in Germany as it is only a very small part of it. From this point of view this aspect of the model could have been omitted. However, in this way, the impact of imports (the use of Y in the production of Z) on export can enter the model. The world demand for the final good is, of course, exogenous.

We also assumed input users in the foreign country are all identical and that this similarly applies to the home country. The foreign part of demand for Y enters the equation with an obvious positive partial. The home country demand for Y is a negative function of final product price, and positive of the price of Z. The partials of the supply function of Y with regard to the input prices should be negative, and it should be positive with regards to the own price. What are the signs of the partial with regards to each endogenous variable?

The positive relation between the own price and supply hinges on decreasing returns to scale. However, when the unit cost is decreasing due to the expansion of the profit maximising production, so do competitive prices. So, we assumed ambiguity between supply and own price.

It is not only the price of input *Y*, but the price of the *Z* as well that plays a role cost of capital in use that should be accounted for. Supply is negatively related to it as it increases costs and reduces optimal output. The reason for including profit maximising final good producers as a source of demand for the home county product, and leaving consumer consideration out of the system is simple. Research shows that intermediate products make up most of the Hungarian export dynamics and not consumer goods.

We introduced a single function G to summarise the relation of the two terms (an excess demand function) and indicated the sign of the partials we assumed for the

$$m * Y_D^{+} + *Y_D(p_Y^{-}, p_Z^{+}) - Y_S(p_Y^{+-}, p_Z^{-}) = 0 \quad (1)$$
$$G_1 = G_1(p_Y^{+-}, p_Z^{+}, Y_D^{+}) = 0$$

model. Exogenous capital cost did not either.

The three term of the equilibrium condition determines how much of the overall demand is spent on *Y* product. Part *m* of foreign demand is devoted to that part of the foreign economy the home country is trading with.

Equation 2. Equilibrium in the foreign market for product *Z*

We obtained the equation again starting from an equilibrium condition. We would like to determine the signs of the partials of that equation. With respect to the price of the final good it should be ambiguous. This is because it enters the demand function (Z_D) with positive sign and the supply function (Z_S) with a negative sign in the export (X) equation below.

The supply is a positive function of the price of Z, while the demand for it is negative, hence in the equation that sums them (X) the partial becomes ambiguous. Nonetheless, this does not matter too much, as that is the price the system is normalised with.

Again, we make it possible for the own price elasticity of supply to be negative and follow a pattern derived from increasing returns to scale. If the price elasticity of the supply of Z is negative than its partial in G_2 becomes ambiguous. If it is positive then the partial definitely becomes negative. Therefore, we did not restrict the sign of this partial.

We also included capital stock in the equation to control for other supply factors than price.

$$Z_D(p_Y^{+-}, p_Z^{-}) + Z_S(p_Z^{+-}, p_Y^{-}) = 0$$
$$X = Z_D(p_Y^{+-}, p_Z^{-}) = Z_S(p_Z^{+-}, p_Y^{-}) \quad (2)$$
$$X = \frac{1}{2}\left(Z_D(p_Y^{+-}, p_Z^{-}) + Z_S(p_Z^{+-}, p_Y^{-})\right)$$
$$G_2 = G_2(p_Y^{+-}, p_Z^{+-}, X^{+}) = 0$$

Equation 3. Income equation of the foreign country

This equation says that the demand for final goods in the foreign country is determined by the total profits in the foreign country. However, it was also assumed that that part of the company sector that trades with the home country is so small that it cannot influence the overall profit and income in the foreign economy. Thereby it was also assumed that home country profits do not play a role in the demand for finals goods in the foreign country. Alternatively, one my interpret this saying that the profits in the home country are zero due to international competition.

$$\begin{aligned} &Y_D = \Pi_Y \\ &G_3(Y_D^+, \Pi_Y^-) = 0 \end{aligned} \qquad (3)$$

Equation 4. The capital stock equation

This equation relates capital stock in the home country and the foreign country. It says that the stock of capital in the foreign country is a positive function of the overall profits there. However, the relation of the foreign capital stock to the home country can go both ways. It can be that foreign firms decide to reduce their capital stock and shift production abroad and thereby increase home country capital intensity. In this case, capital in the two countries is negatively related. Nonetheless, it can also happen that large foreign multinationals in the foreign country make such investment decisions that increase capital stock in both countries.

Capital stock in the home country can increase just because there is simply more of it available *ceteris paribus* in the foreign country. This is particularly so if home country production is technologically tied to production in the foreign country. More capital means more production abroad that needs to be translated in larger capacities in the home country as well. Good times in the foreign country mean more investment to the home country. This is the case when investments in the two countries are more complementary and not substitutes for each other. Now, we should assume an ambiguous partial for the G_4 function with regards to foreign total profit and positive for the home country capital stock in the exports sector.

$$\begin{aligned} &K_Z = f(K \ (\Pi_Y)) \\ &\frac{\partial K}{\partial \Pi_Y} > 0 \\ &\frac{\partial f}{\partial K_Z} <> 0 \\ &G_4(\Pi_Y^+, K_Z^{+-}) = 0 \end{aligned} \qquad (4)$$

In the models we chose the price of the Z sector product as *numeraire*, so it is not going to appear in any of the versions of the system explicitly as all prices are expressed in terms of that price.

We impose the restriction that $P_Z=1$

The chosen normalisation of the system is going to correspond to the real exchange rate used in the empirical part. Hence, there should be foreign price in the nominator and domestic one in the denominator.

Now we have the following endogenous variables appearing:

$$p_Y, \Pi_Y, X, Y_D, K_Z$$

In the econometric part the impact of all exogenous variables appears as part of the error term and only endogenous variables are dealt with. We assumed that the number of firms in the export sector is unchanging, but not their size. It was also assumed that real cost of capital was constant in the foreign country and so is world demand.

2. The partials of the model with regards to exports

We set up the total differential of the system and determine the sign of the partial derivatives of the individual equation with respect to each endogenous variable one by one.

$$\underset{4\times5}{G} \cdot \underset{5\times1}{x} = \underset{4\times1}{0}$$

$$x' = (dp_Y, d\Pi_Y, dX, dY_D, dK_Z)$$

The system of equations we are going to use now is:

$$G_1=0; G_2=0; G_3=0; G_4=0$$

Before we go further we make and another simplification and make use of Equation 3 to replace income with profits.

Naturally, this equation is then dropped. The system of total differentials then become even simpler:

$$\underset{3\times4}{G}\cdot \underset{4\times1}{x} = \underset{3\times1}{0}$$

$x' = (dp_Y, d\Pi_Y, dX, dK_Z)$

So the equation system becomes:

$G_1=0; G_2=0; G_4=0$

We have equation 1, 2 and 4 remaining in the system with the price and Y_D omitted. Foreign income was replaced with foreign profit. Now the system of total derivatives looks like the one below (the signs are indicated at the upper right hand corner of each partial). G contains the partial of the respective equations.

$$\begin{bmatrix} G_{11}^{+-} & G_{12}^{+} & 0 & 0 \\ G_{21}^{+-} & 0 & G_{23}^{+} & 0 \\ 0 & G_{42}^{+-} & 0 & G_{44}^{+} \end{bmatrix} \begin{bmatrix} dp_Y \\ d\Pi_Y \\ dX \\ dK_Z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \quad (2.5)$$

We found the following comparative static results regarding exports:

$$\frac{dX}{dp_Y} = -\frac{G_{23}^{+}}{G_{21}^{+-}} < 0$$

If (1)

$G_{21} > 0$

$$\frac{dX}{d\Pi_Y} = \frac{G_{23}^{+}G_{11}^{+-}}{G_{12}^{+}G_{21}^{+-}} > 0$$

if

$G_{11} < 0 \cap G_{21} < 0$ (2)

or

$G_{11} > 0 \cap G_{21} > 0$

$$\frac{dX}{dK_Z} = -\frac{G_{23}^{+}G_{11}^{+-}G_{42}^{+-}}{G_{44}^{+}G_{21}^{+-}G_{12}^{+}} > 0$$

if

$G_{21} > 0 \cap G_{42} > 0$ (3)

or

$G_{21} < 0 \cap G_{42} < 0$

The sign conditions we imposed on the comparative static results on export equation in the text. In fact, this model is an interpretation when the parameters estimated are long-term multipliers in a simultaneous system. (1), (2) and (3) together imply that $G_{11}>0$, $G_{21}>0$, and $G_{42}<0$.