The Czech Economic Transition: Exploring Options Using a Macrosectoral Model*

Frank Barry[1], John Bradley[2], Michal Kejak[3] and David Vavra[4]

(1) University College Dublin and CEPR
(2) Economic and Social Research Institute, Dublin
(3) CERGE-EI, Charles University, and Academy of Sciences of the Czech Republic
(4) Czech National Bank

January 2000

Abstract

The processes that will drive the next stage of the Czech transition are likely to be similar to those promoting real convergence in the EU cohesion countries. We draw on previous modelling research on the cohesion economies to construct and calibrate a small macrosectoral model of the Czech Republic that serves to highlight key policy issues facing CEE-country decision-makers. Four scenarios are then explored by simulation: the first projects the current pattern of disequilibrium wage setting into the future, while a second looks at the consequences of labour market reform. The other scenarios highlight some of the differences between policy strategies based on indigenous versus FDI-driven export-led growth.

Corresponding author

Frank Barry, Department of Economics, University College Dublin, Dublin 4. Ireland

Frank.Barry@ucd.ie

---

* This project was funded by ACE-Phare Research Contract number P96-6242-R.

1. Introduction

The first phase of the transition of the former command economies of Central and Eastern Europe (CEE) involved considerable disorganisation and a very basic overhaul of industrial and institutional capacity (Blanchard, 1997). Mechanisms operating during this phase entailed substantial inter-sectoral reallocation of labour between the public and private sectors as well as between manufacturing and marketed services. The impact of restructuring generated the well-known U-shaped pattern for GDP and total employment in all CEE countries once the transition process was initiated.

The processes that characterised the initial years of CEE transition cannot be taken as a pattern of behaviour that is likely to apply in the future. The next stage of transition for the advanced CEE countries is more likely to resemble the paths followed in recent decades by the so-called cohesion countries of the EU periphery: Greece, Ireland, Portugal and Spain. These countries — designated as *Objective 1* in EU structural aid programmes — are ones whose structural adjustment lagged behind that of the more developed core EU states. The driving forces behind cohesion include progressive trade integration, foreign direct investment flows, technological catch-up, and externally aided programmes of infrastructural and human-capital development (ESRI, 1997). It is probable that similar processes and adjustment mechanisms will operate in the CEE countries during the second phase of their transition, once the initial restructuring and institution-building stage has been completed

In this paper we draw on our experience of studying development processes in the cohesion-country context to explore scenarios that highlight key policy issues that will face CEE-country decision-makers. Since such a study takes us beyond the initial analysis of Blanchard, 1997 — based as it was on a range of small insightful theoretical models — we need tools that permit the quantitative examination of sectoral structure and policy aspects. In the belief that empirical model frameworks are useful in identifying barriers to real convergence and in exploring the quantitative implications of different policy choices, we design and calibrate a multi-sectoral macromodel of the

Czech economy that is similar in structure to the HERMIN models previously used in the study of the cohesion economies (Bradley *et al*., 1995; ESRI, 1997).

The fact that the second phase of transition will involve continuing massive structural changes in the CEE economies serves as a warning that any formalised empirical modelling should be carried out with due care. Hence, the primary purpose of CEE empirical models should be the study of the consequences of structural shifts in their underlying structure and behavioural relationships and not, as with models of the more advanced economies of the EU, the study of the effects of external shocks feeding through a fixed structure.

Empirical models need to be calibrated with data, and here another very serious difficulty arises. Due to the above arguments data from the early part of the first stage of transition are not likely to be informative about the second stage of transition. Hence, when modelling the present Czech economy one is confined to at most five or six annual data points. Our modelling strategy requires a sectorally disaggregated database, in order to explore the sectoral mechanisms underlying aggregate developments. The construction of such a national database is itself no small task. For example, the occasional use of "extra-budgetary funds" for handling public debt service requires that they be integrated with the general government accounts in order to ensure proper closure of the model's sectoral accounts. Even the derivation of data for such apparently straightforward measures as personal income is fraught with problems in CEE countries as it is often difficult to separate the element of corporate profits that is distributed to the household sector from the part that is retained within the corporate sector to fund investment expenditures.

Our database is designed to be used to quantify parameters in the model's behavioural equations. In many cases, useful information on parameter values can be extracted from the limited run of data using simple calibration techniques. However, for some crucial mechanisms reasonable values cannot be identified from the Czech data. Here we rely on previous modelling research on the EU cohesion countries and adapt estimates from the cohesion country macro-models where these are deemed to be relevant. Our thinking here is that standard macroeconomic relationships — such as the responsiveness of manufacturing output to competitiveness pressures — must already exist in CEE economies, but there are simply too few recent data observations for the relevant coefficients and elasticities to be quantified with any degree of reliability, robustness or precision. Furthermore, once transition is completed, the Czech economy and the other CEE economies are likely to converge in terms of underlying structure and mechanisms and end up as more or less well functioning small open regional economies. Thus we may be able to predict many of their future properties and structures by examining the cohesion economies of the present EU. As a consequence, the Czech HERMIN model must be regarded primarily as an imaginative or speculative tool to facilitate exploration of possible future scenarios rather than as a reliable *ex ante* forecasting tool.

In the next section we present a brief overview of our approach to modelling the Czech economy. This is followed by a discussion of the calibration procedures, derived from our sectorally disaggregated database. We then discuss a series of model simulations designed to explore the implications for real convergence in living standards of scenarios which are more or less amenable to the influence of CEE decision makers.

2. Overview of the Czech Macromodel

The processes of transition and cohesion are systemic, in that they involve specific sectors (such as the restructuring of manufacturing and the growth of market services) as well as the interrelationship of all sectors in the economy through the determination of output, expenditure and income. Consequently, their analysis should ideally be carried out within a general equilibrium or a macroeconomic framework. Early analysis of these processes in the case of Slovenia were carried out using computable general equilibrium (CGE) frameworks (see Potocnik and Majcen, 1996). The main advantage of CGE models for empirical work is that they can be calibrated using data for only one year.

Drawing on previous research findings on the EU periphery, a model of the Czech economy has been developed based on the above general framework and with a view to addressing dynamic issues in economies undergoing large-scale structural change in the presence of market rigidities, particularly in the labour market (ESRI, 1997; Kejak and Vavra, 1999; Barry and Bradley, 1999). Our model is intended to provide an applied theoretical schema to assist in determining how the economies of the cohesion countries function and how the economies of the CEE countries must function if their transformation into Western-style economies is to be successful. Thus, while the HERMIN models of the cohesion countries are mainly positive in nature, our prototype Czech model is in many ways normative.

In the HERMIN framework, the country is modelled as a small open economy (SOE), with production disaggregated into four sectors: agriculture, manufacturing, market services (including building and construction, and utilities) and non-market or public services (including health and education). Most of the behavioural modelling is focused on manufacturing and market services with simpler models of agriculture and the public sector.[1]

We feel that this level of sector disaggregation is the very minimum needed to address structural change and has the dual advantage of being "intellectually controllable" and of facilitating cross-country comparisons in situations where data are relatively scarce. Within this level of disaggregation, an attempt is made to maintain as much theoretical commonality as possible in modelling behavioural processes. To date, four EU country models (Greece, Ireland, Portugal and Spain) and three CEE models (the Czech Republic, Romania and Slovenia) have been developed with a high degree of common structure and notation (Bradley et al, 1995; Barry and Bradley, 1999).

---

[1] For a more complete description of the background to the HERMIN model, see Bradley et al, 1995 and ESRI, 1997.

The demand side of HERMIN is quite conventional, as befits a model whose focus is on medium-term structural change. The key elements of the demand side are illustrated in the box below.

Figure 1: Schematic Representation of Demand Side of the Czech HERMIN Model

Consumption = C(Personal Disposable Income)

Net Trade Surplus = Output - Domestic Demand

Personal Disposable Income = Income + Transfers - Direct Taxes

Balance of Payments = Net Trade Surplus + Net Factor Income From Abroad

*Public Sector Borrowing = Public Expenditure - Tax Rate * Tax Base*

Public Sector Debt = (1 + Interest Rate) $Debt_{t-1}$ + Borrowing

In the variant of the model used in later simulations, a policy feedback rule is used to endogenise government behaviour, i.e., the government sector adjusts passively and tax rates rise automatically if the ratio of public debt to GDP rises much above the present level, i.e., about 15 per cent of GDP.

Drawing on small open economy theory, exports and imports are not modelled separately; rather, the net trade surplus is determined residually by subtracting domestic demand from output. Thus, in current prices,

$$NTSV = GDPMV - (CONSV + GV + IV + DSV)$$

and in constant prices,

$$NTS = GDPM - (CONS + G + I + DS)$$

where *GDPM*(V) denotes GDP at constant (current) market prices; *CONS*(V) is private consumption, *G*(V) is public consumption, *I*(V) is investment, and *DS*(V) are inventory changes. Hence, in its basic form, the model says nothing about the separate behaviour of exports and imports; only the impact on the net trade surplus can be examined.

The main issues that we wish to tackle arise on the supply side of the economy. In HERMIN, the market services sector is treated as purely non-tradeable. Manufacturing, however, contains both traded and non-traded elements. Output in this sector is influenced by domestic and international demand, and by price and cost competitiveness. The price competitiveness term influences the distribution of manufacturing production between traded and non-traded elements, while cost competitiveness affects the attractiveness of the SOE as a base for multinational firms, which respond to the level of international demand prevailing for the products they produce (Bradley and Fitz Gerald, 1988).

Given output and factor-input prices, factor demands in manufacturing and market services are derived via cost-minimisation, subject to an imposed two-factor CES production function. Hence, the evolution of the capital/labour ratio is determined by movements in relative factor prices and by technical progress (incorporated through a time trend).

Another key supply-side mechanism is the wage equation. Wages in the industrial sector are determined as the outcome of a bargaining process between unions and employers, with bargaining theory pointing to four important explanatory variables: output prices, the tax wedge, the rate of unemployment (or structural Phillips-curve effect) and labour productivity (Layard, Nickell and Jackman, 1991).[2] Wage inflation in the industrial sector is then passed on to workers in market services, as it is in the Scandinavian model

[2] The tax wedge arises because workers try to bargain in terms of a take-home wage denominated in consumer prices rather than in terms of gross pre-tax wages denominated in producer prices.

(Lindbeck, 1979). The main supply-side structure of manufacturing is illustrated in the box below, with an analogous structure for market services.

Figure 2: Schematic Representation of Manufacturing Sector of the Czech HERMIN Model

Output = f_1*(World Demand, Domestic Demand, Competitiveness, t)*

Employment = f_2*(Output, Relative Factor Prices, t)*

Investment = f_3*(Output, Relative Factor Prices, t)*

Capital Stock = Investment + $(1-\delta)$ *Capital Stock*$_{t-1}$

Output Price = f_4*(World Price * Exchange Rate, Unit Labour Costs)*

Wage Rate = f_5*(Output Price, Tax Wedge, Unemployment, Productivity)*

Competitiveness = National/World Relative Production Cost and Prices

3. Model Calibration

In structurally changing environments, calibrating economic models using past data is either impossible or invalid. However, we argue that model-based policy analysis can be useful even when accurate estimates are not available.

In macro models empirical calibration is required in two areas:

a) The quantification of structural parameters (e.g., elasticities, marginal propensities to consume, rates of technological progress, etc.)

b) The quantification of lag structures.[3]

Since very recent data from CEE countries are likely to be only partially informative about the dynamics of transition, and data from before 1990 are either not available or are unreliable and/or irrelevant, the econometric calibration of lag structures will not be feasible for the foreseeable future. However since reliable data in a national accounting framework tend to be annual (as in the four cohesion countries and the three CEE countries) rather than quarterly, the need to use only simple lag structures may be a less serious problem.

If one accepts that the need to incorporate dynamics into macro models does not rule out the use of such models when only inadequate data are available, then the calibration issues involved in applying CGE and macro models become very similar. This allows one to focus on the underlying theoretical differences between the CGE and macroeconomic approaches and to treat the two model types as complements rather than substitutes.

In CGE models a single year's data are used to calibrate the equations. The values of many key parameters are taken from other sources in the empirical literature and remaining parameters (usually equation intercepts) are adjusted to force the equation to reproduce the historical result.

The approach we developed to calibrate the CEE HERMIN models attempts to make maximum use of the available annual observations.[4] Hence, we can do slightly better than the single observation CGE approach, but cannot perform credible econometrics.

---

[3] CGE models require only calibration of structural parameters, since they are usually specified as essentially static.

[4] The situation with the CEE economies is that one has data for the period 1990 to 1996 at most, and usually only for the sub-period 1992-1996. Preliminary data for 1997 are available for Romania, but not for the Czech Republic or for Slovenia (at the time of writing). Hence, only five annual observations are available for most National Accounting macro-sectoral aggregates.

The fact that many of the behavioural equations in HERMIN are fairly simple in structure and involve only two or three parameters means that we can make use of the small number of observations to carry out some crude curve fitting exercises. In the case of the linear consumption function for example, we use OLS to produce numerical values for the parameters; we then examine the value of the economically interesting parameter (the MPC) and compare it with the values of the MPC recovered from the cohesion country models (where legitimate econometrics was used). If the value is plausible, we use it. If it is not, we impose a value, drawing on the cohesion country findings, and residually determine the intercept to ensure reasonable within sample tracking performance.

3.1 Sectoral Output Levels

We model manufacturing output as a composite of traded and non-traded elements. To reduce the number of parameters to be estimated, we adopt the following form for the manufacturing output, *OM*, equation:

$$(1) \qquad \ln(OM) = a_1 + a_2\{XSHR\ \ln(OM^*) + (1-XSHR)\ \ln(FDOM)\} \\ + a_3 \ln(ULCM/PM) + a_4 \ln(PM/P^*)$$

where OM^* is 'world' manufacturing output (in what follows, a star denotes a world variable and un-starred variables are domestic), *ULCM* represents unit labour costs in manufacturing, *PM* is the output price, *FDOM* is a measure of domestic demand weighted by manufacturing output content (derived from the input-output table), and P^* is the world manufacturing price.[5] The parameter *XSHR* is the average of the ratio of

[5] "World output" in the Czech case is an average of EU, the rest of OECD, and Central and Eastern European output, with weights of 55%, 10% and 35% respectively. World prices are an average of German and US output prices, converted at the current exchange rate, with weights of 65% and 35% respectively.

exports to the sum of GDP and imports, and is a measure of the openness of the economy.[6]

Even the restricted number of parameters in this equation does not allow us estimate the competitiveness elasticities, and yet these are key economic mechanisms. The coefficient on real unit labour costs represents the supply constraint on output as labour costs rise, while the relative price coefficient represents the reduction in demand for domestic output as its cost rises relative to world output prices. Drawing on the Irish and Portuguese results, we impose values of -0.30 on both (Barry and Bradley, 1999).

The values for the coefficients in equation (1) are as follows:

$$a_2 = 1.12; \quad XSHR = 0.37; \quad a_3 = a_4 = -0.3 \text{ (imposed)},$$

and the implied elasticity of OM with respect to OM^* takes the value 0.41.
Market services on the other hand are modelled as being purely non-traded. A simple linear form of the service sector output equation, *OS*, is specified:

(2) $$OS = a_1 + a_2\, FDOS$$

where *FDOS* is a measure of domestic demand weighted by services-output content. This equation plays a crucial role in generating Keynesian multiplier effects. For example, the impact of changes in investment in building and construction — financed by the state but executed by the market services sector — is central to the analysis of the effects of infrastructural investments of the type financed under the EU Structural Funds. Estimation yields a value of 0.804 for the coefficient on *FDOS* in this equation.

[6] This is based on the admittedly strong assumption that goods sold on the home market can be identified as non-tradeables. For several of the cohesion countries the ratio (for the manufacturing sector) of goods exported to sales on the home market is very close to the weight of world demand relative to domestic demand in the manufacturing output equation, allowing us to constrain the parameter values in this way.

Household consumption enters both these equations through the variables *FDOM* and *FDOS* (the weighted final demand measures). A simple Keynesian consumption function formulation is used, which relates private consumption to real personal disposable income. This specification implies liquidity-constrained behaviour, which is plausible given the relatively unsophisticated nature of financial sectors in CEE countries. An MPC of 0.8 was imposed since calibration from the data indicated implausible values greater than unity.[7]

3.2 Output Prices

Since manufacturing contains traded and non-traded elements, output prices in the manufacturing sector, *PM*, are determined as a mixture of price taking, P^*,and a mark-up on unit labour costs in that sector, *ULCM*

(3) $\ln(PM) = a_1 + a_2 \ln (P^*)+(1- a_2) \ln (ULCM).$

In the estimation, the Czech economy appears to be fairly open and there is a high degree of price-taking, with an elasticity of 0.53 on P^*. Price homogeneity is imposed, meaning that the mark-up elasticity is one minus the price-taking elasticity.

In line with the representation of market services as non-tradeable, the deflator of market services output, *PS,* is determined as a mark-up on unit labour costs in the sector, *ULCS*, with full pass through of costs into prices.

[7] A flavour of the data problems being experienced in the Czech Republic can be conveyed by the following quote from the 1996 *OECD Economic Survey* of that country: "The household sector savings rate is subject to a wide margin of error, and until recently the CSO recommended using estimates by the Czech National Bank rather than those implied by the CSO's own official household income and expenditure figures" (OECD, 1996, page 6).

3.3 Factor Demands

The Cobb-Douglas production function is too restrictive in that it imposes a unitary elasticity of substitution, therefore, we use the CES form of the added value production function and impose it on both manufacturing (M) and market service (S) sectors:

$$Q = A\exp(\,lt)\left[d\{L\}^{-r} + (1-\,d)\{K\}^{-r}\right]^{-\frac{1}{r}}.$$

In this equation, Q, L and K are added value, employment and capital stock respectively, A is a scale parameter, r is related to the constant elasticity of substitution, d is a factor intensity parameter, and l is the rate of Hicks neutral technical progress.

In both the manufacturing and market service sectors, factor demands are derived on the basis of cost minimisation subject to given output, yielding a joint factor demand equation system of the form:

$$K = g_1\left(\left(Q, \frac{c}{w}\right)\right)$$

$$L = g_2\left(\left(Q, \frac{c}{w}\right)\right).$$

Here, w and c are the cost of labour and capital, respectively. Simple autoregressive expectational lags can be imposed by making actual factor demands a function of the lagged values of the driving variables.

This simple scheme, using a putty-putty model of the capital stock (i.e., malleable *ex ante and ex post*), proved difficult to estimate in practice. This is not surprising in light of the derived nature of the capital stock data (using the perpetual inventory formula). Hence, drawing on the approach of d'Alcantara and Italianer (1982), a switch was made to a marginal, or putty-clay, system where investment, the new vintage of capital stock, is driven by output and relative factor prices, and the capital stock is assumed to be malleable *ex ante* but not *ex post*. In the absence of data on vintage output and labour inputs, the corresponding marginal output and employment are crudely proxied by the total levels of these variables. The modified joint factor demand system can then be written in the form:

$$I = h_1\left(Q, \frac{c}{w}\right)$$

$$L = h_2\left(Q, \frac{c}{w}\right)$$

where the capital stock is now generated by a perpetual inventory formula,

$$K_t = I_t - (1 - d)K_{t-1}.$$

Although the factor demand systems in the manufacturing and market service sectors are functionally identical, together with their ancillary identities, they have different estimated parameter values and other crucial differences. For example, in the case of manufacturing, we allow a fraction of profits to be repatriated through the balance of payments to mirror the known behaviour of multinational firms. No such mechanism is included in the market service sector, where distributed profits go directly into private income.

The important parameters in the CES production function are the elasticity of substitution, r, and the rate of technical progress, l. The elasticity of substitution could not be estimated from the available data. Our prior, though, is that technology in the CEE countries lies towards the Cobb-Douglas end of the scale, as it is in Greece and Portugal, rather that at the Leontief end of the scale, as it does in the case of Ireland, because of the importance of FDI (Bradley and FitzGerald, 1988). We imposed a value of 0.95 for ρ in both the manufacturing and market services sectors of the Czech Republic.

In determining the value of l we opted for the value of technical progress in Czech manufacturing, which appears to be factor saving at a rate of about 4.5 per cent per year. The sectoral productivity data suggests that there is negative technical progress in market services (see Figure 5). We are hesitant to extrapolate this into the future however, and so we set this parameter to zero instead.

Our assumptions imply that sectoral capital-labour ratios should depend only on relative factor prices. Developments in these variables are not quite in line with this simplified theory as Figures 3 and 4 show. The falling capital-labour ratio in services is consistent, however, with the declining productivity of the sector, as depicted in Figure 5, though that is also influenced by the rate of technical progress (or regress). The high rate of services investment (relative to sectoral GDP) seen in Figure 6 is occurring alongside an even higher growth in employment. This phenomenon appears to provide at least a partial explanation for Blanchard's finding that Czech productivity growth was disappointing by transition-economy standards even though the overall investment to GDP ratio was high (Blanchard, 1997).

Figure 3: Relative Factor Prices (Cost of Labour / Cost of Capital)

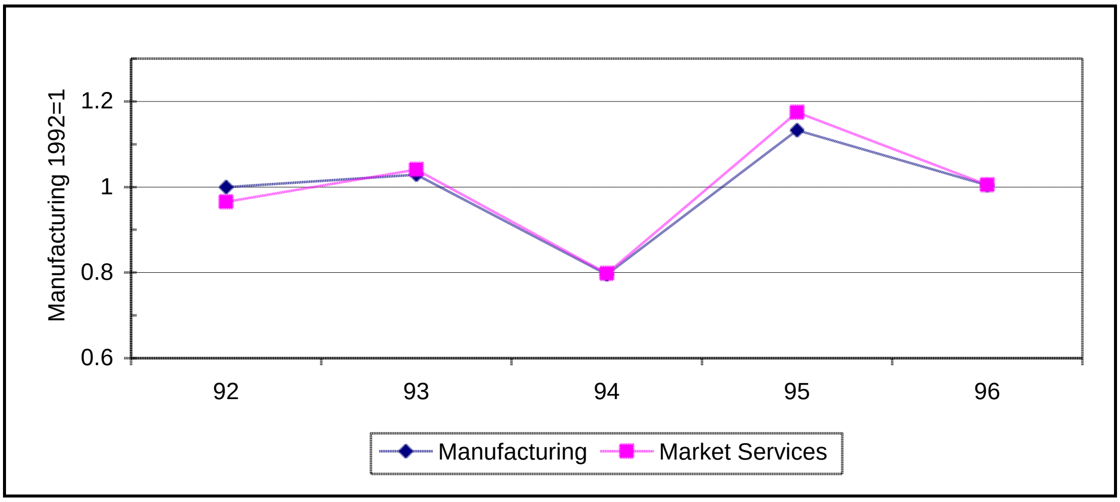


Figure 4: Sectoral Capital-Labour Ratios

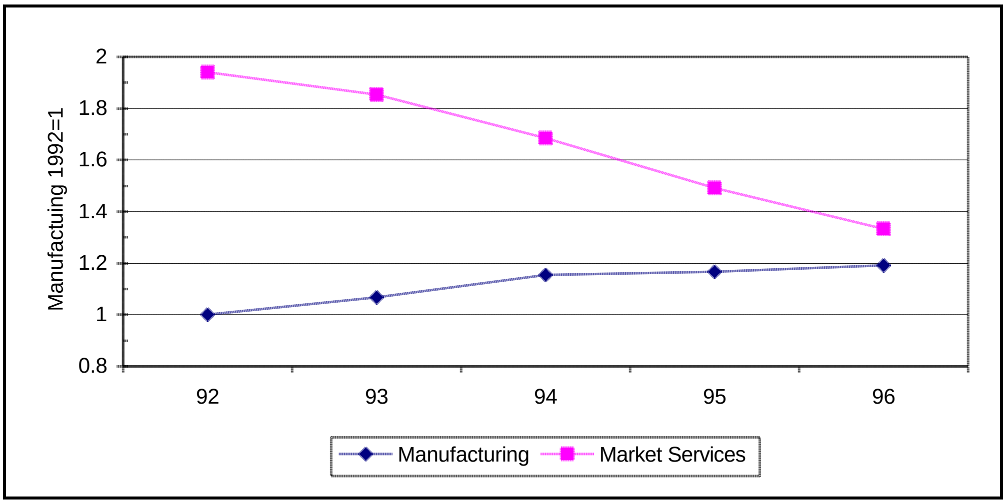


Figure 5: Sectoral Labour Productivity

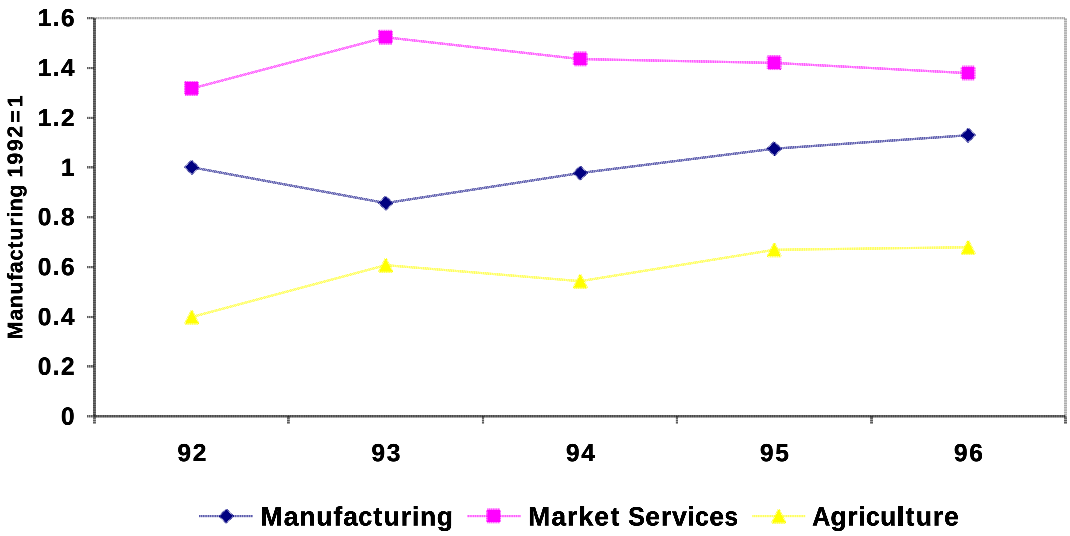
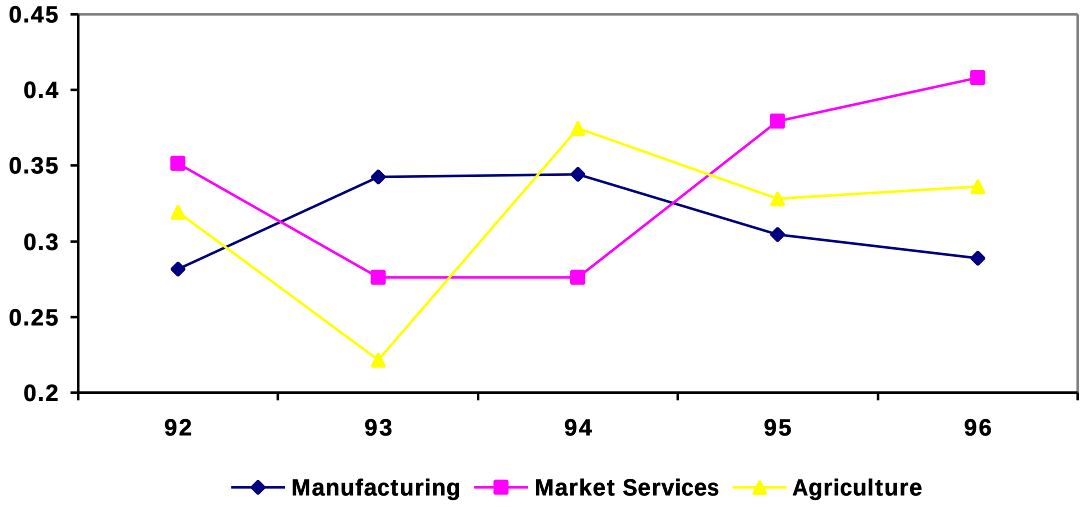


Figure 6: Sectoral Investment/Output Ratios



3.4 Wage Developments

The general form of the manufacturing wage equation is:

(4) $\ln (WM/PM) = a_1 + a_2 \ln (WEDGE) + a_3\, UR + a_4 \ln (LPRM)$

where *WM* is the wage rate, *WEDGE* is the tax wedge, combining all direct and indirect tax effects, *LPRM* is manufacturing-sector labour productivity and *UR* is the unemployment rate. Full price indexation is imposed, as befits a medium-term model.

In the Czech data only the productivity pass-through coefficient can be obtained with any confidence. In fact the elasticity on labour productivity comes in above unity, at 1.09 (Figure 7). Thus labour's share of added value in manufacturing has risen rapidly (Figure 8).

Figure 7: Real Wage and Labour Productivity in Manufacturing

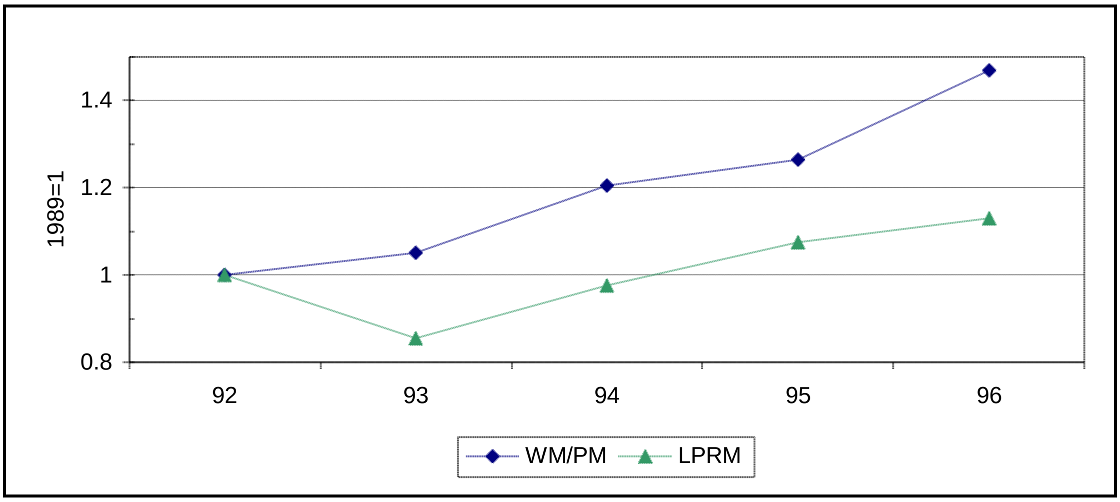
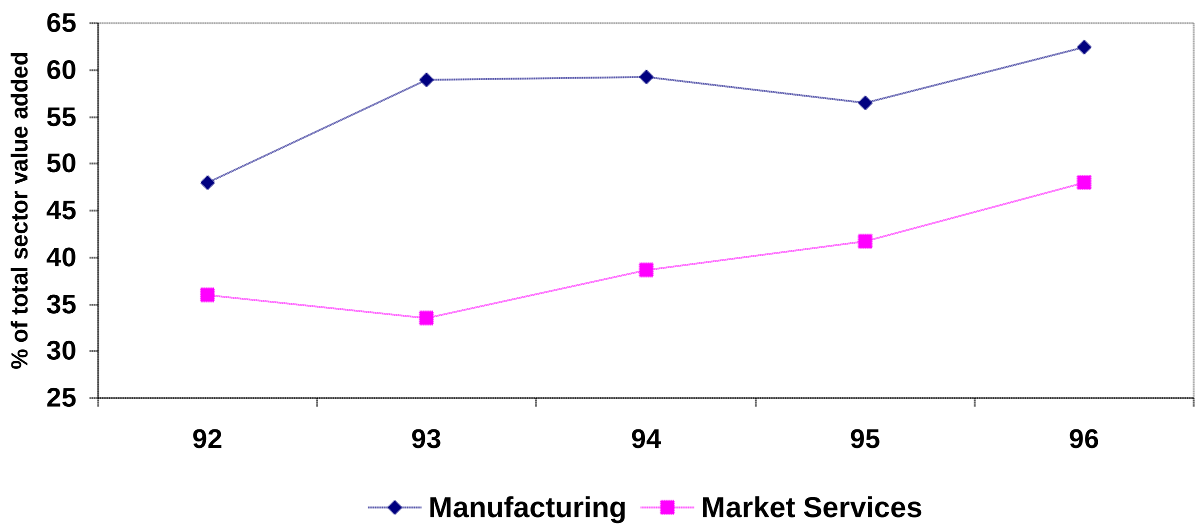
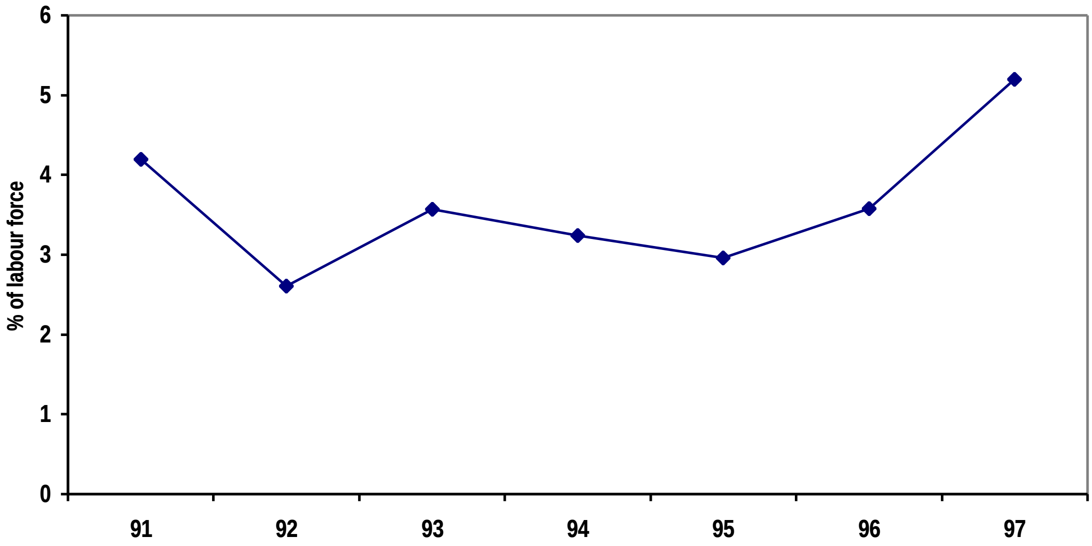


Figure 8: Sectoral Labour Share of Value Added



The rationale for our "Scandinavian model" assumption that wage inflation in manufacturing is passed on to services gives rise to an increasing labour share in that sector also. This wage inflation raises unit labour costs and erodes international cost competitiveness. As our simulations show, a continuation of this trend would have quite severe consequences for industrial performance. These trends are appearing at present in the form of increasing unemployment (see Figure 9). Note that the behaviour of the unemployment rate does not mirror the usual U-shaped output pattern. After an initial rise at the beginning of transition the rate remained steady for several years. It has risen again in the last few years, however, in a pattern that is quite unusual for the transition countries.

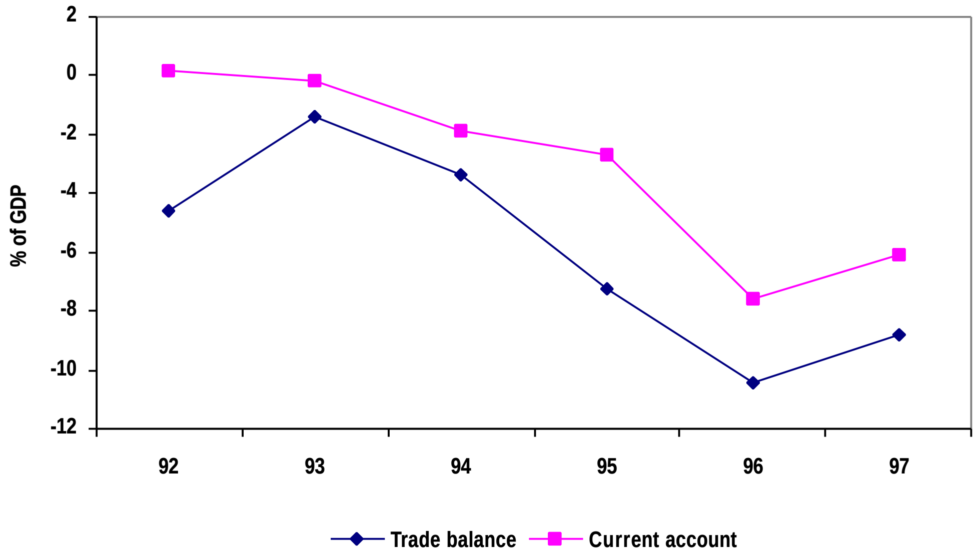
Figure 9: Rate of Unemployment[8]



Finally, as mentioned in our discussion of the demand side of the model, the balance of payments accounts are determined residually. The historical data are portrayed in Figure 10.

[8] The data from the CSO are not fully ILO compatible, but the trend is more important than the level for this discussion.

Figure 10: Trade Balance and Current Account (as a Percentage of GDP)



3.5 Conclusions Regarding Model Calibration

Calibrating the CEE HERMIN models proved difficult even with this simplified structure. The small data sample obviously makes calibration difficult when two or more parameters need to be recovered with only five or six observations. However, the fact that all CEE economies are undergoing massive structural change was another serious complication.

Placing the Czech calibration results in the context of two other CEE economies (Romania and Slovenia), the manufacturing output equation was broadly in line with expectations based on the degree of openness of the three economies. Czech manufacturing proved most sensitive to the development of the world economy, and Romanian least sensitive. Slovenia was an intermediate case, which is surprising in light of its extreme openness.

The CES technologies in manufacturing and market services proved difficult to calibrate. The Slovenian calibration pointed to a rather Cobb-Douglas technology in both sectors.

This pattern was then imposed on the Czech and Romanian models. The remaining calibration indicated very high rates of factor-saving technical progress in Czech and Romanian manufacturing, with factor-using technical progress in Slovenian manufacturing. In market services, the Czech and Slovenian models indicated little or no technical progress, but the Romanian model indicated a moderate rate of factor-using technical progress.

The determination of manufacturing prices, *PM*, was also broadly in line with the extent of openness of the three economies to trade, with the Czech and Slovenian economies characterised by a high degree of price-taking behaviour, and the Romanian economy by a much lower rate.

Attempts to calibrate the wage equation suggest that the transition process has not yet reformed wage bargaining institutions. The Czech data for 1992-96 provided an indication that high wage inflation has eroded international cost competitiveness. This pattern cannot continue without having severe consequences for industrial performance. We could not calibrate the Phillips curve parameter from the data, and so were forced to impose a value, using the Irish parameter. The pass through of productivity into wages was more reasonable in the Romanian and Slovenian cases.

The calibration of the simple Keynesian consumption function gave rise to no surprises in the case of Romania and Slovenia. In the case of the Czech Republic, a plausible value was imposed. It should be noted that the derivation of data on personal income was fraught with problems since in all three CEE countries it proved difficult to isolate that portion of corporate profits which was distributed to the household sector. However, this data problem is likely to become less serious over time as new statistical procedures are implemented.

4. Exploring Scenarios for the Next Stage of Czech Transition

The restructuring required in the early stages of transition of the CEE economies tended to have many common features: the privatisation of productive resources in manufacturing and services, a decline in the dominance of manufacturing, and growth from a very low base of activities in market services (Blanchard, 1997). As these economies approach the next phase of transition, they must address a very different range of problems and policy challenges. From a wide range of development options, country specific choices must be made. Our purpose in this section is to use the HERMIN model to explore some of these options and the nature, extent and speed of convergence or divergence that may follow as a consequence.

What does real convergence mean and how is it measured? A fairly universal measure is real GDP per head in purchasing power standards (PPS), as presented annually for the member states of the EU (see CEC, 1998). However, the only model-consistent benchmark available to us for our simulations is in terms of growth in manufacturing output (OM), since only "world" manufacturing growth appears as a variable in the model. In the various simulations, world manufacturing output is projected to grow exogenously at a rate of 3 per cent per annum. Since the Czech population is fairly static, real convergence is likely to occur only if domestic manufacturing output growth exceeds 3 per cent, and this is the definition we use.

We explore four scenarios here. In the first, we make the assumption that the Czech labour market remains unreformed, in the sense that no account is taken by participants in the wage bargaining process of the need to maintain cost competitiveness in the tradeable segment of manufacturing. In the second scenario we implement a stylised reform of wage bargaining that acknowledges the competitiveness constraint, but make no other changes. In the third scenario we examine the consequences of a policy that seeks to promote convergence through increased dynamism in the indigenous sector of manufacturing, with a reformed labour market. The final scenario examines the likely consequences of a convergence strategy that is based on inward investment rather than indigenous revival.

4.1 Future Growth with an Unreformed Labour Market

In describing our calibration of the Czech model we noted that we had included competitiveness terms in the manufacturing output equation, *OM*, even though such terms could not be identified empirically. They have to be included, nevertheless, because the CEE economies do not possess the degree of market power implied by their absence. We did not impose a Phillips-curve term however, since one can envisage circumstances in which there is little or no feedback from unemployment to wages. This has been found to be the case for Spain (Bradley et al., 1995). A clear consequence of the absence of a Phillips-curve term is high unemployment, as is in fact the case in Spain.

The model variant with no Phillips-curve term in the wage equation, and in which a 1 per cent rise in productivity generates a 1.09 per cent increase in real wages (derived from the within sample calibration), is what we mean by the term "unreformed labour market". Projecting the model under the unreformed labour market scenario suggests that the Czech Republic fails to converge to EU living standards, as shown in Table 1.

Table 1: Unreformed Labour Market

	1996	**2000**	**2005**	**2010**	**2015**
GR(OM*)	1.00	3.00	3.00	3.00	3.00
GR(OM)	4.41	1.86	2.02	2.40	2.98
GR(OS)	-1.13	0.46	0.65	1.01	1.54
GR(GDPFC)	-0.06	0.76	1.04	1.47	2.06
UR	3.56	8.51	12.05	13.83	13.45
RDEBT	11.54	17.02	20.61	19.80	15.33

Table 1 reports the model projections for the growth rates (GR) of world manufacturing output, domestic manufacturing, market services and GDP at factor cost, as well as the associated levels of the unemployment rate, *UR*, and public debt/GDP ratio, *RDEBT*.

The table shows that growth in Czech manufacturing output is consistently below the 3 per cent world growth, growth in market service-sector output is even lower and, not surprisingly, unemployment climbs substantially, to a level above 13 per cent of the labour force by the year 2015, by which time the public sector debt/GNP ratio stands at above 15 per cent.[9] Central to the explanation of why manufacturing output grows at a slower rate than the exogenous world manufacturing growth rate is the competitiveness loss associated with the excess of wage inflation over productivity growth, and the knock-on impacts on market services in terms of slow growth in domestic demand. The lesson that this simulation illustrates is that if the unreformed labour market institutions fail to deliver cost competitiveness, *ceteris paribus*, real convergence to European living standards is unlikely to occur.

4.2 The Impact of Labour Market Reform

Whilst in the Spanish case the unreformed labour market model (i.e., with no Phillips curve) may be plausible, for most other countries a build-up of unemployment of Spanish proportions would lead to wage moderation and a consequent improvement in cost competitiveness, feeding ultimately back into increased employment. This leads us to explore the consequences of the introduction of a Phillips-curve mechanism into the wage bargaining equation of the Czech model, as well as a moderation of the pass-through of productivity into wages.

Amending the model to incorporate a better-functioning labour market improves performance substantially (see Tables 2 and 3). Our basic version of the reformed labour market model, the results of which are depicted in Table 2, reduces the elasticity of real wages with respect to productivity to 0.8 (from 1.09), and entails a Phillips curve coefficient of -0.02 (similar to the Irish and Portuguese values).

---

[9] Note that in Table 1 and subsequently, a policy feed-back rule is used to keep the debt/GDP ratio roughly constant by varying the rate of direct personal income tax.

Table 2: Reformed Labour Market: Medium Phillips Curve

	1996	**2000**	**2005**	**2010**	**2015**
GR(OM*)	1.00	3.00	3.00	3.00	3.00
GR(OM)	4.41	3.11	3.35	3.72	4.06
GR(OS)	-1.13	0.45	0.78	1.28	1.90
GR(GDPFC)	-0.06	1.25	1.60	2.09	2.64
UR	3.56	7.24	9.10	9.05	6.80
RDEBT	11.54	16.19	18.59	18.25	16.76

Table 3: Impact of Labour Market Reform: Output Level in 2015

	OM	**OS**	**GDPFC**
Unreformed Labour Market	499	705	1,326
Reformed Labour Market: No Phillips Curve	575	707	1,402
Reformed Labour Market: Medium Phillips Curve (-0.02)	631	723	1,472
Reformed Labour Market: High Phillips Curve (-0.05)	660	737	1,512

Units: billions of crowns, 1994 prices

We see some improvement in the performance of the economy when we reduce the pass-through of productivity into wages even in the absence of a Phillips curve effect (see Table 3). If we characterise increasing labour market efficiency in terms of an increasing responsiveness of wages to unemployment, we see a systematic improvement in performance as efficiency increases. So, the more efficient the labour market is (in the above technical sense), the higher is the level of output and the lower is the rate of unemployment. Crucially, as seen in Table 2, the reformed labour market is sufficient to ensure real convergence, with manufacturing growth rates now above the "world" average.

4.3 The Consequences of Indigenous-led Growth Policies

Labour market reform alone is likely to improve the prospects of Czech convergence. However, other supporting institutional and policy changes will speed up the process. In this variant of the model we conceptualise the consequences of an industrial policy that succeeds in achieving export-led growth through active support of indigenous manufacturing.[10]

The calibration of the manufacturing output equation, *OM*, reflects the current degree of openness of the Czech economy. Exposure to the world economy will rise as trade integration proceeds, raising the share of tradeables relative to non-tradeables in manufacturing.[11] In this scenario we increase the elasticity of manufacturing output with respect to world output (by 50 per cent) and make the appropriate adjustments to the manufacturing-sector price equation.[12] Such changes would be consistent with both an increase in export orientation for the existing goods mix as well as with a shift in the product mix towards goods with higher income elasticities. Since this path represents an evolution of the *existing* manufacturing base, however, there is likely to be a less radical alteration in the production technology than would occur if the export-led growth strategy were FDI-driven; on the other hand, profits are retained domestically in this scenario.

---

[10] In practice, policies to support indigenous industry coexist with policies to encourage inward FDI. We treat them separately purely for the purposes of exposition.

[11] The structural changes require altering coefficients to increase the dependence of *OM* on OM^* and decrease the dependence on domestic demand *FDOM*, in equation (1). For given levels of OM^* and *FDOM* the changes should not affect *OM*. For this reason, we set indices so that the ratio of log(*FDOM*) to log(*OW*) for 1996, the last within-sample observation, is unity; ESRI (1997).

[12] An increase in openness will also be reflected in an increase in the weight of world prices in the pricing equation. For example, if the whole (1-*XSHR*) of manufacturing output which is initially assumed to be non-traded became tradeable, the impact of world prices on domestic manufacturing prices would rise by $(1- a_2)$, where a_2 is the elasticity of domestic prices to world prices in equation (3). So every 1% switch in the output equation raises the coefficient on world prices in the pricing equation by $(1- a_2)/(1-XSHR)$.

This variant is superimposed on the reformed labour market of Table 2. The difference between the results reported in Tables 2 and 4 arises solely from the increased openness of the economy to world trade. A comparison of these tables, and of Tables 3 and 6, reveals that increased openness is associated with improved economic performance in terms of the level of output achieved, the rate of unemployment over the long term and the public debt/GNP ratio.[13]

Table 4: Indigenous-led Growth

	1996	**2000**	**2005**	**2010**	**2015**
GR(OM*)	1.00	3.00	3.00	3.00	3.00
GR(OM)	2.84	3.58	4.03	4.52	4.89
GR(OS)	-0.75	0.67	1.19	1.88	2.74
GR(GDPFC)	-0.27	1.48	2.03	2.69	3.39
UR	3.87	6.22	6.57	4.38	-0.91
RDEBT	11.37	13.89	12.41	8.30	4.09

The mechanism which drives these results is as follows. The higher the elasticity of Czech manufacturing output with respect to world demand, the more the Czech economy benefits from exogenous world growth. The expansion in the traded sector feeds through to domestic income and further boosts the production of non-traded market services. Superficially this appears to be an attractive route to real convergence. However, such a route may not be open to newly emerging market economies, as it is extremely difficult for indigenous industry to expand its export orientation rapidly (O'Malley, 1989 and 1998). Both the Irish and Portuguese experiences show that FDI inflows were the driving force behind the increased export orientation of the manufacturing sector (Barry and Bradley, 1997; Cabral, 1995). We now turn to an examination of this process.

[13] It should be noted that in Table 4, the rate of unemployment becomes negative in the year 2015. This would not have emerged if an appropriate non-linear Phillips curve response had been incorporated into the model. Alternatively, inward migration, which we again do not include, would have relieved pressure on the Czech labour market long before unemployment fell to zero.

4.4 The Consequences of FDI-led Growth Policies

In this variant of the model, as in the indigenous-led growth variant of Table 4, we again increase the elasticity of manufacturing output with respect to world output by 50 per cent, with corresponding changes made to the output price equation. Several complementary changes are required for the FDI-driven scenario however. First, we change the CES technology in manufacturing to make it less responsive to domestic relative factor prices. Rather than leading to a substitution of capital for labour, higher domestic relative wages in the FDI-driven scenario lead to a reduction in the exposure of multinational companies to the economy under discussion (Bradley and Fitz Gerald, 1988).[14] This particular change proves to have only very slight effects, as seen in Table 5.[15]

Table 5:
FDI-led Growth with Varying CES Elasticity of Substitution: Output Level in 2015

	OM	**OS**	**GNPFC**
FDI-led Growth: Low Value of l (0.50)	654	723	1,493
FDI-led Growth: Medium Value of l (0.75)	656	726	1,497
FDI-led Growth: High Value of l (0.95)	657	728	1,500

Next, we increase the rate of Hicks neutral technological progress to reflect the process of technological diffusion that accompanies inward investment (Blomstrom and Kokko, 1998). This is incorporated by increasing the rate of disembodied total factor productivity growth from 4.5 per cent to 6 per cent. The effects of this are discussed below.

---

[14] Changing any of the CES parameters while requiring the new factor demand system to reproduce the same in-sample predictions for LM and IM requires compensating changes in the other CES parameters. How this is affected is described in detail in Kejak and Vavra (1999).

[15] Of course, if the model was subjected to a shock that radically altered relative factor prices, the outcome would be sensitive to the value of the elasticity of substitution.

Finally, we need to take a position on the likely fraction of manufacturing profits that will be repatriated by the foreign-owned sector of Czech industry. In 1996 (the last within sample observation), this fraction was almost zero in the Czech Republic. In Ireland, on the other hand, in 1996 this fraction was over 60 per cent. In the present simulations we select two values, of 15 and 30 per cent, reflecting the likelihood that a foreign presence in the Czech Republic will remain lower than in Ireland over this period.

Table 6 compares results from the indigenous-led and FDI-led scenarios. The difference between the first two rows is that the rate of technological progress in the manufacturing sector is higher in the latter case, while profit repatriation remains set at zero. (The lower value for the CES elasticity of substitution makes little difference to the results, as discussed above). Positive profit repatriations create a distinction between GDP and GNP of course, so in reporting the outcomes of such scenarios we report the lower GNP numbers.

Table 6: Indigenous Versus FDI-led Growth: Output Level in 2015

	OM	**OS**	**GNPFC**	**UR**
Indigenous-led Growth	711	795	1606	-0.9
FDI-led Growth: No Profit Repatriations	765	804	1,661	3.6
FDI-led Growth: Medium Profit Repatriations	750	786	1,632	5.3
FDI-led Growth: High Profit Repatriations	716	748	1,569	8.8

A comparison of the indigenous-led and FDI-led scenarios implies a trade-off between output and employment, in that the higher rate of technological progress associated with the FDI-led scenario stimulates output whilst increasing the rate of labour shedding, as a comparison of Tables 4 and 7, for example, will reveal.

Output declines as the rate of profit outflow increases, with knock-on consequences for higher unemployment and public debt; Tables 7 and 8.

Table 7: FDI-led Growth: Medium Profit Repatriations: High Technical Progress

	1996	**2000**	**2005**	**2010**	**2015**
GR(OM*)	1.00	3.00	3.00	3.00	3.00
GR(OM)	2.80	3.85	4.28	4.91	5.49
GR(OS)	-0.79	0.59	1.10	1.89	2.98
GR(GNPFC)	-0.30	1.52	2.08	2.86	3.76
UR	3.90	8.31	10.43	9.69	5.26
RDEBT	11.38	16.66	16.57	11.51	4.67

Table 8: FDI-led Growth: High Profit Repatriations: High Technical Progress

	1996	**2000**	**2005**	**2010**	**2015**
GR(OM*)	1.00	3.00	3.00	3.00	3.00
GR(OM)	2.80	3.64	4.02	4.73	5.49
GR(OS)	-0.79	0.46	0.88	1.65	2.76
GR(GNPFC)	-0.30	1.38	1.88	2.67	3.65
UR	3.90	9.54	12.37	12.42	8.84
RDEBT	11.38	19.95	21.95	16.76	8.13

We also examined the sensitivity of the FDI-led outcome to variations in the rate of technological progress. Tables 8 and 9 have the same rate of profit repatriation, while Table 9 has a lower rate of labour shedding technological progress. As alluded to earlier, this results in a trade-off between output and unemployment.

Table 9: FDI-led Growth: High Profit Repatriation: Medium Technical Progress

	1996	2000	2005	2010	2015
GR(OM*)	1.00	3.00	3.00	3.00	3.00
GR(OM)	2.80	2.75	3.06	3.64	4.22
GR(OS)	-0.79	0.36	0.66	1.23	1.99
GR(GNPFC)	-0.30	1.07	1.44	2.04	2.75
UR	3.90	7.25	7.78	6.16	1.75
RDEBT	11.38	19.56	22.00	18.62	12.76

Based on the experiences of Ireland and Portugal, the case represented in Table 8 is the one we deem most relevant to the Czech Republic. Relative to the case of indigenous-led growth, the more likely FDI-led growth outcome has a higher rate of unemployment, a higher debt/GNP ratio, and a terminal level of output that is 2 to 3 per cent lower. Whilst the indigenous-led growth scenario is clearly superior to the FDI-led scenario, it is likely to be much more difficult to achieve in a world economy dominated by large multinationals, with associated barriers to entry for firms from newly emerging market economies.

5. Concluding Remarks

Several interesting lessons emerge from the various scenarios we have examined. The first is that real convergence is by no means automatic. This is apparent also from the cohesion-country experience; thus Greece has barely converged to average EU living standards over the last twenty years, while Ireland experienced little convergence between 1960 and the late 1980s. The importance of the general macro environment to convergence is implicitly recognised by Fischer et al. (1998) who, in forecasting the growth prospects of CEE economies, supplement the standard growth-regression variables with measures of the degree of liberalisation prevailing across a range of markets.

Our own methodology in assessing convergence prospects can be seen as a response to an earlier challenge by Fischer, who wrote that: "Identifying the determinants of investment, and the other factors contributing to growth, will probably require a switch away from simple cross-sectional regressions to time series studies of individual countries;" (Fischer, 1991).

We have shown, with the aid of a calibrated model of the Czech economy, that a continuation of Czech recent wage-setting behaviour can inhibit convergence quite dramatically. We also considered how convergence prospects could be boosted by further moves in the direction of trade integration. The scenario in which the growth acceleration is based on indigenous Czech industry, which gains in efficiency and captures market share abroad might be characterised as the "South Korean" model. Its success would depend on the ability of Czech entrepreneurs to overcome entry barriers associated with the dominance of multinational firms from more highly developed market economies. This would entail the development of innovative and highly income elastic products, efficient marketing and distribution systems, and substantial process and product innovation (Porter, 1990).

The growth acceleration along the alternative development path results from export-oriented foreign direct investment inflows. This might be characterised as the "Irish" model of convergence (Barry, ed., 1999).[16] Success here will depend on the ability of the authorities to make the business climate in the Czech Republic sufficiently attractive to capture a greater share of internationally mobile investment.

Obviously a range of supporting domestic policy interventions would be required to guide the economy along one path or the other. Although our scenario analysis is silent on the nature of these policies, the whole spectrum of macroeconomic, industrial and educational policies will have a role to play. One area where the policies adopted and the structural changes achieved are inextricably linked is in the analysis of Structural Fund-

[16] The characteristics of current FDI inflows to CEE countries are studied by Lankes and Venables (1996).

type expenditures. A natural extension of the present modelling project would be a comparison of the likely effects of EU Structural Funds on the CEE economies with the effects of these funds found for the cohesion countries of the EU.

6. References

d'Alcantara, G. and A. Italianer (1982). *A European Project for a Multinational Macrosectoral Model*, Document MS 11, DG XII, Brussels: Commission of the European Communities.

Barry, F.,ed., (1999) *Understanding Ireland's Economic Growth*, London: Macmillan.

Barry, F. and J. Bradley (1997). "FDI and Trade: the Irish Host-Country Experience", *Economic Journal*, 107(445), pp. 1798-1811, November.

Barry, F. and J. Bradley (1999). *The comparative study of transition and cohesion*, Working Paper WP04, Dublin: The Economic and Social Research Institute, March.

Blanchard, O. (1997) *The Economics of Post-Communist Transition*, Oxford: Clarendon Press.

Blomstrom, M. and A. Kokko (1998) "Multinational Corporations and Spillovers", *Journal of Economic Surveys*, 12(3), pp. 247-77

Bradley J. and J. Fitz Gerald (1988) 'Industrial Output and Factor Input Determination in an Econometric Model of a Small Open Economy', *European Economic Review*, 32, 1227-1241.

Bradley, J. and J. Fitz Gerald (1990) 'Production Structures in a Small Open Economy with Mobile and Indigenous Investment', *European Economic Review*, 34, 364-374.

Bradley J., J. Herce and L. Modesto (1995) 'Modelling in the EU periphery, The HERMIN Project', *Economic Modelling*, Special Edition, 12(3)

Cabral, S. (1995) 'Comparative Export Behaviour of Foreign and Domestic Firms in Portugal', *Banco de Portugal Economic Bulletin*, Lisbon, March.

C.E.C. (1998). *European Economy*, No. 66, Directorate General for Economic and Financial Affairs, Commission of the European Communities, Luxembourg.

ESRI (1997): *Single Market Review 1996: Aggregate and regional aspects: the cases of Greece, Ireland, Portugal and Spain*, (authors: F. Barry, J. Bradley, A. Hannan, J. McCartan and S. Sosvilla-Rivera), London: Kogan Page, in association with the Office for Official Publications of the European Communities, Luxembourg.

Fischer, S. (1991). "Growth, Macroeconomics and Development", in Blanchard, O.J. and Fischer, S. (eds.), *The NBER Macroeconomics Annual 1991*, Cambridge: The MIT Press.

Fischer, S., R. Sahay and C. Vegh (1998) "From Transition to Market: Evidence and

Growth Prospects", IMF Working Paper, WP/98/52, April

Kejak, M. and D. Vavra (1999) *The HERMIN Macromodel of the Czech Republic*, Working Paper 1, Ace-Phare project P96-6242-R, March.

Lankes, H., and A. Venables (1996) "FDI in Economic Transition: The Changing Pattern of Investments", *Economics of Transition*, 4(2), 331-347

Layard, R., S. Nickell and R. Jackman (1991) *Unemployment: Macroeconomic Performance and the Labour Market*, Oxford, Oxford University Press.

Lindbeck, A. (1979) "Imported and Structural Inflation and Aggregate Demand: the Scandinavian model reconstructed", in Lindbeck, A. (ed.) *Inflation and employment in open economies*, Amsterdam, North Holland

O' Malley, E. (1989) *Industry and economic development: the challenge for the latecomer*, Dublin: Gill and Macmillan

O'Malley (1998) The Revival of Irish Indigenous Industry, *Quarterly Economic Commentary*, Dublin: Economic and Social Research Institute

Porter, M. (1990). *The Competitive Advantage of Nations*, London: Macmillan Press.

Potocnik, J. and B.. Majcen (1996). *Possible effects of Slovenian integration into the EU – CGE approach*, Analysis Research and Development, IMAD, Ljubljana.