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PARALLEL MOVEMENT OF INFLATION, DOMESTIC AND FOREIGN EQUILIBRIA

TAMÁS MELLÁR[1]

SUMMARY

The paper attempts to reveal the mechanism of the inflationary policy of the Hungarian governments of the transition period. It investigates whether forced inflation is used as a means of improvement of foreign and domestic equilibria. According to the empirical results it can be deduced that the governments were not highly committed in the struggle against inflation, sometimes they even sacrificed the goal of suppressing inflation. There are, however, some indications, for a cyclical alteration of the pattern of inflation but the existence of the four year business cycles corresponding to those of the general elections could not be unequivocally proven.

KEYWORDS: Inflation; Macromodels; Economic dynamics.

The decade of the Hungarian transition has already produced in some areas homogeneous time series of length necessary to analyse the relevancy of certain macroeconomic relations not only theoretically but using empirical tools as well. The investigation of the relevancy of Phillips curve that sets a specific relation between unemployment and inflation is an extremely interesting problem of the transition countries because its validity is a controversial issue even in the developed countries.[2]

Data referring to the last years clearly show that in the Hungarian economy the trade-off between unemployment and inflation does not prevail, instead a positive correlation of these two macro variables could be observed. The reasons, however, contrary to the developed market economies, can not be found either in the rational expectations or in the existence of positive or negative supply shocks but in the business cycles symmetric to those of the foreign trade. Thus an increase in demand did not yield a price increase because it could be absorbed by the growth of the supply of imported goods. Moreover, the imports of means of production increased very often the domestic productive potential, decreasing at the same time the unit costs. On the other hand, the increase of the foreign trade deficit, sooner or later forced the devaluation of the Hungarian currency and the re

[1] President of the Hungarian Central Statistical Office.
[2] Here we refer to the debate that has lasted for two decades among Keynesian, monetarist and neo-classical economists.

striction of imports. These two impacts jointly led to the decrease of output and to the increase of unemployment and inflation.[3]

The rate of inflation itself is a very important indicator for governments, therefore its control is an extremely vital decision parameter as well. It is well known that a high and increasing inflation means a seigniorage revenue for governments and a non devolvable tax of price hikes for the public. At the same time, rapid inflation costs a lot for the government too. These manifest themselves in higher interests on public debt, in a less favourable position of the current budget balance and in the spread of uncertainty in business life. In spite of these unfavourable effects, under special circumstances, governments resort to a deliberate speeding up of inflation and, later, they are compelled to decrease it. Neither Hungarian governments of the transition period provided an exception to this rule. However, the mechanism of the operating cycle is a bit more complicated than written above. The rate of inflation as planned by the government and the inflationary expectations of the economic agents as well as their dynamic movements also have a role to play. Table 1 illustrates the annual data of observed (actual) and planned inflation, as well as some indicators of the equilibrium position of the Hungarian economy.

Table 1

Some indicators of inflation and macroeconomic equilibrium
(percent)

Year	Planned	Observed	Observed–planned	Balance of state-budget/GDP	Net exports/GDP
	inflation				
1990	19-20	28.9	9	0.3	2.8
1991	35-38	35.0	-1	-3.0	0.8
1992	22-25	23.0	-1	-7.0	0.9
1993	17-19	22.5	4.5	-6.7	-9.0
1994	18-22	18.8	-1.2	-9.6	-9.4
1995	19-20	28.2	8.7	-7.3	-5.6
1996	19-20	23.6	4.1	-4.6	-3.7
1997	18-19	18.3	-0.2	-4.7	-2.2
1998	13-14	14.3	0.8	-4.8	-4.8
1999	10-11	10.0	-1	-4.5	-5.0

Source: Statistical Yearbooks of HCSO and State Budget Provisions of the Ministry of Finance.

In describing the actual mechanism it is assumed that government is basically able to control the extent of inflation and for any period can determine its most acceptable level. Agents of the economy form their inflationary expectations according to their assessment of these processes. What is advantageous for the government if the actual inflation is, to some extent, higher than the planned one. To this statement, however, two restrictions should be added: it is advantageous only in the case of a relatively low rate of expected inflation and if the actual inflation does not become too rapid (does not reach an uncontrollable level). Why is this situation advantageous for the government? Because this way state budget could be balanced more easily, revenues would be higher and expenditures

[3] For more details see *Mellár* (1997).

would be lower and in course of wage bargaining a lower level of real wages could be set, given that the planned inflation serves as a basis of the growth of nominal wages. And, on the other hand, an actual inflation lower than planned would be disadvantageous for the government. However, an inflation which is calibrated more rapid than planned would lead, no doubt, to the increase of inflationary expectations as well as inflation itself and thus the costs of inflation would sooner or later be higher than the mentioned fiscal advantages. The most important factor among the costs of inflation is the increase of interests to be paid for national debt which results in a robust deterioration of the budget balance. This way government is compelled to decrease inflation. Under decreasing inflation when inflationary expectations and the level of planned inflation still remained high, the losses related to a gap between planned and actual inflation already emerge, but they could be temporarily compensated by the gains of decreasing inflation. Nevertheless, when a further reduction of inflation does not offer a considerable surplus, government resorts again to generating an inflation higher than planned. Thus we get back to the starting point of the cycle.

In the next part of this paper a framework and main features of the macromodel describing this process will be explained. Section 2 is about the empirical analysis, and finally, the third part summarises the conclusions.

1. Basic model of inflationary mechanism

In order to study the problem a simple model of two agents has been developed. The first agent is the government and the second one is the rest of all economic agents. The model contains two endogenous variables: expected and planned inflation, two exogenous variables, namely state budget and net exports, and a policy variable (actual or observed inflation). The model consists of a set of two behavioural equations and a loss function which are as follows:

$$\pi_t^e = \alpha_1 \pi_{t-1} + \alpha_2 (\pi_{t-1} - \pi_{t-1}^P) \qquad \alpha_1, \alpha_2 > 0 \qquad /1/$$

$$\pi^P = \beta_1 \pi_{t-1} + \beta_2 D_{t-1} + \beta_3 K_{t-1} \qquad \beta_1, \beta_2, \beta_3 > 0 \qquad /2/$$

$$L_t = \gamma_1 (\pi_t^P - \pi_t) + \gamma_2 \pi_t + \gamma_3 (\pi_t - \pi_t^e) \qquad \gamma_1, \gamma_2, \gamma_3 > 0\,, \qquad /3/$$

where π is the (actual, observed) rate of inflation, superscripts e and P serve for the expected and planned inflation, respectively, while subscripts indicate time. D is the share of balance of state budget in the GDP and K denotes the proportion of net exports to GDP. The first equation describes the rule being applied in forming the expectations of the agents. This can be regarded as some kind of adaptive expectations and consists of a weighted sum of two components: inflation rate of the previous period and the gap between the planned and actual rates of inflation in the preceding period. It is easy to see that government is ‘punished’ by the agents of economy for an inflation higher than planned.

The second equation defines the way of calculating the planned level of inflation. The first term reflects the fact that planned inflation depends to a high degree on the inflation of the previous period, while the second part indicates that planned inflation is the less when the foreign and domestic equilibrium position of the preceding period is the worst. The positive or negative signs of equilibrium variables *D* and *K* reflect the surplus or the deficit of the state budget or the balance of foreign trade.

The third equation is the government's loss function which consists of three parts. The first one describes the loss resulting from the gap between planned and actual inflation. With the weight parameters being positive, it could clearly be seen that an actual inflation less than planned yields a loss and, on the other hand, an inflation bigger than planned provides gains (i.e. a negative loss) for the government. The second part shows that general loss originated from inflation itself which is well known from literature. The third part means the government's loss of credibility caused by an inflation higher than expected. Using the two behavioural equations, the loss function could be transformed into the following reduced form:

$$L_t = (\gamma_2 + \gamma_3 - \gamma_1)\pi_t + \left[\gamma_1\beta_1 - \gamma_3(\alpha_1 + \alpha_2)\right]\pi_{t-1} + \gamma_3\alpha_2\beta_1\pi_{t-2} + \\ + \gamma_1\beta_2 D_{t-1} + \gamma_3\alpha_2\beta_2 D_{t-2} + \gamma_1\beta_3 K_{t-1} + \gamma_3\alpha_2\beta_3 K_{t-2} \qquad /4/$$

For the sake of convenience, new parameters $c_1, c_2, \ldots, c_7$ are introduced. This way the loss function /4/ takes the following form:

$$L_t = c_1\pi_t + c_2\pi_{t-1} + c_3\pi_{t-2} + c_4 D_{t-1} + c_5 D_{t-2} + c_6 K_{t-1} + c_7 K_{t-2}\,, \\ c_1, c_2 \gtrless 0 \qquad c_3, \ldots c_7 > 0 \qquad /4a/$$

The task of the government is, in order to minimise loss, the setting of π_t, the actual inflation of year *t*. This definition of the problem is based on the assumption that government is able to control inflation by its monetary and fiscal policy. This task, however, could not be fully executed because market forces, domestic and foreign ones as well, have a considerable influence on inflation. Nevertheless, using central measures (on tariffs, taxation rules, wage and income bargaining) the government is able to influence the short term changes of price level. This has obviously been proven by the Hungarian practice and price statistics of the transition period: besides the price changes caused by market forces, price movements generated by central measures had a determining role to play. These types of corrections have been implemented by the instruments of fiscal policy. This way it could justify the following question: why could monetary policies not compensate inflation generating fiscal actions? This hindrance is not due to the lack of will or independence of the National Bank of Hungary. The real issue is that for the time being the financial system of Hungary is not developed enough and the monetary instruments are not powerful enough to set an independent inflationary target and to implement active anti-inflationary measures.[4]

It can clearly be seen from the reduced form objective function that only actual inflation and not the planned one is the real decision parameter for the government. Planned

[4] The crawling peg devaluation system introduced by the National Bank of Hungary serves as a good example for this. This has a very important role in preserving domestic and foreign equilibrium and confidence but, even for this, foreign exchange policy cannot be used for anti-inflationary purposes. As regards the weakness of monetary institutions and implements in three transition-countries further contributions can be seen in the paper of *Brada-Kutan* (1999).

inflation is determined by a behavioural rule and, however, while formulating this rule besides the inflation rate of the previous year the evaluation of the state of equilibrium is already taken into account. Nevertheless, planned inflation cannot be considered as a decision parameter to be optimised. It cannot be taken so because, on the one hand, it should be set for the target period and serves as a basis for wage bargaining and for setting the main quantitative characteristics of the budget of the next year. On the other hand, in order to gain an agreeable confidence of economic agents, planned inflation should be in accord with the general inflationary process and data of previous years.

As far as the loss function is concerned, positive signs of parameters $c_4 \ldots c_7$ have to be explained. This positivity implies that an improvement of the equilibrium position (positive balance) increases losses, deteriorates the position of the government. Nonetheless, this is not a real contradiction, and comes from the fact that the loss function is expressed for inflation. As a result of a favourable equilibrium position $(D, K > 0)$ the plan for inflation will not be strained, i.e. planned inflation will be rather high, namely it will expectedly be higher than the actual one, since a bad equilibrium position does not compel government to make a deliberately low plan for inflation. Therefore, government has a loss, because expenditures of the budget adjust to a high planned inflation, while the incomes adjust to an actual lower one.

In order to get a more compact form for the further analysis of the loss function, the equilibrium variables regarded previously as exogenous, shall be endogenize. It is obvious that both domestic and foreign equilibrium depends highly on inflation. Let us assume the following simple relation between equilibrium variables and inflation:[5]

$$D_t = \omega \pi_t \qquad \omega \gtrless 0$$

$$K_t = \phi \pi_t \qquad \phi < 0 \,.$$

Parameter ω may be positive or negative, as the seigniorage and the inflationary tax incomes are greater or smaller than the increase of debt-service. Parameter ϕ is unequivocally negative, because as a consequence of inflation competitiveness is reducing and this yields the deterioration of the balance of foreign trade. Inserting these two equations into /2/ the modified equation of the planned inflation is as follows:

$$\pi_t^P = \beta \pi_{t-1}, \qquad \text{where} \qquad \beta = \beta_1 + \beta_2 \omega + \beta_3 \phi \,. \qquad /2a/$$

Following the former arguments β may be positive and negative as well. Taking into account equation /2a/, the reduced form of the loss function is as follows:

$$L_t = c_1 \pi_t + c_2 \pi_{t-1} + c_3 \pi_{t-2}, \qquad c_1, c_2, c_3 \gtrless 0. \qquad /4b/$$

Parameters c differ from those in /4a/ only because the positive β_1 is replaced here by β of unknown sign.

[5] The relations defined here are simplified ones from many aspects: on the one hand because they describe the relations to the current inflation only, on the other hand because they do not take into account the indirect impacts (since the equilibrium variables have their own effect to the inflation as well). Moreover, these relations disregard further, non inflationary factors.

When analysing loss function /4b/ it is supposed that inflation can not be negative,[6] that is $\pi_t \geq 0$ for any *t*, while minimising the loss function, the following statements can be deduced.

– If all parameters *c* are positive the optimal rate of inflation will be zero for all periods and the cumulated loss will be zero for any period too.

– If $c_1, c_2, c_3 < 0$ then the optimal solution for any period leads to an inflation as high as possible, because this choice minimises the loss function. In this case, however, the equilibrium of the system would be lost and it explodes.

– In any other case a 'mixed solution' i.e. a special mix of periods of zero and positive inflation will be optimal. This is well reflected by the summarised form of the loss function for a finite period of *n*:

$$\sum_{i=1}^{n} L_i = (c_1 + c_2 + c_3)[\pi_1 + \pi_2 + \ldots + \pi_{n-2}] + (c_1 + c_2)\pi_{n-1} + c_1\pi_n \, .$$

Depending on the signs of expressions $(c_1 + c_2 + c_3)$ and $(c_1 + c_2)$ as well as that of parameter c_1 the inflation of the period in question will be positive or zero.

It is easy to see that parameters of non predetermined signs have a particular importance in the formation of the whole process. This is, of course, not by chance because the signs of the parameters have a particular economic meaning. If $c_1 > 0$, for instance, it means that $\gamma_1 + \gamma_2 > \gamma_3$ and this hints at the situation that the losses of the government originating from inflation itself overcome those ones related to an inflation less than planned. That is, a positive c_1 refers to a government which is seriously committed to fight against inflation while a negative c_1 refers to a not really committed government that takes inflation as an implement of trade-off for other goals. The case $c_2 > 0$ means that $\gamma_1\beta > \gamma_3(\alpha_1 + \alpha_2)$, and this can be interpreted in a way that government gives bigger importance to the negative consequences of the lagged effects of inflation of the previous period than to its positive outcomes. Finally, $c_3 = \gamma_3\alpha_2\beta > 0$ shows that government, based on the inflation of the previous period, is inclined to set planned inflation to a higher level, and so it will have a reduced possibility to get extra revenue by speeding-up inflation.

2. Empirical analysis

Empirical analysis consists of three parts: first we test equation /4a/, that is the reduced form of the original model. This will be followed by testing the simplified equation /4b/ that has been derived from endogenous treatment of the equilibrium variables. Finally, the investigation will be concluded by an empirical verification of the behavioural rule of inflationary expectation deduced from equations /1-2/ and /1-2a/.

Taking into consideration the specific reaction-time of underlying macroeconomic variables, the use of quarterly data seems to be suitable. Quarterly consumer price indices

[6] In general this seems to be a rather strong assumption but actually, regarding the transition period of the Hungarian economy, it is not.

for the period 1989–1998, compared to the corresponding quarter of the previous year and computed by a relatively homogeneous methodology are available. As it is usually done, we regarded the annual consumer price index as the measure of inflation, so in the following empirical parts of this paper the term *inflation* means seasonally adjusted quarterly consumer price indices. Homogeneous quarterly data for the balance of state budget and net exports are available only for the period 1992–1998, so the model could be tested for this rather limited time interval.

Relation among inflation, domestic and foreign equilibria

In order to understand the order of integration of time series of the model, first of all unit root tests are to be implemented. The augmented *Dickey-Fuller* test shows that variables of the Hungarian inflation as well as those of the equilibrium position measured by the balance of the state budget and the net exports are integrated of first order.

Table 2

Augmented Dickey-Fuller unit root tests

Model based on	Inflation		Expected inflation		Balance of state budget		Net exports	
Levels	-2.569	(3)	-2.75	(3)	-1.378	(3)	-2.82	(2)
	-1.014	(4)	-1.45	(4)	-2.100	(2)	-2.63	(1)
First differences	-3.839***	(3)	-3.562**	(3)	-3.767**	(3)	-3.757***	(2)
	-2.827*	(4)	-3.01**	(4)	-6.708***	(2)	-4.42***	(1)

* Significant at 0.1 level.
** Significant at 0.05 level.
*** Significant at 0.01 level.
Note: Optimum lags, selected by using AIC and SBC criteria are in brackets, constants are included.

For testing /4a/ some arrangement of the equation is necessary. Assuming that the loss function takes a constant (time-invariant) characteristic (optimal?) level, then after the substitution of $L_t = b$ the following simplified form is obtained:

$$\pi_t = a_0 + a_1\pi_{t-1} + a_2\pi_{t-2} + a_3 D_{t-1} + a_4 D_{t-2} + a_5 K_{t-1} + a_6 K_{t-2}\ , \qquad /5/$$

where $a_0 = b / c_1,\ \ a_1 = -c_2 / c_1, \ldots a_6 = -c_7 / c_1$. Regarding that a reverse relation, i.e. the impact of inflation to equilibrium variables can not theoretically be excluded, the construction and estimation of a VAR model that contains all three variables (inflation, balance of state budget, net exports) seems to be suitable.[7] Results of estimations are shown in Table 3.

Estimates in Table 3 verify the fact that relation with inflation as endogenous variable is the only acceptable one. In the case of the net exports the two period lagged endogenous variable is the only significant explanatory variable, while in the case of the balance of budget no significant regressor could be found.

[7] Given that the variables are not cointegrated, VAR model can be used and consistently estimated even if there are unit roots in the time series.

Table 3

Estimates of the VAR model

Variables	π_t	K_t	D_t
π_{t-1}	1.309 (7.78)	-0.056 (-0.55)	0.028 (0.34)
π_{t-2}	-0.405 (-2.66)	0.054 (0.58)	-0.055 (-0.74)
K_{t-1}	0.429 (1.31)	0.145 (0.73)	0.048 (0.29)
K_{t-2}	-0.675 (-2.20)	0.416 (2.23)	0.191 (1.27)
D_{t-1}	-1.714 (-3.51)	0.518 (1.76)	0.031 (0.13)
D_{t-2}	0.480 (0.86)	0.186 (0.56)	0.046 (0.17)
R^2	0.891	0.306	-0.095
F –statistics	32.92	1.76	-0.34
Log-likelihood	-47.92	-34.80	-29.38

Note: t-statistics in brackets.

A two period lag is desirable from a theoretical point of view, but it is acceptable from a practical view too, since its relevancy was proven by the likelihood ratio test. So the estimated version of /5/ can be written as follows:

$$\pi_t = 1.309\pi_{t-1} - 0.405\pi_{t-2} - 1.734D_{t-1} + 0.48D_{t-2} + 0.43K_{t-1} - 0.675K_{t-2} \qquad /5a/$$

Given that the constant term was not significant on any level, it has been removed from the estimated equation. From an economic aspect this means that the characteristic value of the loss function was 0 in the estimation period, that is the Hungarian governments in the transition period made efforts to minimise their losses. If we assume that parameter c_1 of non predetermined sign is actually positive (this is supported by the estimated value of the objective function, i.e. the assumption that governments evaluate the cost of inflation more than its advantages), then the majority of the signs of the estimated parameters suits the theoretical expectations. Parameters $a_4, a_5 > 0$ are the only exceptions, but, as it can be seen from the t-statistics in Table 3, they are insignificant. The negative effect of significant equilibrium variables, following the philosophy of the model indicates that the improving equilibrium moderates the intention of government to speed-up inflation, thus diminishes it. (It should be noted that it actually means that inflation would not rise over the planned level, since plans are realistic and not underestimated.) It is obvious that neither an other interpretation, independent of the philosophy of the model and based upon standard macroeconomic theory, can be excluded. Namely, one could argue that the decrease of the deficit of the budget yields a decreasing excess demand, while the improvement of net exports eases the pressure that tends towards devaluation, and the resultant of these factors decreases inflation.

The dynamic properties of the Hungarian inflation

Testing the reduced loss function /4b/ means at the same time the empirical analysis of the dynamic properties of the Hungarian inflation. As it has been done in the previous section, assuming once again the constant value of the objective function, the equation can be written in a simple form. Thus we get the following equation:

$$\pi_t = a_0 + a_1\pi_{t-1} + a_2\pi_{t-2}, \qquad /6/$$

where $a_0 = b/c_1$, $a_1 = -c_2/c_1$, and $a_2 = -c_3/c_1$. From an econometric point of view difference equation /6/ can be regarded as an autoregressive process, which can be tested by standard methodology. After some trials it has been found that an AR(2) process fits very well. So the estimated form of equation /6/ is as follows (t-statistics are in parentheses):

$$\pi_t = 22.356 + 1.4063\pi_{t-1} - 0.53\pi_{t-2} \qquad /6a/$$

(7.1) (9.7) (-3.6)

$R^2 = 0.86$ *D-W.* = 2.18 F = 111.37

The roots of the difference equation can easily be computed as λ_1 = 0,70 + 0,19i , and λ_2 = 0,70 -19i. As it is shown, complex roots have been obtained, so depending on the initial values, the general solution of /6a/ is the following:

$$\pi_t = [0.73^t][(\pi_0 - 179.3)\cos 15^o t + (5.3\pi_1 - 3.7\pi_0 - 283.1)\sin 15^o t] + 179.3 \qquad /6b/$$

Having imputed the initial values π_0 and π_1, the actual level of inflation can be computed. Here the constant term means that in the average of a comparatively long time span the ruling government(s) did not strive for a zero loss. On the contrary, they could not resist the short term temptation which may result in a social loss on a longer time horizon. This statement is in contradiction with the testing results of equations /5/ and /5a/. Nevertheless, if as in course of the former analysis, here we suppose again that $c_1 > 0$, then we get from the estimated parameters that $c_2 < 0$ and $c_3 > 0$, which is fully consistent with the previous results. The endogenous treatment of the domestic and foreign equilibria, however, slightly modifies the conclusion that can be drawn from the policies of governments. While in the case of exogenous equilibrium indicators estimation clearly reveals a committed-against-inflation behaviour, now the picture of much less committed governments emerges an the scene. The positive value of the loss function and the cyclical path of inflation show that it is possible that governments sometimes accelerate inflation. Basically, the behaviour is the same, since it remains true that governments in their preferences attributed a bigger value to the costs of inflation than to its gains. This statement is approved of by some results coming from the general solution of /6b/. Since the square root of the conjugated roots is less than one (equals to 0.728) it follows that the process is a stable one and tends to its equilibrium level of 179.27.

The trigonometric function, within square brackets, in the second factor of the particular solution of /6b/ indicates that there is a fluctuating and periodic time path of infla tion. The length of a period has been found to be 24 intervals (360/15) i.e. 6 years (since quarterly data were used). This longitude, however, does not approve of the convincing introductory assumption that the four-year interval between general elections could be taken as a basis of periodicity. It seems to be quite clear that the first two years after the general elections could be taken as an equilibrium oriented and an inflation accelerating period. While, on the other hand, those two years before the coming elections used to be of concessions in fiscal policy and, consequently, of decelerated inflation.

A disturbing factor in following up the whole inflationary process could be attributed to the period about the beginning of the transition when, as a consequence of different shocks, there was a very rapid growth of inflation. Omitting this period and re-estimating the equation for the period 1992 -1999 the following results can be obtained:

$$\pi_t = 19.96 + 1.28\pi_{t-1} - 0.47\pi_{t-2} \qquad /6c/$$
$$(7.8) \quad (7.2) \qquad (-2.8)$$
$$R^2 = 0.79 \qquad D\text{-}W. = 1.95 \qquad F = 49.23$$

In this case the complex roots are $\lambda = 0.64 \pm 0.24i$ indicating a period of 4.3 years.[8] This may verify our previous hypotheses regarding the existence of political business cycles. Nonetheless, these results can be evaluated carefully, because on the one hand the model is based upon an endogenous treatment of some variables, which is not supported fully by economic theory. On the other hand, the periodicity computed from the estimated parameters is extremely uncertain (the modification of parameters, even if they remain within the corresponding confidence interval, may radically change the dynamic properties of the process, e.g. it loses even its cyclical pattern). Furthermore, it should be added that the sample of empirical investigations is very small (it spans only two periods, and makes it very difficult to draw stable behavioural rules).

Quantification of inflationary expectations

For further empirical analyses what is left, is the task of testing equations /1/-/2/ and /1/-/2a/ which refer to the expected and planned inflation. Equations /2/ and /2a/ describe planned inflation and if we substitute them into /1/, the equations of the expected inflation can be obtained as

$$\pi_t^e = (\alpha_1 + \alpha_2)\pi_{t-1} - \alpha_2\beta_1\pi_{t-2} - \alpha_2\beta_2 D_{t-2} - \alpha_2\beta_3 K_{t-2}$$
$$\pi_t^e = a_1\pi_{t-1} + a_2\pi_{t-2} + a_3 D_{t-2} + a_4 K_{t-2} \qquad a_1 > 0\,,\ a_2, a_3, a_4 < 0 \qquad /7/$$

and for the simplified case

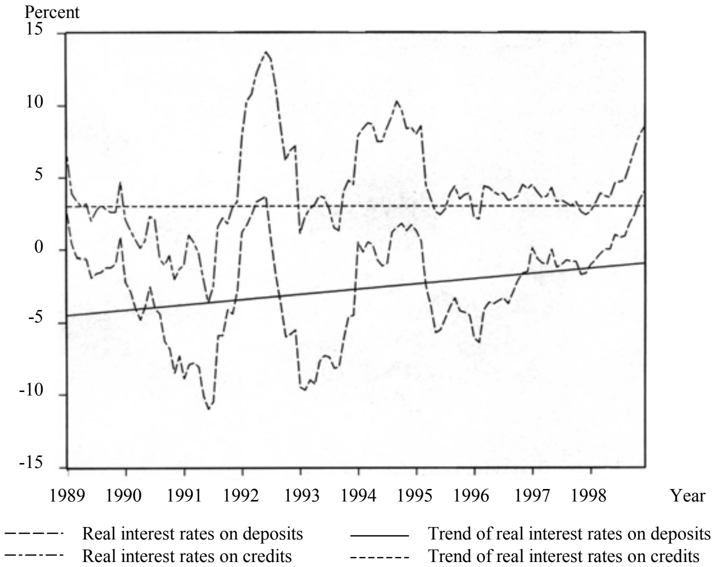
$$\pi_t^e = (\alpha_1 + \alpha_2)\pi_{t-1} - \alpha_2\beta\pi_{t-2}$$
$$\pi_t^e = a_1\pi_{t-1} + a_2\pi_{t-2} \qquad a_1 > 0\,,\ a_2 < 0 \qquad /7a/$$

[8] Since $\cos\alpha = 0.64/\sqrt{0.64+0.24} = 0.9363$, and this refers to 20º30' and 360/20.5 = 4.3 years.

So the relevancy of these two groups of equations should be tested. The basic difficulty of an econometric analysis regarding inflationary expectations lies in that fact that there are no data for expected inflation available. This was the first obstacle to be surmounted by means of estimating expected inflation.[9]

The changes in real interest rates were used as a tool of approximation of expected inflation. Calculating real interest rates based on annual inflation rates and nominal interest rates on deposits and loans of less than one year term, it could be seen that these values are of high volatility.

Figure 1. Short term real interest rates and long term real yields



According to the *Fisher identity* real interest rate in the average of a longer period used to be relatively stable and the nominal interest rate reflects inflationary expectations. This is shown by the following formula:

$$R_t = \hat{r}_t + \pi_t^e ,$$

where R_t is the nominal interest rate and $\hat{r}_t$ is the real interest rate which is relatively stable in time. Since real interest rates are obtained by reducing the nominal interest rate by the rate of inflation

$$r_t = R_t - \pi_t ,$$

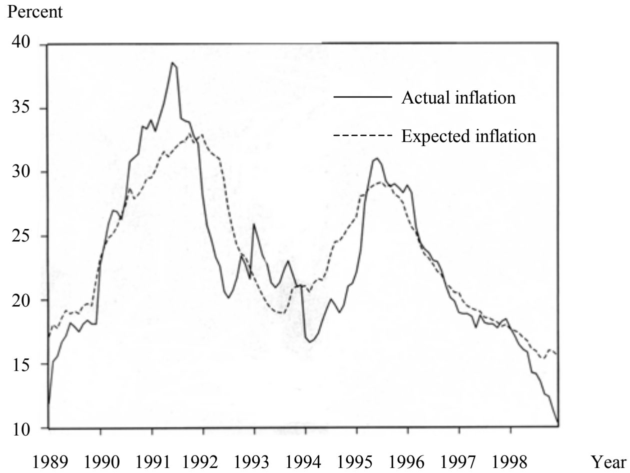
it is easy to obtain the following equation for inflationary expectations:

$$\pi_t^e = \pi_t + r_t - \hat{r}_t . \qquad /8/$$

[9] In literature the estimation technique of adaptive and rational expectation models is well-known, but this method evades the determination of inflationary expectations, which is, however, the inherent element of our investigation.

So, if we knew the long term real yield, it would be easy to determine the expected inflation by using equation /8/. We assume that the constant real rate of interest can be regarded as an average or a trend value. According to this assumption a trend has been fitted to real interest rates fluctuating in time. This trend reflects the tendencies of real yield, prevailing itself for a long term. So the expected inflation can be determined. Equation /8/ could be interpreted as follows: the existence and the extent of differences between real interest rates and long term real yield requirements could be attributed to the fact that the expectations of inflation were inappropriate and as well as to how they deviated from the actual inflation. Having implemented calculations for the returns of both deposits and loans, the expected inflation has been determined as a simple arithmetic mean of the two results.[10] The time series of expected and actual inflation are illustrated in Figure 2.

Figure 2. Actual and expected inflation



We begin testing by the simpler equation /7a/ in which the rule of adaptive expectation is expressed, regarding that current expectations on inflation are determined by a weighted sum of actual inflations of previous periods. First of all the order of integration of expected inflation should be found. Table 2 contains the results of the unit root test. It is clearly seen that the expected inflation like the actual one is a process integrated of first order. Consequently, in a direct way, by fitting a regression equation, testing cannot be validly done. There is, however no obstacle to analyse the cointegrating relation between the two variables. The *Johansen* cointegration test shows that based on the likelihood ratios at 5 percent level of significance, at most one cointegrating relation can be taken into account. The error correction model based on the cointegrating coefficients is as follows:

$$\Delta\pi_t^e = -0.026\left(\pi_{t-1}^e - 1.017\pi_{t-1}\right) + 0.704\Delta\pi_{t-1}^e + 0.050\Delta\pi_{t-1}$$

(-0.40) (-34.7) (5.33) (0.58)

R^2 =0.589 F-statistic = 25.1 Log-likelihood = -55.7

[10] The calculations have been made on the basis of monthly time series of interest rate thus inflation expectations of monthly frequencies (for 12 months) have been obtained. Quarterly indices have been calculated by simple arithmetic means.

The results show that the convergence to the equilibrium level given by the cointegrating relation is rather uncertain, simply because the corresponding parameter is insignificant. Neither parameter expressing the impact of the change of the lagged inflation is significant, which, however would be very important to verify the relevancy of /7a/. Studying these results it is still questionable, whether there exists any relation between the expected and actual inflation. Results of the *Granger* causality test are summarised in Table 4.

Table 4

Granger causality tests
(p – values)

H_0	Number of lags				
	1	2	3	4	5
π is not the cause of π^e	0.284	0.585	0.550	0.715	0.184
π^e is not the cause of π	0.461	0.106	0.091	0.021	0.015
$\Delta\pi$ is not the cause of $\Delta\pi^e$	0.596	0.804	0.740	0.274	0.260
$\Delta\pi^e$ is not the cause of $\Delta\pi$	0.500	0.654	0.535	0.015	0.048

The causality analysis unequivocally indicates that actual inflation could not be taken as a cause of expected inflation while a much higher probability could be attributed to the reverse causal relation. From an economic point of view it means that adaptive type of expectations cannot be taken as a typical one in the case of inflationary expectations. On the other hand, there is a definite influence of the expected inflation on the actual one. Thus the Phillips-curve augmented by expectations holds for the Hungarian economy too.

After rejecting the hypothesis of adaptive expectations it has been worth-while to make reverse proof to investigate that whether or not rational expectations were present in the inflationary process. According to the definition of rational expectations this can easily be done. Since in the case of these expectations a systematic forecasting error does not occure, the following equation should hold:

$$E(\pi_t^e - \pi_t) = 0 \quad \text{and} \quad \pi_t^e - \pi_t = \varepsilon_t \,, \qquad /9/$$

where ε_t is a normally distributed random variable of constant variance. This way it should be tested whether the difference between the two variables followed a normal distribution with zero mean or not. The results of the corresponding normality test indicated that the *Jarque - Bera* value was equal to 0.45 and the empirical level of significance was equal to 0.79. Thus the hypothesis of rational expectation can not be rejected.

Nevertheless, this does not mean that there is no empirical proof for equations /1/-/2/ and the reduced one /7/. Given that equation /2/ contains the change of equilibrium too, and the agents of the economy who behave rationally take into account these changes in forming their rational expectations, this is not a model of pure adaptive expectations. That is why it seems to be suitable to augment the previous error correction model by the exogenous variables of the balance of the state budget and net exports.

After trying different lag-structures the following estimates have been obtained:

$$\Delta\pi_t^e = 0.10\left(\pi_{t-1}^e - 1.046\pi_{t-1}\right) + 0.627\Delta\pi_{t-1}^e + 0.041\Delta\pi_{t-1} - 0.236\Delta D_{t-1} - 0.233K_{t-2}$$

(1.46) (-51.2) (5.53) (0.46) (-1.32) (-1.78) /10/

R^2 =0.713 F-statistic = 12.4 Log-likelihood = -27.5

The inclusion of the equilibrium variables, however, resulted in changes. On the one hand, the quality of estimate is amended, however the majority of deficiencies mentioned before remained. Convergence to the long term equilibrium could not be realised, moreover, neither direction of the movement is suitable, since the convergence parameter is positive and inflation remained insignificant. The signs of parameters of foreign and domestic equilibria are in accordance with theoretical considerations but the level of significance of these variables is not convincing. So estimate /10/ can be accepted as an empirical verification of models /1/-/2/ and equation /7/ only with some reservations.

3. Conclusions

On the basis of the model described in this paper and its empirical verification it can be stated without fail that the governments in the transition period were not unequivocally committed to fight against inflation. Their economic policies considered inflation control often as one of the instrumental variables of improving the equilibrium position and not as a target variable. The econometric analyses did not result in the explanation on the temporal changes in regard of the dominance of target or instrument character. (Due to the characteristics of the applied model these aspects could not be investigated.) Thus in this respect one could resort to the assumption of accelerating inflation in the periods of hard problems of domestic and foreign equilibria (i.e. the periods of intensive strive for equilibrium). Therefore in the period of equilibrium problems inflation served as an instrument, while, on the other hand, in more equilibrated periods inflation was a target and, as a consequence, had much lower rates.

The hypothesis of the cyclical character of the Hungarian inflationary process has not been convincingly confirmed by the autoregressive model based on quarterly data. The four year periodicity that matches that of general elections cannot be proven. The length of periodicity is uncertain, it depends highly on the selected length of the time series used for estimation. Based upon the estimates the existence of governments working according to the philosophy of the political business cycle is probable, but regarding the short time series and further missing information, this statement can not be proven at a convincing level of confidence.

It has been indicated by the analysis of inflationary expectations derived from real rates of interest that the assumptions of adaptive expectations were not valid for Hungary. In the transition period the inflationary expectations could be better attributed to some rational characteristics. This assumption is supported by that fact that the inflation rates of a previous period could not explain the rates of expected inflation, but the inclusion of the indicators of macro-economic equilibrium of the preceding period provide more or less acceptable estimates.

REFERENCES

ALESINA, A.(1989): Politics and business cycles in industrial democracies, Economic Policy, **4,** pp. 57–98.

BANERJEE, A. – HENDRY, D. (1997): The econometrics of economic policy, Blackwell Publishers, Oxford.

BRADA, J. C. – KUTAN, A. M. (1999): The end of moderate inflation in three transition economies? Arizona State University and Federal Reserve Bank of St. Louis.

CHAREMZA, W. W. – DEADMAN, D. F. (1997): New directions in econometric practice. Edward Elgar Publishing Co., Cheltenham.

CSERMELY Á. (1997): Az inflációs célkitűzés rendszere. *Közgazdasági Szemle*, 1997, **3,** pp. 233–253.

ENGLE, R. F. – GRANGER, C. W. J. (1987): Cointegration and error correction: Representation, estimation and testing. *Econometrica*, 2, pp. 251–276.

ÉKES I. (1998): Az infláció okai Magyarországon. *Statisztikai Szemle*, **75,** 4–5, pp. 358–374.

GANDOLFO, G. (1997): Economic dynamics. Springer Verlag, Berlin-Heidelberg.

HAMILTON, J. (1994): Time series analysis. Princeton University Press.

HENDRY, D. (1995): Dynamic econometrics. Oxford University Press.

HUNYADI L. (1994): Egységgyökök és tesztjeik. *Szigma*, **25,** pp. 135–164.

KOVÁCS E. (1989): Idősorok kointegrációja. *Statisztikai Szemle*, **66.** pp. 599–619.

KŐRÖSI G. – MÁTYÁS L. – SZÉKELY I. (1990): Gyakorlati ökonometria. Közgazdasági és Jogi Könyvkiadó, Budapest.

LIELI R. (1999): Az idősormodelleken alapuló inflációs előrejelzések I–II.: egyváltozós módszerek és többváltozós módszerek. *MNB füzetek*, **4,** és kézirat, Budapest.

MCCAFFERTY, S. (1992): Macroeconomic theory. Harper and Row, New York.

MELLÁR T. (1997): Makrogazdasági célok és gazdaságpolitikai ciklusok. *Szigma*, **28,** pp. 111–130.

SIMON A. (1996): Az infláció tényezői 1990-95-ben. *MNB füzetek* **1**, Budapest.

TURNOVSKY, S. (1995): Methods of macroeconomic dynamics. *The MIT Press*, Cambridge Massachusetts.

CORPORATE INVESTMENT FINANCE, 1992–1997*

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SUMMARY

The paper deals with the investigation of the structure of corporate investment financing. The data of Hungarian firms are compared in several relations. The international comparison focuses on the question to what extent the composition of investment finance in Hungary is similar to the characteristics of the developed market economies. Changes in the sources of finance during the 1992–97 transition period are also analysed. Sets of the Hungarian firms have been classified according to various criteria in order to detect to what extent the enterprise characteristics influence the availability of financial sources.

KEYWORDS: Financial structure; Internal – external sources; Investment.

The aim of this research is to investigate the financial structure of corporate investment. Investment financing is a way to combine various sources, either external (e.g. borrowing or raising new equity) or internal ones (e.g. retained earnings generated in production or by other operations). There are costs and utilities connected both to the users and to the providers of the funds. The firm considers interests paid on borrowing as cost, whereas utility is the profit generated by these funds. The borrower sizes up mainly the risk connected to the transfer of management rights over the funds opposed to the expected yields.

The research applies empirical methods. Data of Hungarian firms are compared in several relations. International comparison focuses on the question to what extent the composition of investment finance in Hungary is similar to the characteristics of the developed market economies. Changes in the sources of finance during the 1992–1997 transition period are also analysed. The population of the Hungarian firms have been classified according to various criteria in order to detect to what extent the characteristics of the enterprise influence the availability of financial sources.

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1. Research methodology

Empirical results indicating the composition of corporate financing are difficult to compare due to methodological differences. In most cases corporate balance sheet data are used, therefore national differences in business accounting rules among countries may heavily distort the results. In some instances significant variance may be found in accounting practices also within one single country. Because of these inherent methodological problems the efforts to compare detailed data of different enterprises at international or even at national level can be only partially successful. It implies as many sets of data as many results and conclusions. The strength of our analysis – in this respect – lies in the detailed data set of enterprises, which enables us to compose homogeneous series.

Even if the differences in business accounting practices are disregarded, additional methodological problems may arise. There are two basic ways of examining the structure of the financing of firms by statistical methods: in the economic literature these are usually referred to as gross versus net sources methodology.

The *gross sources methodology* investigates the structure of financing all long term investments, where either financial or physical investments are concerned. The *net sources methodology* analyses the structure of financing physical (real capital) investments only. As a matter of fact, in economic sense the way of financing real capital inputs (as a factor of production) is the relevant question. Therefore the choice between the gross and net sources methods depends on the assumption: 'What is the ultimate purpose of financial investments in non-financial enterprises'. If financial investments are considered as pure financial portfolio activities, where the enterprise invests assets on financial markets or as bank deposits expecting interest and/or capital gains in return, then the net sources method is the appropriate one. If the term financial investments (as recorded in the balance sheets) mainly includes direct capital investments from the headquarters to subsidiaries, then financial investments are understood as a way of creating productive real capacities like physical investments at headquarters do. In this situation it is realistic to assume that similar considerations (cost of capital, risks etc.) influence the decision on choosing among various financial funds. It can be argued, therefore, that the gross sources method is the relevant one.

The data come usually from financial business reports which record only the major classes for assets and liabilities, sources and uses. Outward direct investments are not recorded separately. Because of the lack of additional information, at enterprise level the ultimate purpose of financial investments is not to be identified. It means that statistical observations do not help to classify financial investments either as direct or as portfolio.

In order to support the choice between gross and net sources methods we had to rely on the assumption as follows:

– in developed market economies financial investment of non-financial enterprises cover mostly direct investments in subsidiaries,

– whereas in Hungary – in the transition period 1992–1997 – financial investments of non-financial firms – if any – covered mostly the purchase of government securities or deposits in banks.

It implies that

– gross sources methodology is applied for international comparison, when the financial structure of Hungarian firms is compared to that of some selected EU member states, and

– net sources methodology is applied for analysing at enterprise-group level the composition of financing in the Hungarian economy.

A simplified 'Sources and Use of Funds' table[4] illustrates the differences between gross and net sources methodology as follows:

Uses	Sources
	11. Non-financial sources, total
	12. of which: retained profit
	13. depreciation
	14. provisions
1. Long term financial investments	*15*. Changes in long term external liabilities
2. Short term financial investments	*16*. Changes in short term external liabilities
	17. Issued capital
3. Gross fixed capital formation	
4. Changes in stocks	
5. Uses, total	*18*. Sources, total

The gross sources method estimates the composition of long term – financial and physical – investments {(1) + (3) + (4)} as follows:

Share of non-financial sources: (*11*) / { (1) + (3) + (4)}
Share of financing by creditors: (*15*) +(16-2) / {(1) + (3) + (4)}
Share of equity finance: (*17*) / {(1) + (3) + (4)}

The net sources method estimates the composition of long term physical investments {(3) + (4)} as follows:

Share of non-financial sources: (*11*) / {(3) + (4)}
Share of financing by creditors:(*15*-1) +(16-2) / {(3) + (4)}
Share of equity finance: (*17*) / {(3) + (4)}

It is evident that in both cases the shares add up to one.

Within the two main streams of methods several sub-variations may exist depending on how individual items derive from the accounting reports of an enterprise are classified. For example whether loans received from companies with majority interest in the firms are classified as loans or as equity finance, or whether provisions for employees' pension funds are considered as the firm's own or external sources.

[4] In many cases the sources and use of funds table is compiled as the differences of closing and opening balance sheets. (This may distort the data if revaluation are not recorded separately.)

Comparing the formulae for net and gross methods, it is easy to demonstrate that in an enterprise which is financially expansive (the value of long term financial investments is > 0), the net method shows a larger share of non-financial internal sources and equity financing, whereas the share of financing through financial intermediaries seems to be less important.

As *Shaffer* (1999) shows in a remark to *Corbett* and *Jenkinson's* study (1997), the net sources method may be misleading in certain circumstances, because during a steady-state growth at aggregate level it concludes that total investment is financed exclusively via retained earnings. Debt financing is netted out. This statement is a further argument for our choice to apply gross method at aggregate level. At the level of different groups of enterprises the assumption of steady state growth is less realistic, therefore the use of the net sources method should not distort the results by underestimating the level of debt financing.

Our research compares the composition of the financing of enterprises in two aspects. The first one is an international comparison seeking to find to what extent the debt structure and corporate financial flows in Hungary converge to the developed EU member economies. The international data derive from 'ready-made' publications. The second approach focuses on various enterprise groups in Hungary and tries to identify the factors, which explain the differences both in the structure and the changes of the composition of financial sources.

The composition of financing as percentages are presented in tables. In most cases the differences between the structures are obvious. In order to illustrate the results in an aggregated form too, a quadratic distance measure has been defined. Each composition of financing as percentages has been taken as a point in the three dimensional space. The distance of two points is calculated as follows:

$$d = \sum_{i=1}^{3}(x_i - y_i)^2 ,$$

where x_i and y_i denote the shares to be compared. If the two distributions are the same, d takes its minimum value (d=0), while in case of maximum dissimilarity d=2, unless negative percentages occur.

2. Data sources

In order to produce comparable and robust results, a simplified structure of financing is analysed. We used business balance sheets, flow data were estimated as differences in the levels of stocks between subsequent years.

For EU member countries most data were taken from the annual OECD publication *Non-Financial Enterprises Financial Statements*, OECD 1994. The data are fairly heterogeneous as regards the coverage of the sample and the accounting principle followed by the individual countries. The OECD publication made no attempt to harmonise the basic materials available in the countries, instead of that it allows the countries to present different tables and encourages them to provide detailed notes and explanations which may orientate the users. For an international comparison we rearranged the original data and compiled a uniform set of tables for each country. For this aim we made use of the footnotes and methodological explanations attached to the tables.

In the case of Germany the data supplied to the OECD publication were heavily fragmented. Therefore the data supplied in a publication of the Deutsche Bundesbank have been used instead.

In the case of Hungary, a detailed data set is at our disposal. We have access to the database maintained by the Hungarian Central Statistical Office. This database includes the annual corporation tax declarations of all enterprises obliged to submit such a declaration. There are about 200 thousand units in the database. For the large enterprises the information derived from the tax declaration is supplemented by a special statistical questionnaire, which provides detailed information on various flows and stocks, e.g. on the changes in the stocks of fixed assets. The balance sheets of these large enterprises are also collected. The database covers the period 1992–1997.

The data for the large corporations are considered highly reliable due to the fact that

– tax data are usually of high quality,
– the data are checked by statisticians,
– missing data are substituted and reconciled.

The project makes use of the data of these nearly 4000 large enterprises. This subset provides a fairly good coverage of the universe of the Hungarian corporation sector, represented by the figures of the year 1994.

Table 1

The main indicators of the Hungarian corporation sector

Indivator	Non-financial corporations with limited liability, total	Large corporations	Share (percent)
Number of enterprises	76 672	3 394	4.4
Total assets (billion HUF)	8 647	5 993	69.3
of which: invested assets (billion HUF)	5 347	4 074	76.2
current assets (billion HUF)	3 189	1 872	58.7
Owners equity (billion HUF)	4 913	4 022	81.9
Sales turnover (billion HUF)	8 171	4 667	57.1
Trading profit/losses (billion HUF)	129	107	82.9
Gross fixed capital formation (billion HUF)	507	327	64.5

From the nearly 4000 large enterprises we have selected a subset of about 1500 units. These are the firms which were operating during all those years between 1992–1997 and so their life paths could be followed at individual level. We will refer to them as the subset of *permanently functioning firms*.

Within the subset of permanently functioning firms *fixed capital investors* (FCI) form an even more homogeneous group of enterprises. They are defined as follows: a firm is called FCI if the changes in the value of tangible and intangible assets between the closing and opening balance sheet is positive. The number of FCI firms is about 700-800, with some fluctuations during the period.

The research concentrates on large corporations. The reason for this delimitation is twofold. It is well known that in the period 1992–1997 small and medium size firms could obtain hardly any external sources for investment financing. Therefore economic behaviour concerning the choice among alternative sources is relevant only to large corporations. In addition, the quality of data available for small and medium size firms is also limited concerning their analytical value.

3. International comparison – gross sources method[5]

First we put Hungary in an international framework and analyse the relation of the srtucture of investment financing of Hungary and 10 developed countries. The basic results can be seen in Table 2.

Table 2

Investment financing structures
(annual average, percent)

Country	Gross income finance	of which:		Financing through inter-mediation	Financing by direct sources	*Total*
		depreciation	net profit			
France	56.4	47.1	4.0	25.0	18.6	*100.0*
United Kingdom	42.4	36.2	6.1	15.1	42.5	*100.0*
The Netherlands	71.9	48.8	23.1	11.9	16.2	*100.0*
Austria	105.0	79.6	–	-1.6	-3.4*	*100.0*
Finland	61.1	49.1	12.0	29.6	9.3	*100.0*
Spain	63.4	74.8	-11.4	15.8	20.8	*100.0*
Italy	67.8	44.1	4.9	17.0	15.2	*100.0*
Belgium	60.3	58.5	1.8	8.3	31.4	*100.0*
Sweden	71.7	47.6	24.1	17.2	11.1	*100.0*
Germany	79.2	77.2	1.9	16.0	4.8	*100.0*
Hungary	39.0	85.0	-46.0	30.1	30.9	*100.0*
Hungary 1996	45.0	39.1	5.9	32.8	22.2	*100.0*

* Other sources.

International comparison reinforces the usual hypothesis that firms in Hungary as a newly developing economy rely more on external sources than on internal accumulation of the firms. This finding is mainly relevant during the first years of the transition period. The 1996 data indicate a closing up on the financial structure of developed market economies.

The following matrix in Table 3 illustrates the distances between the pairs of countries. As a general rule, the financing structures are fairly similar, Austria is an exception.

[5] The time series of the individual countries do not refer to the same period. In the first step we constructed the longest possible time series of the different countries. Ordering these results according to the decline of the share of gross income finance in financing investments we got a very heterogeneous picture: Austria was the first with 96.9 and the United Kingdom was the last with 39.5 percent. In the case of long term debt Finland's share was more than 32 percent and Austria had less than 9 percent. The detailed comparison of the 'other sources' was not possible as issue of shares wasn't published as an individual item in each case.

Table 3

Matrix of pairwise distances

Country	France	United Kingdom	The Netherlands	Austria	Finland	Spain	Italy	Belgium	Sweden	Germany
France	0.000									
United Kingdom	0.087	0.000								
The Netherlands	0.042	0.157	0.000							
Austria	0.355	0.630	0.166	0.000						
Finland	0.013	0.166	0.048	0.306	0.000					
Spain	0.014	0.091	0.011	0.262	0.033	0.000				
Italy	0.021	0.139	0.004	0.208	0.024	0.005	0.000			
Belgium	0.046	0.049	0.038	0.331	0.094	0.018	0.039	0.000		
Sweden	0.035	0.185	0.005	0.167	0.027	0.016	0.003	0.062	0.000	
Germany	0.079	0.278	0.020	0.104	0.053	0.051	0.024	0.112	0.010	0.000

In order to assess the position of Hungary, we defined an average composition of financing for the market economies (Austria as an outlier was disregarded) and Hungary is compared to this average.

Distances between Hungary and the average of 9 countries: in the years of

1992: 0.267;
1993: 0.215;
1994: 0.031;
1995: 0.042;
1996: 0.036.

The time series for 1992–1996 indicates that during this period the financing structure of the Hungarian firms came closer to that of the average market economy.

4. Inter-sectoral comparison

In the case of inter-sectoral comparison first we present the net sources method and later the empirical findings of the analysis.

4.1. Net sources method

As already mentioned for inter-sectoral and inter-industrial comparison of Hungarian firms, the net sources method was considered appropriate. For the nearly 4000 large enterprises the specification of the database enabled us to compile fairly detailed ‘sources and use of funds’. The items in ‘sources and use of funds’ tables have been estimated as differences between the values in closing and opening balance sheets. The serial number in brackets identify the structure of the financial report to be submitted to the registration court as defined in the Hungarian act on accounting. The symbol Δ refers to the difference in closing and opening value. Depreciation has been taken from the income statement.

Uses	Sources
	11. Non-financial sources: net retained profit (Δ47)
	12. Non-financial sources: depreciation
	13. Non-financial sources: reserves and provisions (Δ44+Δ45+Δ46+Δ48)
1. Cash, short term deposits (Δ37+Δ29+Δ32)	*14*. Short term bank credits (Δ63+Δ64+Δ65+Δ66)
2. Long term deposits and loans granted (Δ17+Δ18)	*15*. Long term bank credits (Δ54+Δ55+Δ56+Δ59)
3. Direct investments (Δ15+Δ16)	*16*. Issued capital stock (Δ43-Δ30)
	17. Liabilities due to companies having majority interest in them (Δ58-Δ31)
	18. Bonds issued (Δ57)
4. Shares and securities for resale (Δ33)	
5. Receivable (Δ28-Δ61)	*19*. Payable (Δ62)
6. Accrued revenue (Δ40)	*20*. Accrued expenses (Δ67)
7. Tangible fixed assets (Δ08)	
8. Intangible fixed assets (Δ02)	
9. Stocks of inventory (Δ20)	
10. Depreciation	

The capital structure of physical investments is analysed in two aspects.

– The first view distinguishes between short and long term external sources. It analyses when the economy is getting stabilised, to what extent short term sources are being transformed to long ones in financing physical investments:

Gross income finance: 11+12+13
Long term external sources: 15+16+17+18-2-3
Short term external sources: 14+19+20-1-4-5-6

– The second view analyses the importance of credit institutions versus stock markets in financing investment:

Gross income finance: 11+12+13
Net financing through credit institutions, financial intermediaries: 14+15-1-2
Direct financing : 15+16+17-3-4
Other net sources:[6] 19+20-5-6

4.2. Results

In Table 4 we show the structure of investment financing for the total set of large enterprises.

It is obvious that during the mid nineties the structure of corporate investment financing changed profoundly. As newly privatised firms became profitable, the share of gross income finance increased. By this means the high costs and risks connected with external financing could be avoided. In 1996 nearly one half of all investments was al

[6] In the tables classified to direct sources.

ready financed from retained earnings. The rest was equally distributed between sources acquired via the financial intermediaries and via the direct capital market.

Table 4

The structure of investment financing
(percent)

Source	1992	1993	1994	1995	1996
	Intermediation or direct sources				
Gross income finance	24.2	41.6	52.5	50.4	48.6
Financing through intermediaton	24.6	1.9	30.7	32.7	27.5
Financing by direct sources	51.2	56.5	16.8	16.9	23.9
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Short or long term sources				
Gross income finance	24.2	41.6	52.5	50.4	48.6
Long term sources	67.4	62.3	28.9	37.4	44.5
Short term sources	8.4	-3.9	18.6	12.2	6.9
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

This tendency demonstrated in Table 5 is even more evident for the subset of FCIs (Fixed Capital Investors).

Table 5

Composition of net financial sources of fixed capital investors (FCIs)
(percent)

Source	1992	1993	1994	1995	1996	1997
	Intermediation or direct sources					
Gross income finance	29.5	45.7	46.4	38.4	63.0	77.3
Financing through intermediaton	27.6	15.0	37.6	36.4	45.5	32.2
Financing by direct sources	42.9	39.3	16.0	25.2	-8.5	-9.5
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Short or long term sources					
Gross income finance	29.5	45.7	46.4	38.4	63.0	77.3
Long term sources	58.0	59.0	30.7	46.1	19.9	30.0
Short term sources	12.5	-4.7	22.9	15.5	17.1	-7.3
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

The results demonstrate the changes in financing fixed real investments as a marked characeristic feature during the transition of the Hungarian economy. From year to year the share financed from retained earnings increased steadily, with the exception of 1995, when the temporarly introduced restrictive fiscal measures reduced the firms' profit level. As the economic expansion restarted in 1997, it was financed dominantly from retained income. Over three-quaters of all real investments was financed from internal sources. The rest is acquired as long term indirect sources. In some instances short term external sources are substituted by long term ones, which reduce the risk of investment financing.

Enterprise classes and financing choices

In order to detect the factors influencing the availability of and/or the choice among various sources of investment financing, FCI enterprises have been classified in several subgroups. It was assumed that

– size,
– ownership,
– technology,
– profitability,
– and sales direction

may influence the composition of financial sources.

Our results indicate that some conventional assumptions – on factors influencing credit availability at micro level – do not work. Neither the size of firms (measured either by sales turnover or by the value of total assets) nor the size of the investment, or the technology have a marked impact on the composition of the use of fresh financial sources.

On the other hand, ownership and profitability proved to have significant influence on financial sources.

The quadratic distance measures in Table 6 demonstrate the distances among public and private firms are in general greater than that of among national and foreign enterprises.

Table 6

Quadratic distances
(percent)

Source	1992	1993	1994	1995	1996	1997
	Public-Foreign controlled firms					
Intermediation or direct sources	0.169	0.371	0.033	0.178	0.176	2.224
Short or long term	0.153	0.830	0.013	0.189	0.032	2.368
	National private - Foreign controlled firms					
Intermediation or direct sources	0.336	0.179	0.125	0.101	0.079	0.515
Short or long term	0.167	0.558	0.040	0.094	0.020	0.037
	National private – Public firms					
Intermediation or direct sources	0.881	0.956	0.033	0.460	0.041	2.391
Short or long term	0.586	0.270	0.010	0.493	0.099	1.862

The following tables (Tables 7–9) help to evaluate the impact of the ownership of the enterprises to the structure of their financial sources. The distribution of the number of the firms by the different variables of study can be found in the Appendix.

Table 7

Composition of FCIs' net financial sources by ownership – public firms

Source	1992	1993	1994	1995	1996	1997
	Intermediation or direct sources (percent)					
Gross income finance	53.8	64.7	43.0	11.8	51.1	-32.1
Financing through intermediaton	33.0	-14.2	42.8	43.0	38.2	49.9
Financing by direct sources	13.2	49.5	14.2	45.2	10.7	82.2
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Short or long term sources (percent)					
Gross income finance	53.8	64.7	43.0	11.8	51.1	-32.1
Long term sources	36.8	67.8	29.1	69.2	34.1	106.9
Short term sources	9.4	-32.5	27.9	19.0	14.8	25.2
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Table 8

Composition of FCI's net financial sources by profitability – foreign controlled firms

Source	1992	1993	1994	1995	1996	1997
	Intermediation or direct sources (percent)					
Gross income finance	22.1	28.1	45.5	45.8	60.7	89.5
Financing through intermediaton	39.2	33.3	28.8	30.6	61.9	-5.6
Financing by direct sources	38.7	38.6	25.7	23.6	-22.6	16.1
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Short or long term sources (percent)					
Gross income finance	22.1	28.1	45.5	45.8	60.7	89.5
Long term sources	55.9	30.0	35.8	43.4	19.7	18.7
Short term sources	22.0	41.9	18.7	10.8	19.6	-8.2
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Table 9

Composition of FCI's net financial sources by ownership – national private firms

Source	1992	1993	1994	1995	1996	1997
	Intermediation or direct sources (percent)					
Gross income finance	-3.3	22.5	47.4	60.2	64.1	77.1
Financing through intermediaton	17.3	65.6	52.8	42.1	40.5	50.2
Financing by direct sources	86.0	11.9	-0.2	-2.3	-4.6	-27.3
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Short or long term sources (percent)					
Gross income finance	-3.3	22.5	47.4	60.2	64.1	77.1
Long term sources	87.4	85.4	20.8	18.4	8.4	33.1
Short term sources	15.9	-7.9	31.8	21.4	27.5	-10.2
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Ownership is the dominant factor concerning the composition of financing. Foreign owned firms (either new or purchased during privatisation) could generate huge retention. In addition to finance new investments a part of the income is used to repay past liabilities, and to switch external sources into internal ones. (Some empirical evidences indicate that the extremely high profitability of some foreign owned firms is due to the income transfers between subsidiaries. Profit tax ratios in Hungary are low which may stimulate record profit in the Hungarian subsidiary through accounting high export prices in intra firm deliveries (transfer prices). For expansive firms to finance new investments from income accounted through transfer pricing may be a rational option.

During the nineties the group of public enterprises have significantly reduced. In most cases only bad (unprofitable) firms remained unprivatised. To this group belong some public utilities, which generate losses because of low administrative prices (e.g. public transport). Their investments are financed from long term credits, guaranted usually by government. The following set of tables (Tables 10 and 11) reveals the effect of profitability to the structure of sources.

Table 10

Composition of FCI's net financial sources by profitability (firms with profit > 0)

Source	1992	1993	1994	1995	1996	1997
	Intermediation or direct sources (percent)					
Gross income finance	46.9	63.0	58.4	67.4	79.3	94.8
Financing through intermediaton	24.6	-0.1	26.6	24.7	39.9	32.6
Financing by direct sources	28.5	37.1	15.0	7.9	-19.2	-27.4
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Short or long term sources (percent)					
Gross income finance	46.9	63.0	58.4	67.4	79.3	94.8
Long term sources	46.4	66.6	27.6	28.0	9.2	15.3
Short term sources	6.7	-29.6	14.0	4.6	11.5	-10.1
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Table 11

Composition of FCI's net financial sources by ownership (firms with profit < 0)

Source	1992	1993	1994	1995	1996	1997
	Intermediation or direct sources (percent)					
Gross income finance	2.9	1.0	21.1	-86.7	-9.9	-33.3
Financing through intermediaton	32.2	50.2	59.9	80.3	66.4	23.1
Financing by direct sources	64.9	48.8	19.0	106.4	43.5	110.2
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Short or long term sources (percent)					
Gross income finance	2.9	1.0	21.1	-86.7	-9.9	-33.3
Long term sources	76.3	44.1	37.0	126.5	68.3	128.1
Short term sources	20.8	55.9	41.9	60.2	41.6	5.2
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Profitability is also a decisive factor as far as the composition of real investment financing is concerned. The relation is straightforward in the sense that profit generated in the past rendered the finance of new investments from cheap internal sources possible. Loss making firms, on the other hand, have no other choice but to acquire direct sources (either issuing shares traded on capital market or raising funds from the owners).

The existence of an informational asymmetry can also be detected. It means that lenders (banks or direct investors) cannot distinguish between good and poor risks, and sources are traded on similar conditions irrespective of the actual risks of repayment. The high price of external sources stimulates good companies to finance their investment of retained earnings. The best stratum of firms relies almost exclusively on retention (called: gross income finance), the second stratum on long term commercial credits. Only the least profitable stratum is forced to use short term and/or direct sources. Generally speaking, only companies with large internal sources can afford to invest. It implies, instead of expectations for the future return on investments, the availability of existing sources determine investment decisions.

Non-profitable enterprises are forced to use either short or long term external sources. Long term sources are more suitable to overcome long term structural problems. The results indicate that heavy loss-makers are financed by long term sources. It may be explained that this subgroup includes large state owned firms. Their reorganisations are financed mainly from credits with state guarantee. In the case of temporary loss makers, short term external sources have a dominant role.

Classification criteria which proved to be less important

As we have already seen, ownership and profitability are relevant variables in explaining the structure of the sources of investments. There exist in the same time some factors of less importance. Nevertheless, some results concerning these variables will be presented in this section. Table 12 shows results by technology or economic activity.

Table 12

Composition of FCIs net financial sources by branches

Branches	Gross income finance		Financing through intermediaton		Financing by direct sources	
	1992	1997	1992	1997	1992	1997
	Intermediation or direct sources (percent)					
Agriculture	-6.7	32.8	10.2	57.6	96.5	9.6
Mining	-29.0	108.0	19.8	-135.4	109.2	127.4
Manufacturing	37.8	104.3	21.7	6.4	40.5	-10.7
Electricity, water etc.	12.8	32.1	-2.8	84.4	90.0	-16.5
Construction	50.5	72.3	-5.8	49.2	55.3	-21.5
Trade	-23.3	13.3	14.0	25.8	109.3	60.9
Hotels, restaurants	57.3	491.1	-19.9	849.6	62.6	-1240.7
Transportation	50.6	43.5	21.0	59.2	28.4	-2.7

(Continued on the next page.)

(Continuation.)

Branches	Gross income finance		Financing through intermediaton		Financing by direct sources	
	1992	1997	1992	1997	1992	1997
	Short or long term sources (percent)					
Agriculture	-6.7	32.8	93.1	58.0	13.6	9.2
Mining	-29.0	108.0	107.6	127.0	21.4	-135.0
Manufacturing	37.8	104.3	55.9	22.1	6.3	-26.4
Electricity, water etc.	12.8	32.1	89.6	74.4	-2.4	-6.5
Construction	50.5	72.3	55.2	-13.6	-5.7	41.3
Trade	-23.3	13.3	102.9	122.3	20.4	-35.6
Hotels, restaurants	57.3	491.1	45.5	-773.9	-2.8	382.8
Transportation	50.6	43.5	39.3	7.4	10.1	49.1

Technology – as indicated by the industrial classification – is of less importance concerning the structure of financing. This finding may be surprising, because technology may influence the length of time until the capital is locked up. As risk grows with the time span, according to prior belief technology should have been significant.

Despite the significant – but occasional – differences within branches, the general tendencies are evident: financing by short term external sources were shifted to long term ones, the share of gross income finance is increasing.[7]

Next we try to group the enterprises by sales direction (exporters – domestic suppliers). This grouping can be seen in Tables 13 and 14.

Table 13

Composition of net financial sources by the share of exports – intermediation or direct sources (percent)

Source	1992	1993	1994	1995	1996	1997
	Firms over 50 percent exports					
Gross income finance	49.3	33.4	47.7	100.4	88.4	140.4
Financing through intermediaton	16.3	47.4	25.5	0.4	8.9	-11.6
Financing by direct sources	34.4	19.2	26.8	-0.8	2.7	-28.8
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Firms with 0-50 percent exports					
Gross income finance	47.5	51.4	42.9	23.3	61.2	66.8
Financing through intermediaton	12.1	-6.2	38.7	36.1	55.4	30.8
Financing by direct sources	40.4	54.8	18.4	40.6	-16.6	2.4
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Firms with no exports					
Gross income finance	3.7	40.7	51.5	48.0	55.0	63.3
Long term sources	48.1	36.2	38.7	54.2	42.1	55.6
Short term sources	48.2	23.1	9.8	-2.2	2.9	-18.9
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

[7] In certain industries the small number of firms could distort the results. Accumulated losses of the previous years are recorded as negative values in gross income finance.

Table 14

Composition of FCIs net financial sources by the share of exports – short or long term sources (percent)

Source	1992	1993	1994	1995	1996	1997
	Firms over 50 percent exports					
Gross income finance	49.3	33.4	47.7	100.4	88.4	140.4
Financing through intermediaton	34.0	36.6	29.5	11.8	20.2	15.8
Financing by direct sources	16.7	30.0	22.8	-12.2	-8.6	-56.2
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Firms with 0-50 percent exports					
Gross income finance	47.5	51.4	42.9	23.3	61.2	66.8
Financing through intermediaton	49.9	67.2	32.3	61.5	21.1	30.9
Financing by direct sources	2.6	-18.6	24.8	15.2	17.7	2.3
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
	Firms with no exports					
Gross income finance	3.7	40.7	51.5	48.0	55.0	63.3
Long term sources	74.2	52.7	28.6	22.5	17.5	34.8
Short term sources	22.1	6.6	19.9	29.5	27.5	1.9
Investment in non-financial assets	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

In the late eighties, it was a commonplace to say that firms' performances were mostly assessed according to the location of output markets. Firms delivering to convertible export markets were considered stable with positive perspectives, whereas the performance of firms selling on the domestic market were treated much more cautiously. In 1992 this was still true as far as the access to long term sources are regarded. In 1997 this distinction could not be detected. Comparing exporters and domestic suppliers, there is no significant difference in the composition of investment financing. Only those firms are exceptions, which deliver the overwhelming majority of their output abroad. But these firms are mostly subsidiaries of multinational enterprise groups, and their financing decisions are taken at the headquarters.

As a last question, we analysed whether the *size* of investments had a significant impact on the structure of financing. In order to answer this question in 1997 the firms have been classified in groups according to the size of investments. For each pair of groups we defined the quadratic distance measure. Correlation coefficient has been estimated between the size of investments and the average distance of the groups. The value of the correlation coefficient is -0.21 (in the case of intermediation or direct sources) and -0.01 (in the case of short and long term sources). Based on these result we can state that the size of the investments has no effect on the composion of financing.

5. Conclusions

Our empirical investigations detect some new features in corporate financing used for fixed capital investments. It decribes how major sources of financing changed during the transition. In central planning, private savings were suppressed and the income generated by firms were mainly centralised and reallocated through state banks. In the first half of the nineties capital inflows came mainly from foreign investors in the form of direct financing. Later on, as the newly establised large private firms, the majority of foreign controlled firms became profitable, the share of internal sources – referred to as gross income finance – increased. Since the second half of the ninties, the structure of real investment financing in Hungary has been very similar to that of the developed market economies.

As far as the composition of financial sources is concerned, a clear distinction may be drawn between enterprises that engage in fixed capital investments and those that do not. The former group is heavily dependent upon retentions. This is consistent with the idea that enterprises undertaking fixed capital investments intend to remain in business for some time.

The dominance of own resources implies that newly established enterprises without the support of solid capital owners are forced to rely on more expensive external sources. There is also evidence that bank borrowing is used mainly by companies that do not generate surplus internally. A clear order of sources is established: enterprises prefer to use firstly retentions, then bank credits and finally direct sources such as issue of equity.

The pattern of capital structure that an enterprise uses greatly depends on the type of ownership, by 1997 private foreign and national private enterprises were making much more use of retentions. Publicly owned firms rely more on debt financing, probably with government quarantee. There is no direct effect upon the preferred form of financing resulting from the size of enterprises.

APPENDIX

NUMBER OF FIRMS ACCORDING TO DIFFERENT BREAKDOWNS

1. Number of firms by ownership

Ownership	1992	1993	1994	1995	1996	1997
Public	168	95	74	52	49	40
Foreign	140	149	147	156	149	157
Private	565	353	435	519	540	565
Mixed	8	7	8	8	10	3
All	*881*	*604*	*664*	*735*	*748*	*765*

2. Number of firms by profitability

Profitability	1992	1993	1994	1995	1996	1997
Profit > 0	417	435	498	609	629	623
Profit = 0	75	54	50	20	32	33
Profit < 0	389	115	116	106	87	109
All	*881*	*604*	*664*	*735*	*748*	*765*

3. Number of firms by branches

Branches	1992	1997
Agriculture	300	204
Mining	7	3
Manufacturing	267	286
Electricity, water etc.	4	12
Construction	38	34
Trade	177	175
Hotels, restaurants	8	10
Transport	13	14
All	*814*	*738*

4. Number of firms by the share of exports

Share of exports	1992	1993	1994	1995	1996	1997
With over 50 percent exports	88	74	88	88	103	104
With 0-50 percent exports	243	196	194	206	214	200
With no exports	550	334	382	441	431	461
All	*881*	*604*	*664*	*735*	*748*	*765*

REFERENCES

ÁBEL, I. – ÖCSI, B. (1999): Finanszírozási szerkezet és tulajdonforma. *Közgazdasági Szemle*, Október pp. 888–904.

BALASSA, Á. (1966): A vállalkozói szektor hosszú távú finanszírozásának helyzete és fejlődési irányai. MNB Füzetek 7. Budapest.

BONIN, J. P. – SCHAFFER, M. (1995): Banks, firms, bad debts and bankruptcy in Hungary 1991–94. *Centre for Economic Performance.* Working Paper. **657.**

COBHAM, D. – SUBRAMANIAM, R. (1997): Corporate finance in developing countries: New evidence for India. Mimeo.

CORBETT, J. – JENKINSON, T. (1997): How is investment financed? A study of Germany, Japan, the United Kingdom and the United States. *The Manchester School,* Supplement, pp. 69–93.

CSERMELY, Á. (1996): A vállalkozások banki finanaszírozása Magyarországon, 1991–1994. MNB Füzetek **6.**

HELFERT, E. A. (1994): Techniques of financial analysis. *IRWIN.*

KERÉKGYÁRTÓ GY. – MUNDRUCZÓ GY. (1987): Statisztikai módszerek a gazdasági elemzésben. *Közgazdasági és Jogi Könyvkiadó.*

SCHAFFER, M. (1999): A note on the net financing sources and uses approach. Mimeo, March.

SZALAVETZ, A. (1998): On the reliability of hard indicators utilized to measure restructuring performance. Mimeo, ACE program P95-2019-R.

TÓTH, I. J. (1999): A legnagyobb feldolgozóipari cégek helyzete és kilátásai, 1998–1999. *Tárki*. Konjunktúra Kutatási Füzetek. **1**.

FINANCIAL accounts for Germany 1990 to 1996, *Deutsche Bundesbank*, Special Statistical Publication, **4.**

ECO-LINE: A MACROECONOMETRIC MODEL OF THE HUNGARIAN ECONOMY*

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SUMMARY

This paper provides an overview of ECO-LINE, a quarterly macroeconometric model of the Hungarian economy designed for short and medium term forecasting and policy analysis. The model is a simplified description of the Hungarian economy, mainly based on National Accounts concepts. ECO-LINE consists of four main blocks, such as the demand and supply blocks determining real categories and employment, the block of prices and money and the block of income distribution. The paper provides an outline of the basic structure of ECO-LINE followed by an introduction to the set of stochastic equations. It also reports ex post simulation properties of the model and illustrates its performance by means of some policy simulations.

KEYWORDS: Macroeconomic modelling; Econometrics.

ECO-LINE is a quarterly macroeconometric model of the Hungarian economy designed for short and medium term forecasting and policy analysis. It has been developed and maintained at ECOSTAT, the institute for economic analysis of the Hungarian Central Statistical Office. The model presents a simplified description of the Hungarian economy, mainly based on National Accounts concepts. ECOLINE is considered the first attempt to provide forecasting and policy analysis for the Hungarian economy within a macroeconometric modelling framework.

This paper provides an overview of ECO-LINE as it stands at its current stage of development. It is expected that ECO-LINE will evolve over time not only as a reflection of ongoing efforts to refine already available stochastic equations on the one hand and broaden the stochastic block by constructing and testing additional behavioural equations on the other, but also by means of further increasing the complexity of interactions among the different blocks of the model.

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The paper is organized as follows. The subsequent section outlines the basic structure of ECO-LINE followed by an introduction to the set of stochastic equations in the third section. Next, ex post simulation properties of the model are detailed while the fifth section provides an illustration of the performance of ECO-LINE via some policy simulations. Conclusions close the paper.

1. The basic structure of ECO-LINE

ECO-LINE consists of four main blocks, such as the demand and supply blocks determining real categories and employment, the block of prices and money and the block of income distribution. The 13 stochastic equations lie in the center of the model complemented with 241 identities.[3] This section describes the basic structure of the model whereas the next one introduces the group of stochastic equations in ECO-LINE. Figure 1. provides some details with respect to the connections among the different blocks of the model.

Additional to employment and wage determination, the supply block provides the potential, theoretical supply by means of a production function. GDP is determined from the demand side as a sum of private and public consumption, investments, exports and imports. The demand and supply blocks are connected via the capacity utilization factor defined as the ratio of aggregate demand to potential GDP as generated in the supply block. Real and nominal categories are related by prices determined by stochastic equations.

Labour demand is formulated as a function of the capacity utilization rate and real wages whereas labour supply is dominantly determined by demographic factors. Actual values of labour demand and labour supply imply the corresponding rate of unemployment.

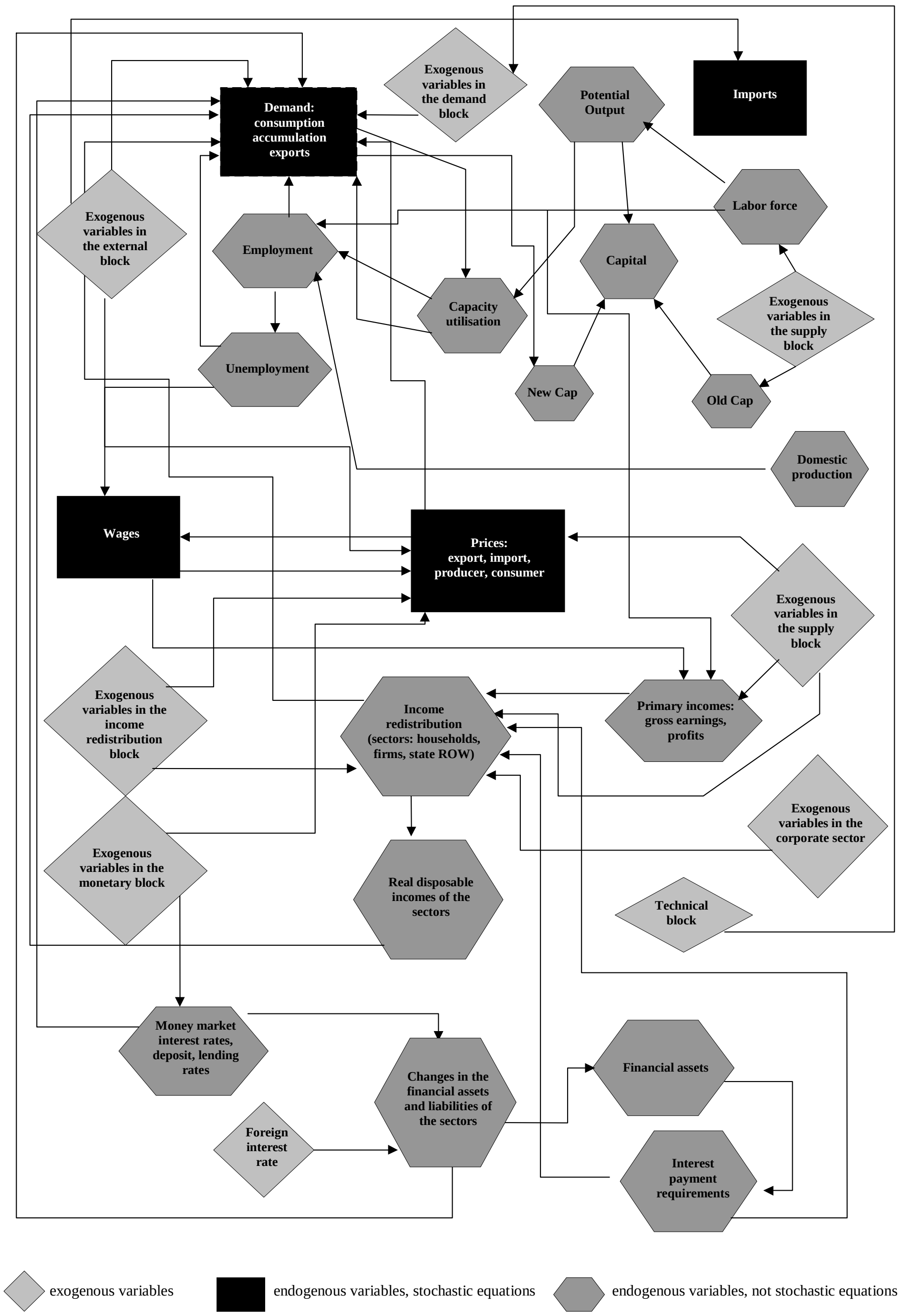
Domestic prices are represented by the consumer price index (CPI) and the producer price index (PPI) while the effect of world markets is transmitted via export and import prices. CPI strongly follows PPI and money supply whereas PPI is dominantly affected by import prices. Export and import prices are driven by world market tendencies.

With respect to the income block, disposable incomes of the corporate sector and households, the state budget, foreign disposable income and the balance of payments are all determined by means of their income balances and the balance of payments. There are three income balances in the model such as the income balances of the corporate sector, private households and the state budget. Profits and savings of the corporate sector are calculated by subtracting wages and taxes from the net GDP. This balance includes both the amount of wages as input items to the balance of private incomes and the taxation items of the state budget balance.

Disposable income is determined in the balance of private incomes by adding mixed, proprietor and transfer incomes to the wages paid in the corporate sector and subtracting taxation items. Savings are derived as the difference of disposable income and consumption.

[3] The highly detailed nature of the state budget in the model explains the relatively large number of identities.

Figure 1. The basic structure of ECO-LINE model



Balance of the state budget contains three parts as follows: the central budget and the two social security funds. The revenue side of all sub-balances includes taxes, contributions paid by the corporate sector and households whereas on the disbursement side certain benefits paid for them and transfer income payments. Aggregation of the balances of the three income proprietors complemented by the balance of payments provides the income distribution matrix of the national economy.

The main exogenous determinants of the model are the very items affecting foreign trade turnover (world market prices, the boom of external markets, devaluation) and lending interests in real terms affecting venture investments directly and taxation items (personal income taxes, corporate taxes, taxes related to customs and imports, VAT-rate, etc.).

2. The stochastic equations

This section presents the methods of estimation and testing as well as the estimated stochastic equations of the model.

2.1.Equation specification, diagnostic testing and estimation

Preferred stochastic equations in the model rest upon economic theory, the analysis of historical data and careful diagnostic testing. Theoretical considerations along with temporal patterns of the data formed the basis of the initial specification for each equation. Once an initial specification has been obtained, it might have undergone some further changes in order to meet the requirements of several diagnostic tests and gain a, both theoretically and econometrically acceptable, functional form.

Prior to running any regression each potential variable was tested against the hypothesis of random walk using the Augmented Dickey-Fuller unit root test (*Dickey* and *Fuller*, 1979) and the Phillips–Perron test (*Phillips* and *Perron*, 1988) in order to determine their order of integration. Besides *R*-squared and *t*-statistics, diagnostic tests for white noise errors and functional forms were also conducted for each stochastic equation. For equations where visual inspection of the dependent variable suggested structural change in the parameters, stability tests were run whereas if endogeneity of an independent variable was assumed, tests for the orthogonality of the regressor to the disturbance term were carried out. Precision in predicting historical data was considered as an additional important information to evaluate a particular specification.

In addition to the Durbin–Watson (DW) test against the first order serial correlation in the disturbances, autocorrelations and partial autocorrelations of the equation residuals and the Ljung–Box Q-statistics (*Ljung* and *Box*, 1979), the Breusch–Godfrey Lagrange multiplier (LM) test for autocorrelation (up to order five) was also applied (*Breusch*, 1978; *Godfrey*, 1978). Compared to the DW the advantage of the LM test is that it is applicable to higher order errors and it is valid in the presence of lagged dependent variables in the regression equation. To test heteroscedasticity in the residuals, the test proposed by White (*White*, 1980) was applied.

Regression specification error test (RESET) by *Ramsey* (1969) was run for each stochastic equation to test omitted variables, incorrect functional form and correlation between regressors and disturbances. Normal distribution of residuals was tested by the Jarque–Bera test (*Bera* and *Jarque*, 1981).

The comparison of forecasted and actual values of a dependent variable for the estimation period can provide important information about the predictive power of a stochastic equation. Predictive powers were evaluated based on Mean Absolute Percentage Error (MAPE) values of in-sample forecasts.

Where suspected, structural change in the parameters of an equation were checked by the Chow breakpoint test (*Chow*, 1960). In a few cases, where endogeneity of an independent variable was suggested by economic theory, the version of the Hausman test proposed by Davidson and MacKinnon (1989, 1993) was applied.

Appropriate estimation methods were selected depending on the results of the respective diagnostic tests. Four of the thirteen stochastic equations were estimated by Ordinary Least Squares (OLS) and eight by Nonlinear Lesat Squares (NLS). Given that labour is found to be endogenous in the production function this equation was estimated by Two Stage Least Squares (2SLS). With respect to the used econometric software package, Version 2.1 of EViews (Quantitative Micro Software, 1994–1997) was applied to carry out diagnostic testing and estimation of stochastic equations.

2.2 The demand equations

The so-called Houthakker–Taylor formula is applied to model household consumption behaviour. Real purchased consumption is related to real disposable income (*QDI*), the price level (*CPI*) and the rate of inflation. Additionally, real deposit rate (*IDEPR*) is included to account for the impact of savings on consumption. As shown in equation /1/, there is a significant and negative relationship ($p < 0.05$) between consumption and price level observed in the previous quarter whereas the negative effect of deposit rate turns out to be only marginally significant.

Real household consumption /1/:

$$\underset{}{\mathrm{LOG}(QCPUR)} = \underset{(0.837)}{1.490} + \underset{(1.133)}{0.278}\cdot\mathrm{LOG}(QCPUR(-1)) + \underset{(1.597)}{0.445}\cdot\mathrm{LOG}(QDI(-1)) -$$

$$-\underset{(-2.581)}{0.131}\cdot\mathrm{LOG}(CPI(-1)) - \underset{(-0.204)}{0.179}\cdot\mathrm{DLOG}(CPI(-1)) - \underset{(-2.032)}{0.013}\cdot IDEPR(-1) +$$

$$+\underset{(4.235)}{0.279}\cdot DUMMY2 + \underset{(5.188)}{0.271}\cdot DUMMY3 + \underset{(7.344)}{0.324}\cdot DUMMY4 + [AR(2) = \underset{(-1.779)}{-0.576}]$$

Estimation Method: Nonlinear Least Squares
Number of Observations: 20

R-squared = 0.963			MAPE = 1.892		
Breusch–Godfrey	F-statistic = 0.583	P = 0.716	White	F-statistic = 0.609	P = 0.787
Jarque–Bera = 1.826		P = 0.401	RESET	F-statistic = 2.410	P = 0.152

Note: Here and in the following equations *t*-statistics are in parentheses; for the description of the variables see Appendix.

Business investment is modelled as being positively related to real income measured by real GDP (*QGDP*), foreign direct investment (*DIHD*) and the rate of capacity utilization (*UT*). On the other hand, it is supposed to be negatively associated with real deposit rate (*ICREDR*). With the exception of the non-significant but negative effect of real deposit rate, all the remaining variables enter the equation with highly significant parameters and the expected sings.

At the current stage of model building (mainly due to an insufficient number of observations to yield econometrically satisfactory equations), direct exports and public investments are considered exogenous in ECO-LINE.

Real private investment /2/:

$$\underset{}{DLOG(QINVBU)} = \underset{(-2.891)}{-0.260} + \underset{(15.605)}{6.972}\cdot DLOG(QGDP(-4)) - \underset{(-0.921)}{1.001}\cdot DLOG(ICREDR) +$$

$$+ \underset{(2.815)}{0.139}\cdot DLOG(DIHD(-6)) + \underset{(2.276)}{7.615}\cdot D(UT(-2)) + \underset{(5.445)}{0.674}\cdot DUMMY2$$

Estimation Method: OLS
Number of Observations: 18

R-squared = 0.975			MAPE = 16.225		
Breusch–Godfrey	*F*-statistic = 0.866	*P* = 0.547	White	*F*-statistic = 2.073	*P* = 0.159
Jarque–Bera = 0.565		*P* = 0.754	RESET	*F*-statistic = 1.080	*P* = 0.376

2.3 The supply equations

As shown in equation /3/, real potential GDP (*QGDPPT*, calculated as *QGDP/UT*) is modelled within the Cobb-Douglas production function framework and determined by the stock of capital (*CAP*) and the level of employment (*L*).

Real potential GDP /3/:

$$D(LOG(QGDPPT)) = \underset{(-1.478)}{-0.080} - \underset{(-0.427)}{1.564}\cdot D(LOG(OLDCAP)) +$$

$$+\underset{(3.461)}{1.625}\cdot DLOG(NEWCAP) + \underset{(7.631)}{6.628}\cdot DLOG(L)$$

Estimation Method: 2SLS — Instruments: DLOG(*OLDCAP*), DLOG(*CELMKER*) DLOG(*W*), DLOG(*NEWCAP*)

Number of Observations: 24

R-SQUARED = 0.858			MAPE = 5.585		
Breusch–Godfrey	*F*-statistic = 2.478	*P* = 0.079	White	*F*-statistic = 1.770	*P* = 0.163
Jarque–Bera = 0.275		*P* = 0.872			

Given that aggregate data on the capital stock have not been collected since 1990 a specific calculation method should be introduced to make the aggregate production function estimable. Starting with 1990, quarterly values of *OLDCAP* are generated by subsequently subtracting depreciation and adding investments aiming at the modernization of old capital to the known value of capital stock in 1989. NEWCAP is generated for each quarter as the respective sum of the values of greenfield investments in the 1990s. *L* and *NEWCAP* enter the production function with the expected positive parameters with low levels of significance ($p < 0.01$) whereas the parameter of *OLDCAP* is negative but insignificant.

Real quarterly values of direct import depend on aggregate domestic demand (QBELF, defined as the sum of consumption and investments) on the one hand and the world price index on the other. It is indicated in equation /4/, that both parameters are significant and have the expected signs: positive for aggregate domestic demand and negative for the world price index.

Real direct import /4/:

$$\begin{aligned} DLOG(QMDIR) = &\underset{(1.729)}{0.026} + \underset{(3.694)}{0.649}\cdot DLOG(QBELF) - \underset{(-2.451)}{1.578}\cdot DLOG(WPI/PPID) + \\ &+[AR(1)=\underset{(-4.365)}{-0.672}] \end{aligned}$$

Estimation Method: Nonlinear Least Squares
Number of Observations: 28

R-squared = 0.572			MAPE = 16.164		
Breusch–Godfrey	*F*-statistic = 0.584	*P* = 0.712	White	*F*-statistic = 1.148	*P* = 0.359
Jarque–Bera = 0.213	*P* = 0.899		RESET	*F*-statistic = 1.029	*P* = 0.374

Equation /5/ to /7/ describe the labour market. According to equation /5/, labour demand increases in the rate of capacity utilization (*UT*) and decreases in real wages (*W/CPI*). As indicated by the positive and very significant value of the respective parameter in equation /6/, labour supply is determined by the total number of potential workers (*MFORR*). Nominal wages are modelled with an error correction equation. Beside the error correction term (*RESBERH*), lagged value of the dependent variable as well as the consumer price index (*CPEI*2) and the unemployment rate (*U*) are included in the equation. As shown in equation /7/, the highly significant effects of the adjustment to the long run equilibrium on the one hand and the lagged dependent variable on the other are strong enough to determine the actual nominal wage rate with a very good regression fit (*R*-squared = 0.99).

Labour demand /5/:

$$\begin{aligned} DLOG(L) = &\underset{(-7.253)}{-0.129} + \underset{(6.546)}{0.154}\cdot UT - \underset{(-2.224)}{0.037}\cdot D(LOG(W(-1)/CPI(-1))) + \underset{(8.783)}{0.032}\cdot DUMMY3 + \\ &+ [AR(3)=\underset{(-8.221)}{-0.852}] \end{aligned}$$

Estimation Method: Nonlinear Least Squares
Number of Observations: 24

R-squared = 0.866			MAPE = 0.665		
Breusch–Godfrey	*F*-statistic = 0.303	*P* = 0.903	White	*F*-statistic = 0.847	*P* = 0.534
Jarque–Bera = 0553		P = 0.759	RESET	*F*-statistic = 2.679	*P* = 0.098

Labour supply /6/:

$$\mathrm{LOG}(SL) = 8.226 + 0.005 \cdot \mathrm{LOG}(MFORR) + 0.003 \cdot TR964 + [\mathrm{AR}(4)=0.715]$$

(512.650) (3.031) (3.847) (21.593)

Estimation Method: Nonlinear Least Squares					
Number of Observations: 24					
R-squared = 0.976			MAPE = 0.396		
Breusch–Godfrey	F-statistic = 1.187	P = 0.361	White	F-statistic = 0.692	P = 0.607
Jarque–Bera = 0.386		P = 0.825	RESET	F-statistic = 1.392	P = 0.274

Nominal wages /7/:

$$\mathrm{DLOG}(W) = -0.344 \cdot RESBERH(-1) + 0.884 \cdot \mathrm{DLOG}(W(-4)) + 0.032 \cdot \mathrm{DLOG}(CPIE2) -$$

(-4.590) (24.590) (0.607)

$$- 0.097 \cdot \mathrm{DLOG}(U) + [\mathrm{AR}(1)=-0.526]$$

(-1.284) (-2.778)

Estimation Method: Nonlinear Least Squares					
Number of Observations: 24					
R-squared = 0.989			MAPE = 1.400		
Breusch–Godfrey	F-statistic = 0.861	P = 0.534	White	F-statistic = 0.545	P = 0.803
Jarque–Bera = 0.386		P = 0.824	RESET	F-statistic = 0.333	P = 0.722

2.4 The price equations

Equation /8/ and /9/ present the estimated stochastic equations of the Consumer Price Index (*CPI*) and the Producer Price Index (*PPI*), respectively.

CPI is determined by producer prices, the money supply (*MON*201) and by consumer price expectations (*CPIE*2), however the latter enters the equation with a less significant parameter.

Consumer price index /8/:

$$\mathrm{DLOG}(CPI) = 0.006 + 0.471 \cdot \mathrm{DLOG}(PPIFT(-1)) + 0.443 \cdot \mathrm{DLOG}(CPIE2) -$$

(0.442) (2.423) (1.832)

$$- 0.002 \cdot TR95Q3 + 0.027 \cdot \mathrm{DLOG}(QDI(-1)) +$$

(-2.466) (0.967)

$$+ 0.266 \cdot \mathrm{DLOG}(MON201(-2))$$

(2.121)

Estimation Method: OLS					
Number of Observations: 21					
R-squared = 0.723			MAPE = 1.103		
Breusch–Godfrey	F-statistic = 1.075	P = 0.429	White	F-statistic = 1.039	P = 0.477
Jarque–Bera = 0.440		P = 0.802	RESET	F-statistic = 0.005	P = 0.948

As shown in equation /9/, producer prices are highly dependent on import prices (*PIMPD*) as well as wage and salary income (*EARNING*).

Equation /10/ to /13/ provide details on the determination of export and import prices. The result suggest that export and import prices are being dominantly determined by exogenously given world prices. This appears to be a highly plausible observation for a small open economy.

Producer price index /9/:

$$\underset{}{\text{DLOG}(PPIFT)} = \underset{(2.777)}{0.019} + \underset{(1.928)}{0.235}\cdot\text{DLOG}(PIMPD(-1)) + \underset{(4.157)}{0.169}\cdot\text{DLOG}(PIMPD(-2)) + \underset{(3.220)}{0.029}\cdot DUM95Q1 + \underset{(5.189)}{0.066}\cdot\text{DLOG}(EARNING(-1)) + \underset{(3.550)}{0.231}\cdot\text{DLOG}(PPIFT(-2)) + \underset{(2.150)}{0.028}\cdot DUMMY4$$

Estimation Method: OLS
Number of Observations: 27

R-squared = 0.750			MAPE = 1.927		
Breusch–Godfrey	F-statistic = 0.419	P = 0.828	White	F-statistic = 0.556	P = 0.826
Jarque–Bera = 0.443		P = 0.801	RESET	F-statistic = 2.452	P = 0.114

Direct export price index /10/:

$$\text{DLOG}(PXDIRD) = \underset{(-10.473)}{-0.115} + \underset{(2.849)}{0.616}\cdot\text{DLOG}(WPI(-1)) + \underset{(15.657)}{0.401}\cdot DUMMY3 + \underset{(2.746)}{0.070}\cdot DUMMY4 + [\underset{(-5.422)}{AR(1)=-0.774}]$$

Estimation Method: Nonlinear Least Squares
Number of Observations: 27

R-squared = 0.907			MAPE = 4.347		
Breusch–Godfrey	F-statistic = 0.957	P = 0.417	White	F-statistic = 0.783	P = 0.549
Jarque–Bera = 1.405		P = 0.495	RESET	F-statistic = 0.327	P = 0.725

Export price index /11/:

$$\text{DLOG}(PEXPD) = \underset{(-1.573)}{-\,0.014} + \underset{(2.402)}{0.463}\cdot\text{DLOG}(WPI(-1)) + \underset{(1.595)}{0.518}\cdot\text{DLOG}(PPID) + \underset{(4.133)}{0.075}\cdot DUMMY3$$

Estimation Method: OLS
Number of Observations: 27

R-squared = 0.583			MAPE = 3.732		
Breusch–Godfrey	F-statistic = 0.859	P = 0.527	White	F-statistic = 0.780	P = 0.575
Jarque–Bera = 0.541		P = 0.763	RESET	F-statistic = 0.017	P = 0.899

Direct import price index /12/:

$$\mathrm{DLOG}(\mathit{PMDIRD}) = \underset{(-4.922)}{-0.055} - \underset{(-4.126)}{0.472}\cdot\mathrm{DLOG}(\mathit{PMDIRD}(-1)) + \underset{(4.617)}{1.087}\cdot\mathrm{DLOG}(\mathit{WPI}) +$$
$$+ \underset{(5.064)}{0.223}\cdot\mathit{DUMMY}2 + [\mathrm{MA}(1)=\underset{(-10.797)}{-0.935}]$$

Estimation Method: Nonlinear Least Squares
Number of Observations: 28

R-squared = 0.895			MAPE = 7.369		
Breusch–Godfrey	F-statistic = 2.479	P = 0.071	White	F-statistic = 0.832	P = 0.541
Jarque–Bera = 0.007		P = 0.997	RESET	F-statistic = 0.602	P = 0.621

Import price index /13/:

$$\mathrm{DLOG(PIMPD)} = \underset{(-3.681)}{-0.028} + \underset{(8.108)}{0.801}\cdot\mathrm{DLOG(WPI)} +$$
$$+ \underset{(4.478)}{0.132}\cdot\mathrm{DUMMY4} + [\mathrm{MA}(1)=\underset{(-733.198)}{-0.990}]$$

Estimation Method: Nonlinear Least Squares
Number of Observations: 26

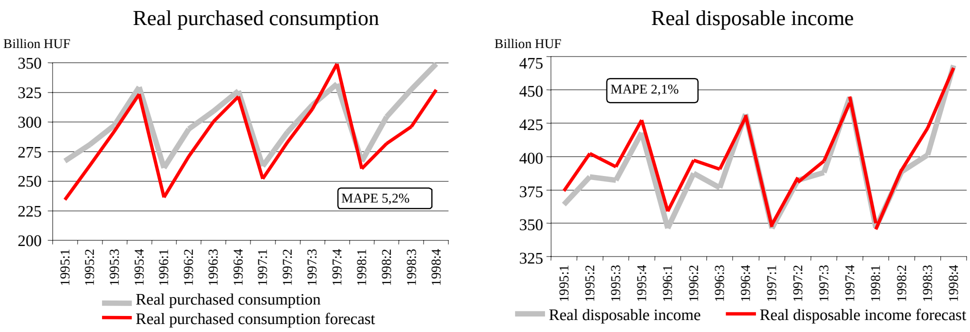
R-squared = 0.648			MAPE = 3.720		
Breusch–Godfrey	F-statistic = 1.989	P = 0.132	White	F-statistic = 0.325	P = 0.807
Jarque–Bera = 0.861		P = 0.650	RESET	F-statistic = 0.647	P = 0.595

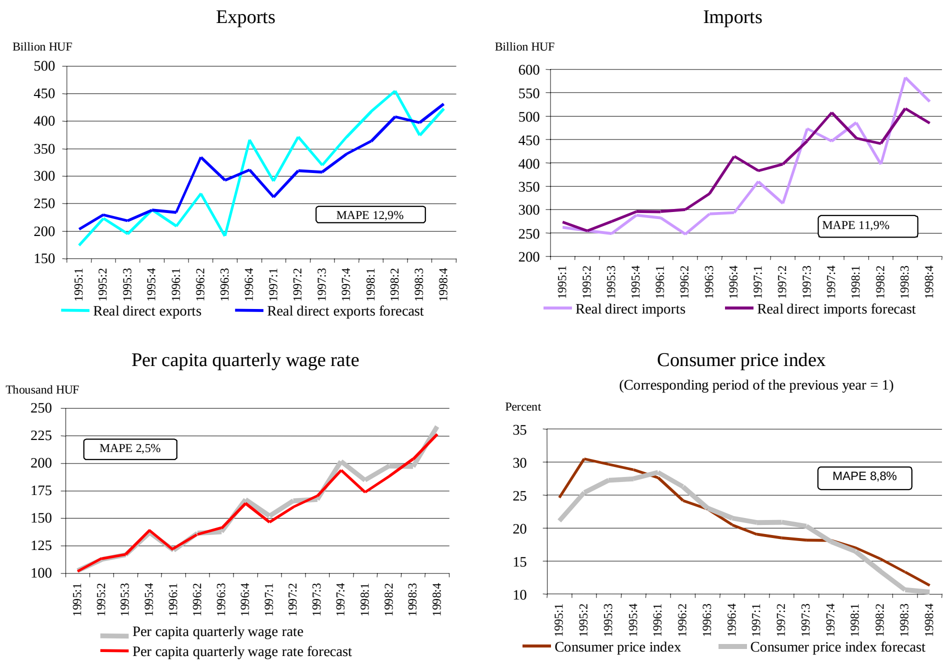
3. Ex post simulation properties of the model

The simulation properties of the model are illustrated in Figure 2. The model simulation was applied for the 1995:1–1998:4 period. The actual data were used for the exogenous assumptions.

The dynamic simulation results seem to be rather acceptable especially in view of the fact that the structure of the Hungarian economy was not completely stable in the examined period (especially the foreign trade sector).

Figure 2. Ex post simulation properties

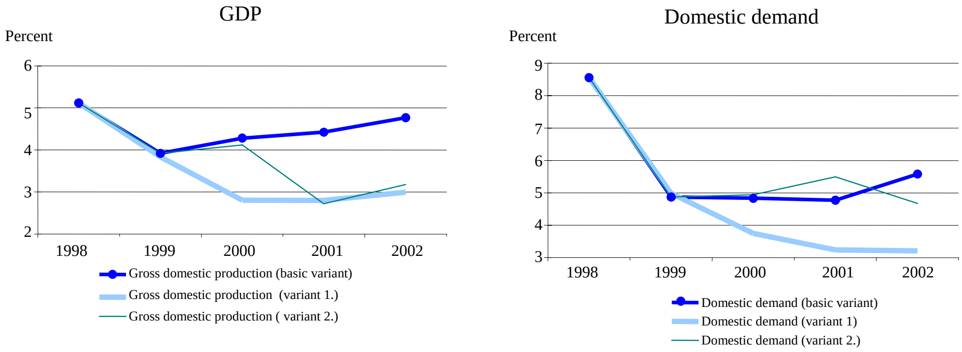




4. Ex ante policy simulation analyses using the model – an illustration

To illustrate the performance of ECO-LINE, the main results of three policy simulations are summarized subsequently. The following scenarios are considered: the base scenario which is characterized by a high accumulation rate; the external shock variant which models the effects of undesirable changes in the world economy and the scenario of an expansive fiscal policy. Forecasted values of some important variables are presented in Figures 3a and 3b.

Figure 3a. Ex ante simulations using ECO-LINE
(Annual growth rates)



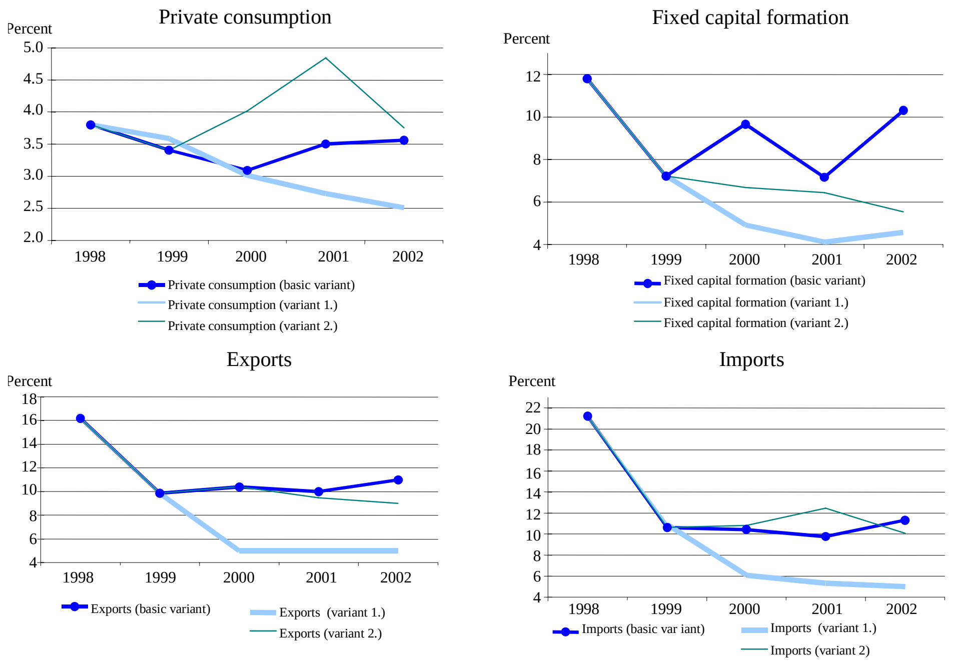
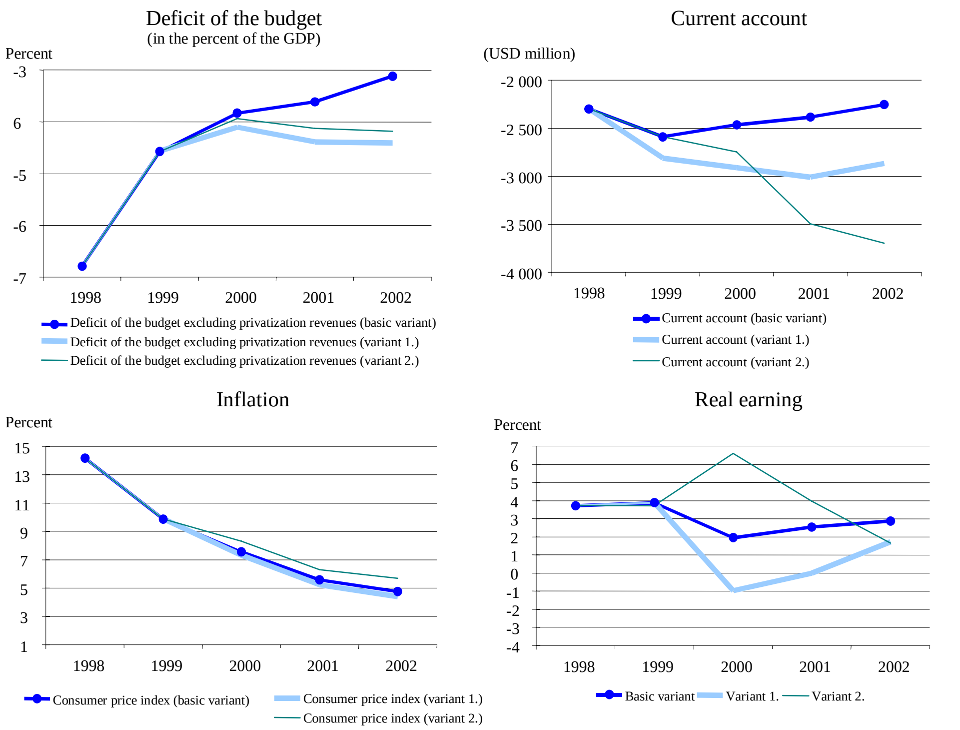
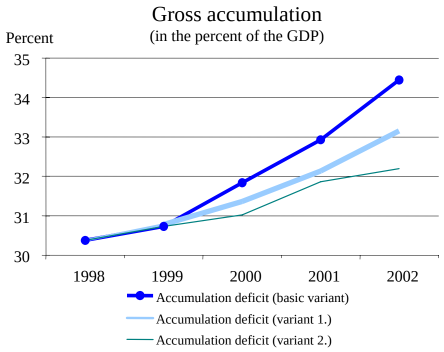
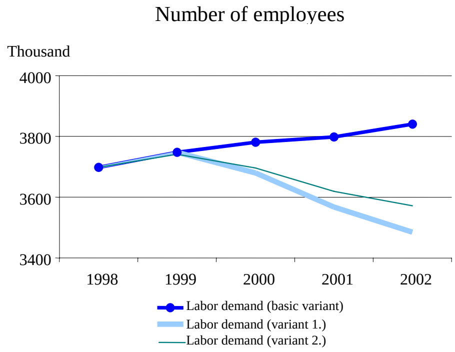


Figure 3b. Ex ante simulations using ECO-LINE







4.1. The base scenario

The baseline variant considers the conditions of a balanced path based on a high accumulation rate needed for a successful catching up process. Economy is assumed to grow under favourable external circumstances without any considerable danger to the macroeconomic equilibrium. A rather high accumulation rate accompanied by an acceptable deficit of the foreign trade balance assigns a relatively slow disinflationary path. Table 1 details the major results of this scenario.

Table 1

Main macroeconomic indicators of the base scenario
(Constant price growth indices)

Item	1998	1999	2000	2001	2002
Gross domestic production (GDP)	5,1	3,9	4,3	4,4	4,8
Final consumption	3,8	3,2	3,0	3,4	3,5
Private consumption	3,8	3,4	3,1	3,5	3,6
Public consumption	3,8	2,4	2,2	3,0	3,0
Accumulation of fixed assets	11,8	7,2	9,7	7,2	10,3
Accumulation, gross	23,2	9,1	9,4	7,9	10,2
Domestic demand	8,6	4,9	4,8	4,8	5,6
Exports	16,2	9,9	10,4	10,0	11,0
Imports	21,2	10,6	10,4	9,8	11,3
Inflation	14,2	9,9	7,6	5,6	4,8
Producer price index	11,5	5,5	5,0	4,3	4,1
Exchange rate (HUF/USD)	214,4	235,9	249,4	256,8	263,0
Current account balance of payment (USD, million)	-2297,0	-2589,2	-2461,9	-2384,1	-2254,5
Current account balance (in percentage of GDP)	-4,8	-5,1	-4,6	-4,2	-3,7
Central government balance (HUF billion)	-553,9	-436,9	-410,4	-429,3	-410,5
Central government balance (in percentage of GDP)	-5,4	-3,7	-3,1	-2,9	-2,6
General government balance (HUF billion)	-694,0	-546,9	-510,4	-529,3	-500,5
General government balance (in percentage of GDP)	-6,8	-4,6	-3,8	-3,6	-3,1

The average growth rate amounts to 4–5 percent whereas accumulation increases by 9–10 percent annually. Assuming the utilization of considerable EU transfers, the latter figure may even exceed 10 percent in 2002. Consumption is expected to increase by 3 percent on average. Considering the cyclic effect of elections, the corresponding figure for 2001–2002 may exceed this value.

Exports are projected to increase dynamically by 10 percent annually. Because of the high accumulation, imports are projected to grow similarly. Consequently, the deficit of the trade balance may amount to USD 4 billion in 2002. Based on our calculations this figure is not expected to involve further significant deterioration of the balance of payments since other current items (e.g. the performance of tourism) and transfers projected by the accession to the EU may compensate for the deterioration of the trade balance. However, this trend has to be broken in the long run. Financing of the current account is of a favourable pattern. The annual inflow of active foreign capital is expected to amount to USD 1.5–2 billion. Regarding portfolio investments, the increment is projected to a total of USD 1 billion annually.

The deficit of the state budget would decline continuously. The GDP-rated deficit is projected to amount to 3.1 percent by 2002. The number of employees increases slightly since the recovery of high productivity areas of the competitive sector is expected to be accompanied by an employment drop in the public sector. The increase in the retirement age limit does not modify the unemployment rate considerably. Inflation is expected to approach 4–5 percent by 2002 whereas real incomes are projected to grow about 2.7–3.7 percent annually.

4.2. The external shock variant

The possibility of unfavourable foreign market relations remaining far below the world economic environment assumed in the basic scenario cannot be ruled out completely. Our second variant considers these undesirable conditions. This would apparently affect growth and equilibrium relations and require different economic policy reactions. Table 2 provides a summary of the major macroeconomic results of the simulation.

A considerable slowdown of the world economy would involve a significant decline in the growth of exports to 5 percent. Imports would increase more rapidly than exports would, though the dynamics of growth would decline as well. Foreign trade deficit would increase extremely resulting in the slowdown of economic growth (induced by the contraction in export demand).

Deceleration of economic growth would involve the increase of state budget deficit by means of decreasing revenues. Considerable growth in the foreign trade deficit would result in an increase in the government deficit. Should this trend remain stable, economic policy would have to intervene and revise exchange rate policy in the form of a single action, like by increasing the scrawling peg devaluation rate or by the postponement of devaluation. Under unfavourable conditions, the recent disinflation path may be broken. A higher inflationary path, a greater deficit of the state budget and the account would increase the interest level both in nominal and in real terms. This would incline the costs of debt financing and decelerate the long-term growth potential by means of restricting the accumulation rate.

Table 2

Main macroeconomic indicators of the external shock variant
(Constant price growth indices)

Item	1998	1999	2000	2001	2002
Gross domestic production (GDP)	5,1	3,8	2,8	2,8	3,0
Final consumption	3,8	3,4	2,9	2,8	2,6
Private consumption	3,8	3,6	3,0	2,7	2,5
Public consumption	3,8	2,4	2,2	3,0	3,0
Gross fixed capital formation	11,8	7,2	4,9	4,1	4,6
Gross capital formation	23,2	9,1	5,9	4,4	4,7
Domestic demand	8,6	5,0	3,7	3,2	3,2
Exports	16,2	9,9	5,0	5,0	5,0
Imports	21,2	10,9	6,1	5,3	5,0
Inflation	14,2	9,9	7,3	5,2	4,4
Producer price index	11,5	5,5	4,5	3,8	3,6
Exchange rate (HUF/USD)	214,4	235,9	249,4	256,8	263,0
Current account balance of payment (USD, million)	-2297,0	-2810,5	-2910,3	-3007,1	-2865,9
Current account balance (in percentage of GDP)	-4,8	-5,6	-5,6	-5,5	-5,0
Central government balance (HUF, billion)	-553,9	-435,8	-436,5	-515,6	-569,9
Central government balance (in percentage of GDP)	-5,4	-3,6	-3,3	-3,7	-3,8
General government balance (HUF, billion)	-694,0	-545,8	-536,5	-615,6	-659,9
General government balance (in percentage of GDP)	-6,8	-4,6	-4,1	-4,4	-4,4

4.3. The fiscal expansion variant

The main precondition of the base scenario is the realization of certain fiscal and income policy targets as referred to. However it is worth demonstrating the macroeconomic consequences of a fiscal policy being more expansive than considered necessary.

According to the calculations of the model, a considerable growth of expenditures accompanied by the current rate of public investments would result in a rapid increase of private consumption. Either a growth in paid transfers or an increase in the payments to public institutions (generated dominantly by the growth of wages in the public sector) would increase household disposable income. A significant part of this increment would be spent on consumption goods considering the great extent of consumption postponed in the past years. This would not necessarily generate problems itself since the recovery of internal demand could improve the positions of indigenous companies as well. However, increasing state budget deficit caused by a significant growth in government expenditures would impose major burden on the state budgets of subsequent years. Private savings would increase at a rate slower than the deterioration of state deficit (decreasing investments in the competitive sector and/or growing the demand for external financing). In other words, the increment of demand would result in lower investment and higher consumption growth rates.

Another important effect would be a higher level of inflation induced by the fact that the supply side could meet the increasing demand only partially. However, economic effects described above might be restrained slightly by two additional effects: a higher level of inflation causes smaller growth in real earnings on the one hand and a less rapidly increasing government budget deficit on the other.

Table 3

Main macroeconomic indicators of the fiscal expansion variant
(Constant price growth indices)

Item	1998	1999	2000	2001	2002
Gross domestic production (GDP)	5,1	3,9	4,1	2,7	3,2
Final consumption	3,8	3,2	4,0	4,7	3,8
Private consumption	3,8	3,4	4,0	4,8	3,8
Public consumption	3,8	2,4	4,0	4,0	4,0
Accumulation of fixed assets	11,8	7,2	6,7	6,4	5,5
Accumulation, gross	23,2	9,1	7,2	7,3	6,7
Domestic demand	8,6	4,9	4,9	5,5	4,7
Exports	16,2	9,9	10,4	9,5	9,0
Imports	21,2	10,6	10,8	12,5	10,1
Inflation	14,2	9,9	8,3	6,3	5,7
Producer price index	11,5	5,5	7,0	5,8	6,2
Exchange rate (HUF/USD)	214,4	235,9	249,4	256,8	263,0
Current account balance of payment (USD, million)	-2297,0	-2589,2	-2746,7	-3492,2	-3695,0
Current account balance (in percentage of GDP)	-4,8	-5,1	-5,1	-6,1	-6,0
Central government balance (HUF, billion)	-553,9	-438,1	-427,2	-507,6	-586,9
Central government balance (in percentage of GDP)	-5,4	-3,7	-3,2	-3,4	-3,6
General government balance (HUF, billion)	-694,0	-548,1	-527,2	-607,6	-676,9
General government balance (in percentage of GDP)	-6,8	-4,6	-3,9	-4,1	-4,2

5. Conclusions and plans for further developments

In this paper we have provided an outline of ECO-LINE, a macroeconometric model of the Hungarian economy.

Besides an overview of the general structure of the model and the connections among its different blocks, an introduction to the set of stochastic equations (positioned at the heart of ECO-LINE) was provided. In addition to ex post simulations demonstrating the model’s satisfactory performance in forecasting historical data, ex ante simulations for three different scenarios of the Hungarian economy illustrated the way ECO-LINE can be utilized for policy purposes.

ECO-LINE is planned to evolve over time both by refining some of the already specified stochastic equations and by developing some additional equations for the stochastic block.

Besides necessary improvements in the stochastic section, some of the important interrelations among different blocks of ECO-LINE should be further developed. With respect to necessary refinements in the stochastic section, improvements in the equations of private investment and direct exports are planned on the one hand and developing a money demand function on the other. Regarding interrelations between certain blocks, a more detailed structure of interactions between the monetary block and the real block should be developed in the near future.

APPENDIX

List of variables in the stochastic equations

ECO-LINE Notation	Description
CPI	Consumer price index
CPIE2	Expected *CPI*
DIHD	Net direct foreign investments
*DUMMY_*	Quarterly dummy variable
EARNING	Wages and salaries
ICREDR	Real credit rate
IDEPR	Real deposit rate
L	Total employment
MFORR	Number of potential workers
MON201	Money supply - currency
NEWCAP	New capacities
OLDCAP	Old capacities
PEXPD	Export price index (USD)
PIMPD	Import price index (USD)
PPIFT	Producer price index (HUF)
PMDIRD	Direct import price index (USD)
PXDIRD	Direct export price index (USD)
QBELF	Aggregate domestic demand
QCPUR	Real household consumption
QDI	Disposable real income (in 1991 prices)
QGDP	Real GDP (in 1991 prices)
QGDPPT	Real potential GDP (in 1991 prices)
QINVBU	Real private investment (in 1991 prices)
QMDIR	Real direct import s
QCPUR	Real purchased consumption (in 1991 prices)
SL	Labour supply
TRXXQY	Trend variable starting with year XX quarter Y
UT	Capacity utilization rate
W	Per capita quarterly wage rate
WPI	World price index

REFERENCES

BERA, A. K. – JARQUE, C. M. (1981): Efficient tests for normality, homoscedasticity and serial independence of regression residuals: Monte Carlo evidence. *Economics Letters*, 7, pp. 313–318.

BREUSCH, T. S. (1978): Testing for autocorrelation in dynamic linear models. *Australian Economic Papers*, **17,** pp. 335–355.

CHOW, G. C. (1960): Tests for equality between sets of coefficients in two linear regressions. *Econometrica*, **28,** pp. 591–605.

DAVIDSON, R. AND J. G. MACKINNON (1989) Testing consistency using artificial regressions. *Econometric Theory*, **5,** pp. 363–384.

DAVIDSON, R. – MACKINNON, J. G. (1993): Estimation and inference in econometrics. *Oxford University Press*.

DICKEY, D. A. – FULLER, W. A (1979): Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, **74,** pp. 427–431.

GODFREY, L. G. (1978): Testing for multiplicative heteroscedasticity. *Journal of Econometrics*, **8,** pp. 227–236.

LJUNG, G. – BOX, G. (1979): On a measure of lack of fit in time series models. *Biometrika*, **66,** pp. 265–270.

PHILLIPS, P. C. B. – PERRON, P. (1988): Testing for a unit root in time series regression. *Biometrika*, **75,** pp. 335–346.

Quantitative Micro Software (1994–1997). *EViews User's Guide.*

RAMSEY, J. B. (1969): Tests for specification errors in classical linear least squares regression analysis. *Journal of the Royal Statistical Society, Series B*, **31,** pp. 350–371.

WHITE, H. (1980): A heterosedasticity-consistent covariance matrix and a direct test for heteroscedasticity. *Econometrica*, **48,** pp. 817–838.

COMPOSITE LEADING INDICATORS FOR THE HUNGARIAN ECONOMY

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SUMMARY

In most developed countries, the method of leading indicators is widely used for very short-term forecasting purposes.

The first part of this paper provides a summary about the theoretical foundations and the methodology of the computation of the leading indicators. The second part presents an application: a composite leading indicator for the Hungarian industrial production is derived. At the end of the paper we can see present forecast based on the constructed leading indicator, and a short evaluation about the behaviour of this composite leading indicator is also provided.

KEYWORDS: Business cycles; Leading indicators; Forecasting.

The method of using leading indicators in forecasting is well known and widely used all over the world. Since the first leading indicators were computed in the United States, almost all developed countries and also numerous international organisations calculate composite indicators for their short-term forecasts.

1. Concept and history

In the following introductory chapter the basic concept and a short history of leading indicators will be outlined. However, the history of leading indicators goes back to the 30s in the United States, in this paper we deal only with the history of constructing leading indicators in Hungary. Further historical details are given by *Reiff*, *Sugár* and *Surányi* (1999).

1.1 Business cycles definition and leading indicators

One of the first attempts to give an exact definition of business cycles was made by *Wesley C. Mitchell* in 1947 (quoted in *Lahiri* and *Moore* 1991 and in an OECD study).[4]

[1] Economic researcher, Ministry of Economic Affairs, Department of Economic Analysis.
[2] Head of department, Ministry of Economic Affairs, Department of Economic Analysis.
[3] Economic researcher, Ministry of Economic Affairs, Department of Economic Analysis.
[4] OECD leading indicators and business cycles in member countries 1960–1985. Sources and methods. **39**, 1987.

'Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organise their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.'

In brief, a business cycle consists of exactly one (general) expansion and exactly one (general) contraction, and contains no minor cycle that is near of the same length as itself. It has to be noted that the term cycle may be misleading: in everyday terms it represents something regular. According to Mitchell's definition, however, it is not regular: neither in length, nor in amplitude.

Mitchell's business cycle definition should not be connected to the other well-known business cycle theories either. Probably the most prominent alternative business cycle theory is that of Kondratief's, which suggests that western economies exhibit forty- to sixty-year cycles; these business cycle theories, however, define the length of the successive cycles, which is not the case in Mitchell's definition.

Traditionally, business cycles were analysed using 'pure' time series, in the sense that absolute expansions and absolute contractions were determined. But this method could hardly be used after the 2nd World War, when most economies and therefore most time series were quickly and consistently growing, and no contraction phases (in absolute terms) could be detected. It seemed to be quite obvious that most series exhibited a long-term time trend, and that the fluctuations in these time series could be measured as fluctuations around the trend. Most statisticians accepted this view, and the traditional business cycle analysis was converted into a trend-cycle analysis. In this context the expansion means that the time series is growing relative to its long-term trend; that is closely related to an increased growth rate. Similarly, a contraction does not have to be understood in absolute terms; it is only a relative slowdown compared to the long-term time trend.

Most time series can therefore be characterised by their cycles; this gives the possibility to compare the cycles of different series.

There may exist certain series whose cycles are more or less consistently leading the cycles of the business activity; these series (known as leading indicators) can be used to forecast the business activity. The series by which the cycles of the business activity are identified are called reference series. (Possible candidates for the reference series are GDP, total industrial production, production of an influential industry etc.; for more details, see Section 3.)[5]

The cyclical properties of the reference series can therefore be compared to the cyclical properties of many other time series. It is possible that we find some series whose cycles turn consistently a fixed number of months before the turns in the reference series. Based on this, we can state that a specific series has, say approximately a 6-month lead relative to our reference series.

Furthermore, if we find more than one series whose turns are leading the turns of the reference series, we can improve our turning point forecasts. If we identify ten series that

[5] Not only leading, but coinciding and lagging indicators can also be defined this way.

can be used as leading indicators, each of which has a turn with a fairly high probability before the turns of the reference series, we can reasonably expect that most of the indicator series will have a turn before the turn in the reference series; therefore their (weighted) average will almost certainly forecast the turns in our reference series. This is called *composite leading indicator*, and can eliminate some of the statistical noise that can influence the original series. However, the different components of our composite indicator should capture different economic aspects.

Many researchers have tried to capture the economic rationale behind the existence of the leading indicators. For the summary of theoretical foundations see de *Leeuw* (1991). For an alternative probability model-based leading indicator computation see *Gregoir* and *Lenglart* (1998), *Neftci* (1991) and *Stock* and *Watson* (1991).

1.2. Leading indicator computations in Hungary

The first attempts to construct a composite leading indicator system for Hungary began in 1994, with the financial help from the European Union PHARE/TACIS Foundation.[6] The research was led by a group in the Hungarian Ministry of Finance, with the co-operation of some experts from the National Bank of Hungary (NBH) and the Hungarian Central Statistical Office (HCSO).[7]

This research group chose the industrial production as a reference series; this was available from 1980 on a monthly basis. They examined almost 30 time series to identify those which could be used as leading indicators. The series under examination were selected on the basis of the OECD-experience. The quantitative data were supplied by the Hungarian Central Statistical Office (HCSO) and the National Bank of Hungary, while the business survey data came from the KOPINT-DATORG (Social Research Center in Hungary).

The research has found that the following series could be used as leading indicators:

– expectations about future production (BS),[8]
– current stock levels (BS),
– household savings, deflated by the consumer price index,
– consumer prices (inverted,[9] monthly changes),
– credit rates for the firms (inverted, within one year).

(The researchers have also identified coinciding and lagging indicators; see *Hoós*, *Muszély* and *Nilsson*, 1996.)

However, these attempts had to face some very serious problems: as in the middle of the 1990s, Hungary was only about five years after a major transition, there were no long

[6] The preparation for the research is documented in *Hoós* (1994) and in *Hoós* and *Muszély* (1996).

[7] The researchers obtained technical help from the OECD Statistics Directorate Transition Economic Division, under the CCET (Centre for Co-operation with Economies in Transition) program. The initial research began in 1995, and the first results were achieved in 1996. Among the Central-Eastern-European countries Hungary was the first (together with Poland, see *Kkudrycka, 1995*) where leading indicator system has been established similar to those in the developed countries (for a detailed description see *Hoós, Muszély and Nilsson,* 1996).

[8] BS stands for Business Survey series.

[9] Inverted means that the series is transformed in such a way that the original peaks become troughs and vica versa. For example, the average of our indicator series is 100; so when we invert a series, we obtain each element of the inverted series by dividing 10 000 by the original element of the series. This way the average of the inverted series remains approximately 100.

enough time series upon which the computations could be based. Although the data of these nine years available are hardly ideal today, it can be still regarded as sufficient to make initial computations. Also, today we have a much more stable economic situation in Hungary; the well-known mechanisms from developed countries can be observed better nowadays than four years ago. This provides a chance to obtain more stable leading indicators.

2. Computation of leading indicators

In this chapter the general methodology of constructing leading indicators will be presented.

2.1. Basic assumptions

In order to define the turning points of a specific time series, we assume that this time series consists of four components:

$$y_t = T_t + S_t + C_t + I_t \qquad /1/$$

where y_t is the original value of the time series, and T_t, S_t, C_t, I_t are the trend, seasonal, cycle and irregular components of the time series, respectively. (In equation /1/, the relationship between the different parts is not necessarily additive: in fact it can be multiplicative or quasi-additive etc. We used this formulation only to define the different parts of the series.)

To define the cycles, we have to extract the seasonal and the trend components from the original series. The deduction of the seasonal component can be made by any of the well-known seasonal adjustment methods. As for the trend component, we can not give any exact definition for it. In the mentioned OECD study there is a summary of the properties we expect from a long-term trend. These include that 'the resultant trend should be a real 'long-term trend' and should not itself be too flexible'.[10] In fact we are looking for a trend that 'in some sense 'goes through' the appropriate major cyclical fluctuations in the series'.[11]

After the extraction of the seasonal and the trend components, we will only have the cycle and the irregular terms. It is not possible to derive the pure cycle component by getting rid of the irregular component, but we can reduce its likely effects by computing a moving average of the seasonally adjusted and de-trended data. The length of the moving average can be determined as the Month of Cyclical Dominance (MCD): this is the time-span upon which the cyclical components dominate the irregular components. The turning points of the time series will be the turning points of this MCD moving average of the seasonally adjusted and de-trended series.

Further on we summarise the alternative methods that can be followed when we use seasonal adjustments and de-trending; we also discuss the method for turning point determination.

[10] See *OECD* (1987) p. 33.
[11] See *OECD* (op. cit.) p. 33.

2.2. Seasonal adjustment[12]

In traditional theory, different mechanisms are responsible for the growth and business cycles, and the seasonal movements are regarded as noises contaminating the data; therefore seasonal factors need to be adjusted. This view is widely accepted among the experts of the topic.[13]

The summary of the different seasonal adjustment methods is out of the scope of the present paper. It has a wide literature and all steps of the different methods can be followed. So at this point it is enough to note that we have tried two types of seasonal adjustments, namely the X-12-ARIMA and the SEATS/TRAMO (in what follows, simply SEATS). The results can be seen in *Reiff*, *Sugár* and *Surányi* (1999), which states that the two methods lead to very similar outcomes, and the choice between them does not affect the cyclical patterns of the seasonally adjusted series considerably. Therefore we decided that during our future calculations of the leading indicators we would use only one of them. For this purpose we selected SEATS, which we consider to be more reliable. (Again, for a much more detailed analysis of this topic we refer to *Sugár*, 1999 and to *Reiff*, *Sugár* and *Surányi*, 1999).

2.3. De-trending

There are two well-known, alternative de-trending methods. One of them, the Phase-Average-Trend (PAT) method has been developed in the United States by the National Bureau of Economic Research (NBER), and this method was also adapted by the OECD for their leading indicators. This is the traditional de-trending method, which is virtually used in all indicator computations. The other method is the Hodrick-Prescott filter, available in most econometric software.

The phase-average trend method

As an overview, let us discuss the main steps of the PAT method (the description is based on *Nillson*, 1987 and *Kudrycka*, 1995).

1. Determination of an initial trend; calculation of the ratio to initial trend.

2. Determination of the turning points of the ratio to initial trend; these initial turning points determine the initial phases.

3. Calculation of the initial phase averages, then the 3-month moving average of the phase averages.

4. Connecting the phase averages, then forming a 12-month moving average we obtain the final trend.

It has to be noted that the PAT method uses a turning point determination (Step 2), namely the Bry-Boschan procedure; this will be discussed in the next section. The steps

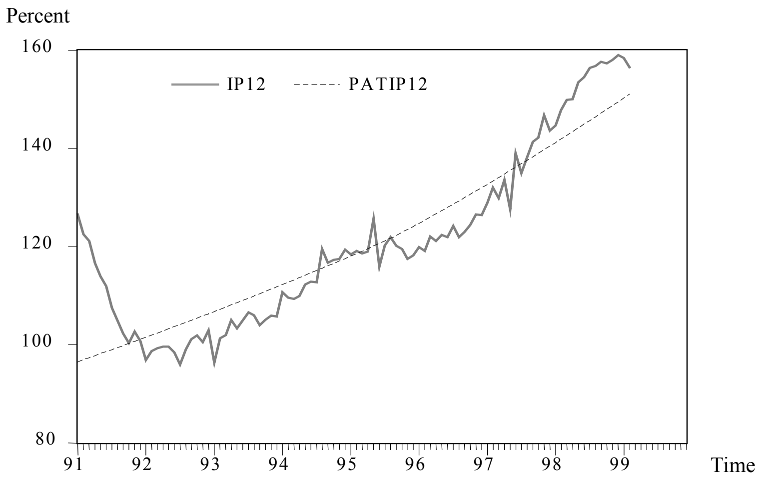
[12] Sugár studied extensively the seasonal adjustment methods. A much more detailed description is provided in *Sugár* (1999).

[13] However, *John Wells* found that in most cases the seasonally unadjusted indicators perform much better than the seasonally adjusted ones. For more on this, see *Wells* (1999).

are discussed in details in *Nilsson* (1987), *Kudrycka* (1995), and also in the initial version of this paper (*Reiff – Sugár – Surányi*, 1999).

As an illustration let us consider Figure 1.

Figure 1. The phase-average trend (PATIP12) of the seasonally adjusted industrial production



In this figure we can see the seasonally adjusted Hungarian industrial production, IP12 (in 1992 prices, monthly average 1992=100, the seasonal adjustment has been made by X-12-ARIMA), and the phase-average trend of this series (PATIP12):

The Hodrick-Prescott filter

The Hodrick-Prescott filter is a well-known de-trending method, and it is available in the latest econometric softwares. The method was developed by *R. J. Hodrick* and *E. C. Prescott* to analyse the post-war US business cycles.

Let us denote again the original, seasonally adjusted time series by y_t, and the smoothed series by s_t. The Hodrick-Prescott smoothing of a time series tries to minimise the deviation of the smoothed series from the original one under the constraint that the smoothed series should be 'sufficiently smooth', which means that the fluctuation in the first differences of the smoothed series should be sufficiently small. The loss function to be minimised is

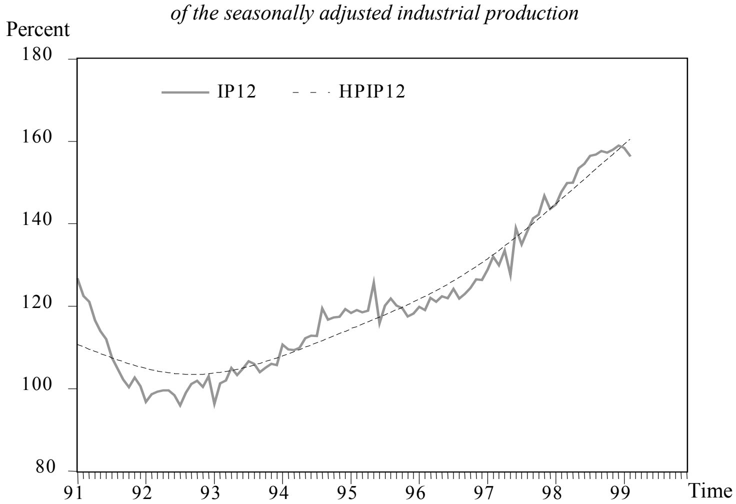
$$\sum_{t=1}^{T}(y_t - s_t)^2 + \lambda\sum_{t=2}^{T-1}\big((s_{t+1} - s_t) - (s_t - s_{t-1})\big)^2 \to \min. \qquad /2/$$

Parameter λ is the weight of the smoothness in our objective function; the higher λ is, the higher importance we put on the smoothness of the resulting series. If λ goes to infinity, we end up with the linear trend.

The main disadvantage of this method is that the choice of the λ parameter is arbitrary. Hodrick and Prescott suggested that λ should be 100 for annual data, 1 600 for quarterly data and 14 400 for monthly data. Of course, any other value can be chosen, and in the case of leading indicators, the final results depend on the choice of λ at the de-trending section.

In Figure 2 we can have a look at the Hodrick-Prescott trend (HPIP12) of the same series (IP12) examined for the phase-average trend. The value of parameter λ was 14 400, according to the recommendations.

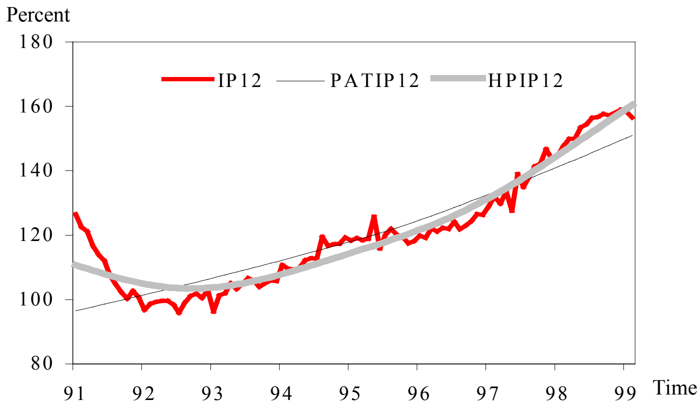
Figure 2. The Hodrick-Prescott trend (HPIP12) of the seasonally adjusted industrial production



Comparison of the de-trending methods

As a comparison, it is worth having a look at the alternative de-trending methods jointly.

Figure 3. Comparison of the alternative de-trending methods



We can see substantial differences between the two long-term trends. The phase-average trend is much smoother, it is almost a linear trend, while the Hodrick-Prescott trend is much ‘closer’ to the original series. If we chose a much higher λ, the two methods would produce very similar results.

So the difference between the alternative de-trending methods is mainly caused by the choice of parameter λ for the Hodrick-Prescott filter. If we use the conventional value of 14 400, then it leads to a non-linear trend, at least relative to the phase-average method. This means that the de-trended series are of smaller amplitude, and may also lead to differences in the final turning points (see Figure 4. in Section 4.).

The similarity of the phase-average method and the Hodrick-Prescott filter with a high λ put serious questions about the phase-average method. It may well be that the phase-average method can be approximated by a suitable Hodrick-Prescott filter, and therefore it is not necessary to deal with the phase-average method at all. To verify this claim, however, longer time series should be examined as well, which unfortunately are not yet available for Hungary.

As a summary we can say that the Hodrick-Prescott method seems to be less controversial for us. The reason for this is that it is computed in the same way at the whole range of the time series, while the phase-average method uses regression at the beginning and at the end and moving averages in between. As a consequence, the Hodrick-Prescott filter looks much more reliable where it is crucial to be reliable, i.e. at the end of the series. Another argument supporting the Hodrick-Prescott filter is that the number of arbitrary choices necessary to make during the computations is only one, namely the choice of parameter λ (but, on the other hand, it is a crucial one), while at the phase-average method we have much more freedom at each steps.

2.4. Turning point determination: the Bry-Boschan procedure

Sometimes it is quite easy to determine the turning points of a given series: one has to look at the graph and mark the peaks and the troughs. There are some cases, however, when this method does not work, as it is not quite obvious which of the consecutive peaks or troughs should be regarded as real turns, and there may be a question about minor cycles: when a cycle of relatively short length should be regarded as a cycle itself, and when it is only a small fluctuation inside a longer cycle.

It is very important therefore, to have some basic principles for the identification of turning points, and to use them consistently. These principles were laid down by *Gerhard Bry* and *Charlotte Boschan* in 1971 (*Bry – Boschan*, 1971). According to their arguments, in the turning point determination ‘the programmed approach differs substantially from previously used techniques, which rely heavily on impressionistic judgements and are subject to a number of procedural constraints’. It is desirable, therefore, to exclude the possibility of any subjective decision about turning points.

We used this pre-programmed method for the turning point determination.[14] The description of the procedure along with a short evaluation can be found in *Bry* and *Boschan* (1971) and in *Nilsson* (1987).

[14] We are grateful to *György Muszély*, member of the leading indicator research group of the Hungarian Ministry of Finance for providing us with the program.

3. Constructing a composite leading indicator for Hungary

Although some economic reforms were implemented during the 1980s, Hungary operated as a socialist economy until the beginning of the 1990s. The process of the transition into a market economy began only in 1989 or 1990; a newly elected government in 1990 initiated an institutional reform.

These facts mean that the reliability of the long time series is highly questionable in Hungary. Any series can only be used from 1991 at best, as the data before and after the transition cannot be compared. During our research, we decided to concentrate only on the data of the 1990s. This may be problematic because of the shortage of the time series, but this cannot be resolved. However, an eight and a half year time span is sufficient to make at least initial computations.

3.1. The data

We collected data from three different sources. Most of the 'natural' time series are taken from the monthly reports of the HCSO and some monetary time series could be found in the monthly reports of the National Bank of Hungary. We had some difficulties at the beginning of the 1990s: as the transition into market economy required major changes in the statistical system as well, some of the series were not reported at the beginning of the decade. Therefore some of the time series started only in 1992, 1993 or 1994, and the cyclical properties of these series could only be examined in these periods. (The names and the starting dates of the series are reported in Tables 2-4.)

The third source of our data are the business survey series by the Hungarian research institute, KOPINT-DATORG. This institution has conducted business surveys from the 1980s, and we used some selected business survey data from 1990. The incorporation of business survey data represented some technical difficulties for us, as these surveys are made only quarterly. We decided to transform these series to monthly ones for the sake of comparability with the other series. The method of the transformation was the simplest one: we used linear approximation between the data points. The reason for this is that we did not want to make any initial assumptions and did not want to add any extra information to the original data that could have affected the final results.

3.2. The reference series[15]

One of the most important steps in the construction of a composite leading indicator is the choice of the reference series. Hopefully, we wish to forecast the turning points in GDP, so this is a natural candidate to be the reference series. In Hungary, however, GDP-calculations were made only on an annual basis until 1994; from that time quarterly GDP-data are available. This means that we could not make any approximations for the monthly Hungarian GDP in any way, therefore this possibility was excluded.

Another possibility is to use a composite coinciding index as a reference series. But we had no such index as we have a limited number of initial researches from this area.

[15] See Section 1. for the definition of the reference series.

We do not know whether the natural candidates (capacity utilisation, number of hours worked, industrial energy consumption etc.) as coincident indicators, perform well or not.

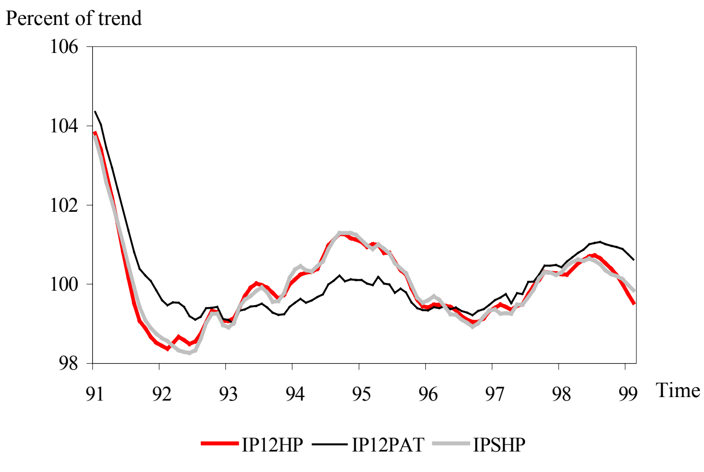
There is one more possibility which is often used in other countries: the data of industrial production. Although this represents only a part of the GDP, it can be regarded as a reliable indicator of the state of the economy; it can therefore be a good proxy for the whole GDP. Furthermore, many countries and also the OECD use the industrial production as a reference series, and this will allow the comparison of the results.[16]

Industrial production data in Hungary are available monthly; we used a base index of industrial production where the average of 1992 is 100.

After choosing the reference series, it is important to determine its turning points; these will serve as a basis for the comparison of the cyclical behaviour of the different series. In some countries (in the United States, for example) there are officially announced turning points of the economy; in this case these official turning points can be used in the analysis. In Hungary, however, there are no such turning point dates, so we had to calculate them ourselves.

During the computations, we used all the available methods for seasonal adjustment and de-trending: the X-12-ARIMA and SEATS, and the Hodrick-Prescott filter as well as the phase-average method. Due to the short series, however, we faced some difficulties in computing the phase-average trend for most of the series; for the industrial production, only three combinations of these methods have led to turning point determination: no phase-average trend could be prepared for the SEATS seasonal adjustment.

Figure 4. Cycles of industrial production in Hungary after seasonal adjustment, de-trending, smoothing and normalising



In an ideal situation all of the three available methods should give the same turning points; these could then be used as reliable ones. But this was not the case: the methods reported similar, but not identical turning point dates. In all cases we experienced four turning points, out of which the two in the middle seemed to be stable. But the turning

[16] As noted before, the research group in the Hungarian Ministry of Finance also used the industrial production data as a reference series.

points at the end, and especially at the beginning proved to be very uncertain (this observation may be in line with the fact that the phase-average method is very unreliable at the end and at the beginning; for more on this, see *Reiff*, *Sugár* and *Surányi*, 1999). The seasonally adjusted and de-trended series (after normalisation) are plotted in Figure 4.

We can see that the main difference is caused by the different de-trending method. The IP12HP and IPSHP exhibit only minor differences, while the IP12HP and IP12PAT differ substantially. The turning points of each series are listed in Table 1.

Table 1

The turning points of the Hungarian industrial production according to the alternative seasonal adjustment and de-trending methods

Series	Trough	Peak	Trough	Peak
IP12HP*	92 Feb	94 Oct	96 Oct	98 Jul
IP12PAT**	93 Feb	94 Sep	96 Sep	98 Aug
IPSHP***	92 Jun	94 Nov	96 Sep	98 Jun

* IP12HP: Industrial Production after X-12-ARIMA seasonal adjustment and Hodrick-Prescott filter de-trending.
**IP12PAT: Industrial Production after X-12-ARIMA seasonal adjustment and Phase-Average Trend method de-trending.
***IPSHP: Industrial Production after SEATS seasonal adjustment and Hodrick-Prescott filter de-trending.

Although the turning points were not identical, they exhibit a similar pattern, they seem to be plausible and matching our intuition about the economic processes in the decade.

As the exact dates of the turning points are unclear, we decided not to choose from the alternative dates but to leave them as they were. We decided that we would make calculations with all of them, with the two de-trending methods and the two seasonal adjustment methods, and evaluate each result on the basis of the turning points in the industrial production series that had been calculated with the same pair of methods.

3.3. The cyclical indicators

We examined the cyclical pattern of the following series.

Interest rates. We had five types of nominal interest rates available from 1991: these are very short-term (less than one month) deposit rate, short-term (less than one year) deposit rates, long-term deposit rates, short-term credit rates and long-term credit rates. All interest rates were published monthly, and they represent weighted average rates (including the contracts at all financial institutions).

We could have considered the incorporation of real interest rates as well, but in this case we should have had data about the inflationary expectations. This is problematic, however, and since that the correlation between the nominal and real interest rates is likely to be positive as higher nominal interest rates indicate higher risk (this will not necessarily be true in the future, as Hungary is likely to experience much shorter inflationary period than before). Therefore we decided to use the easily available nominal interest rates.

Exchange rates. Hungary is highly dependent on foreign trade, and this is greatly influenced by the exchange rates. We examined nominal exchange rates (the HUF to USD, DEM and Euro). Again, we could have examined real exchange rates or real exchange rate indices, but this would have required further computations as well. For the sake of simplicity we used these nominal rates.

Productions of specific industries. There are data available about the production in real terms (tons, pieces etc.) of selected industries. It may well be the case that some industries have stimulating effects to the whole industry, or there may be some influential industries that are in close correlation with the overall production of the whole industry. These were the reasons why we tried the coal, electric energy, fertilisers, cement and bony raw meat productions as leading or coincident indicators.

Budget. The monthly income of the budget may indicate the state of the economy through the tax revenues, for example; conversely, monthly expenditures can stimulate the industrial production. We therefore tried these series.

Unemployment. According to international experiences, both the number of the unemployed and the unemployment ratio can be useful coinciding or lagging indicators.

Price indices. We had six price index series available on a monthly basis, and most of them were natural candidates to be leading indicators. We examined base price indices (January 1992=100): food prices, energy prices (as the price of a main input of the industry), consumer prices, producer prices, foreign sales prices and domestic sales prices.

Working hours and employment. We could collect data about employment and working hours from the HCSO. We used the monthly data of the number of hours worked in industry, the number of the employed in industry, and the number of the blue-collars in industry. These series are likely to be moving along with the reference series.

Earnings. It is natural that the earnings should influence industrial production in either way. On the one hand, they are indicators of input prices, and on the other hand they represent the productivity of the industry. We used the monthly data of gross nominal average earnings in industry and gross nominal average earnings in construction (in HUF per month).

Money supply. From 1994 the National Bank of Hungary has been publishing consistent and comparable data about the M3. We chose M3 because this is the only money supply data that is available directly, and further, we think that money supply aggregates are closely linked.

Current account balance. The export and import performance of the industry and services, and the capital account may indicate the actual state of the economy. The current account balance has been available monthly in USD since 1991.

Business survey series. We had great expectations as regards the business survey series; international experience and tendencies showed that they play a more and more important role in composite leading indicators. The Polish example also suggested that these series have relatively high explanatory power (in Poland the calculations showed much higher correlation coefficients in case of business survey series, see *Kudrycka*, 1995).

We had some data from the KOPINT-DATORG; the answers to the following questions have been classified as better/improving, same/not changing, and worse/deteriorating.

1. What is your opinion about the current situation of your company?
2. What is the current production of your firm compared to the previous year?

3. What is the current production of your firm compared to the previous quarter?
4. What is the current capacity utilisation of your firm?
5. What is the current stock level of your firm (final product)?
6. How will the situation of your firm change during the next 6 months?
7. What is your prognosis about the future sales of your firm?
8. What is the capacity level of your firm compared to the prognosed needs during the next 12 months?
9. What is your prognosis about the domestic demand during the next 12 months?
10. What is your prognosis about the number of the employed at your firm during the next 6 months?
11. What is your prognosis about the sales prices of your firm during the next 12 months?
12. What is your opinion about the current state of the Hungarian economy?
13. What is your prognosis about the future tendencies in the Hungarian economy?

As we can see, all answers to these questions represent changes; these changes in opinions can influence industrial production in the future.

We transformed the balances into numbers by giving 1 point to the worse/deteriorating answer, 2 points to the same/not changing answer, and 3 points to the better/improving answers. (As originally we had only the relative frequencies of the answers in hand, this way we obtained a number between 100 and 300.)

It is a delicate issue among researchers whether these business survey series should or should not be de-trended. Some experts argue that these data cannot exhibit long-term trends as they are bounded. We, however, chose de-trending as our series were quite short, and most of them exhibited a clear rising trend during the 9 year span of available data. There is no unique view at international level in this question, however.

3.4. Methods of evaluation of the cyclical indicators

In the evaluation step we followed the practice of the OECD (see for example *Kudrycka*, 1995). We applied the peak and trough analysis and the cross-correlation method.

At the peak and trough analysis we counted the number of turns in each series, then checked whether any peak or trough may be matched to a peak or trough in the reference series. Therefore we could count the number of missing, and the number of extra turns.[17] Then we computed the mean lag at turning points (that gives a positive number if the series lags, and negative number if the series leads the reference series), and we also computed the median lag at turning points. These numbers however are not too reliable, as they are computed from three or four data points at most. Nevertheless, if they are close to each other, that can be regarded as a positive sign about their reliability. Finally, we computed the mean deviation of the lags at turning points from their mean, as an indicator of the variability of the lags. The smaller this number is, the more reliable the cyclical indicator is.

[17] We say that a specific turn in an indicator series is extra, if no matching turn can be identified in the reference series. And we say that we have a missing turn if a specific turn in the reference series does not have a corresponding turn in the indicator series.

In the cross-correlation method, we computed correlation coefficients if the cyclical indicator series were lagged by different numbers of months relative to the reference series. We determined the lag of each cyclical indicator for which the correlation coefficient was the highest (in absolute value). This lag can be regarded as the time span at which the cyclical indicator has the highest explanatory power (in linear relationship) for the reference series.

A cyclical indicator was selected as a reliable one if the peak and trough analysis did not show too many extra or missing turns, if the mean lag, the median lag and the lag giving the highest correlation coefficient were consistent, and if the mean deviation of the lags at turning points was small. The results of the two evaluation methods are shown in Tables 2-4.

3.5. Final selection of cyclical indicators

In Tables 2-3 the de-trending method is the Hodrick-Prescott filter; the seasonal adjustment method is X-12-ARIMA in Table 2, and SEATS in Table 3. As the results are quite similar, we selected the same series as leading indicators in these instances. The selected series for leading indicators are shaded in the tables.

The first selected time series is the long-term credit rate. All interest rates seem to behave well, with similar mean, median and cross-correlation lags. However, we decided to select only one of them as they are likely to represent the same information set. Probably the best among them is the long-term credit rate with the most consistent mean, median and cross-correlation lags, and with the lowest mean deviation value. Also, the credit rates may directly influence the investment decisions of the firm and it is very intuitive that they have quite a long lead compared to the industrial production. An alternative reasoning that connect interest rates to industrial production can stress the importance of the inflation; during the first half of the decade Hungary experienced high inflation rates (20-35%), in which case a decline in the inflation (and in the interest rates) could lead to an upswing in the industrial production through the reduced uncertainty about future prices.

The second selected series is the exchange rate of the Euro (to HUF). It is quite intuitive that the USD exchange rate has much lower predicting power to the industrial production turning points, as the Hungarian economy is integrated mainly into the European Union (with approximately 70 percent of its foreign trade going to the Euro-zone). It is not clear, however, why the inverse of the Euro rate should have such a long lead; this means that if the Euro is strong, then a trough can be expected in the Hungarian economy and vice versa. However, this can be in connection with the import sensitivity of the Hungarian industry. Also, we can stress here the role of inflation: when the Euro is strong, then the HUF is weak (which in fact can be caused by inflation), and this hurts the Hungarian economy.

The third selected series is gross nominal earning in industry. Although there is a missing turn in this case, we have consistent mean, median and cross-correlation lags and a very small mean deviation value. The economic rationale behind this series can be that firm owners, seeing the extended possibilities in the future offer higher wages to employ more people in their companies.

Table 2

The evaluation of the cyclical indicators in the X-12-ARIMA, HP filter case

	Start date	MCD	No. of turns	Extra turns	Missing turns	Lag at turning points			Cross correlation	
						Mean	Median	Mean dev	Lag	Coeff
NATURAL TIME SERIES										
Interest Rates										
Within 1 month deposit rate (inv)	1991	3	6	2		-14,50	-18,5	6,750	-13	0,724
Short term deposit rate (inv)	1991	3	4			-13,00	-16,5	6,500	-13	0,763
Long term deposit rate (inv)	1991	4	5	1		-10,00	-12,0	5,000	-12	0,776
Short term credit rates (inv)	1991	3	4			-10,75	-14,5	6,375	-11	0,766
Long term credit rates (inv)	*1991*	*4*	*4*			*-10,75*	*-13,5*	*4,875*	*-10*	*0,767*
Exchange Rates										
USD	1991	3	7	3		-3,00	-4,0	7,500	5	0,368
DEM (inv)	1991	3	5	1		-6,75	-8,0	7,250	-7	0,888
Euro (inv)	*1992*	*3*	*4*			*-6,25*	*-7,5*	*7,250*	*-6*	*0,865*
Industry Productions										
Coal (inv)	1991	6	8	4		-0,50	-1,0	3,500	0	0,617
Electric Energy	1991	6	8	4		7,00	8,0	8,500	10	0,460
Fertilizers (inv)	1992	6	6	3	1	8,67	7,0	10,222	4	0,555
Cement	1991	4	7	3		-0,75	-1,5	6,250	-4	0,555
Bony Raw Meat (inv)	1991	3	6	2		-0,75	-1,5	3,875	1	0,865
Budget										
Monthly Income (inv)	1992	6	6	2		-3,25	-3,0	6,250	-2	0,613
Monthly Expenditure	1992	6	NO SIGNIFICANT RELATIONSHIP							
Monthly Balance (inv)	1992	6	6	4	2	-3,50	-3,5	6,500	-8	0,423
Unemployment										
Number of Unemployed (inv)	1991	3	4			8,25	8,5	3,250	7	0,807
Unemployment Ratio (inv)	1991	3	6	2		6,75	5,5	5,250	7	0,700
Price Indices										
Food Prices (inv)	1991	3	6	3	1	-12,67	-15,0	4,444	-11	0,457
Energy Prices (inv)	1991	3	5	2	1	4,33	2,0	7,778	-3	0,517
Consumer Price Index (inv)	1991	3	7	4	1	-5,67	-5,0	1,556	-4	0,674
Producer Price Index (inv)	1992	3	5	2	1	8,00	10,0	4,667	-3	0,569
Sales Prices of Foreign Trade (inv)	1992	3	4	2	2	-10,00	-10,0	6,000	-5	0,584
Sales Prices of Domestic Trade (inv)	1991	3	5	2	1	-0,33	1,0	3,778	-2	0,572
Working Hours										
Working Hours in Industry	1994	6	3	1	1	-3,00	-3,0	4,000	-1	0,882
Number of Employed in Industry	1994	3	3	1	1	-2,50	-2,5	6,500	0	0,794
Number of Manual Workers in Industry	1994	3	4	1		-1,33	0,0	5,111	0	0,803
Earnings										
Gross Earnings in Industry	*1994*	*6*	*2*		*1*	*-7,00*	*-7,0*	*1,000*	*-8*	*0,784*
Gross Earnings in Construction	1994	6	2		1	-8,50	-8,5	0,500	-7	0,768
Money Supply										
M3	1994	3	2		1	-16,50	-16,5	5,500	-10	0,705
Current Account Balance										
Monthly Current Account Bal. (inv)	1991	6	7	4	1	-2,67	2,0	6,889	-2	0,683
Economic Situation in Germany										
Industrial Production in Germany	1990	3	5	1		6,50	4,5	4,750	12	0,624

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(Continuation.)

	Start date	MCD	No. of turns	Extra turns	Missing turns	Lag at turning points			Cross correlation	
						Mean	Median	Mean dev	Lag	Coeff
BUSINESS SURVEY SERIES										
Firm's Current Situation	*1990*	*3*	*6*	*2*		*-5,25*	*-5,5*	*0,750*	*-6*	*0,754*
Current Prod. Compared to Prev. Year	*1990*	*3*	*4*			*-5,25*	*-5,0*	*0,375*	*-4*	*0,707*
Current Prod. Compared to Prev. Quart.	1990	3	6	2		-6,75	-7,5	1,375	-5	0,667
Current Capacity Utilisation	1990	3	6	2		1,25	0,0	6,750	-2	0,585
Current Stock Level	1990	3	6	3	1	5,33	7,0	5,556	7	0,743
Prognosis of Firm's Future Situation	*1990*	*3*	*4*			*-11,75*	*-12,0*	*4,250*	*-12*	*0,796*
Prognosis of Firm's Future Sales	1900	3	6	2		-12,50	-10,5	6,000	-13	0,691
Capacity Level Comp. to the Needs (inv)	*1990*	*3*	*4*			*-3,50*	*-3,0*	*6,000*	*-6*	*0,662*
Prognosis of Firm's Domestic Demand	*1990*	*3*	*4*			*-5,25*	*-5,5*	*2,250*	*-10*	*0,715*
Prognosis of the Number of Workers	1990	3	6	2		-8,75	-5,5	5,625	-13	0,769
Prognosis of Own Dom. Sales Prices	1990	3	8	4		-3,00	-1,5	4,500	0	0,560
Country's Current Situation	1990	3	NO SIGNIFICANT RELATIONSHIP							
Prognose of Country's Future Situation	1990	3	NO SIGNIFICANT RELATIONSHIP							

Table 3

The evaluation of the cyclical indicators in the SEATS, HP-filter case

	Start date	MCD	No. of turns	Extra turns	Missing turns	Lag at turning points			Cross correlation	
						Mean	Median	Mean dev	Lag	Coeff
NATURAL TIME SERIES										
Interest Rates										
Within 1 month deposit rate (inv)	1991	3	6	2		-15,25	-18,5	5,125	-14	0,718
Short term deposit rate (inv)	1991	3	4			-13,75	-16,5	4,875	-13	0,760
Long term deposit rate (inv)	1991	4	5	1		-10,75	-11,0	4,250	-12	0,760
Short term credit rates (inv)	1991	3	4			-11,50	-14,0	4,750	-12	0,767
Long term credit rates (inv)	*1991*	*4*	*4*			*-11,50*	*-13,0*	*3,250*	*-11*	*0,763*
Exchange Rates										
USD	1991	3	7	3		-3,75	-3,5	6,750	-18	0,308
DEM (inv)	1991	3	5	1		-7,50	-8,0	5,500	-7	0,881
Euro (inv)	*1992*	*3*	*4*			*-7,00*	*-7,5*	*5,500*	*-7*	*0,851*
Industry Productions										
Coal (inv)	1991	6	8	4		-0,50	-1,0	6,000	0	0,597
Electric Energy	1991	6	6	2		6,00	8,0	9,500	10	0,460
Fertilizers (inv)	1992	6	7	4	1	7,33	6,0	8,444	3	0,753
Cement	1991	4	7	3		-1,25	-1,0	3,250	-3	0,466
Bony Raw Meat (inv)	1991	3	6	2		-2,50	-1,5	4,500	2	0,880

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(Continuation.)

	Start date	MCD	No. of turns	Extra turns	Missing turns	Lag at turning points			Cross correlation	
						Mean	Median	Mean dev	Lag	Coeff
Budget										
Monthly Income (inv)	*1992*	*6*	*4*			*-3,25*	*-3,5*	*3,250*	*-5*	*0,701*
Monthly Expenditure	1992	6	3	1		-16,33	-16,0	3,778	-15	0,494
Monthly Balance (inv)	1992	6	5	2	1	-5,33	-9,0	4,889	-7	0,497
Unemployment										
Number of Unemployed (inv)	1991	3	4			7,50	6,0	3,750	6	0,818
Unemployment Ratio (inv)	1991	3	6	2		6,25	5,0	4,750	4	0,688
Price Indices										
Food Prices (inv)	1991	3	6	3	1	-12,67	-15,0	3,778	-12	0,486
Energy Prices (inv)	1991	3	5	3	1	3,00	1,0	9,333	-3	0,510
Consumer Price Index (inv)	1991	3	7	4	1	-6,33	-5,0	3,111	-5	0,698
Producer Price Index (inv)	1992	3	5	3	1	7,00	6,0	5,333	-1	0,581
Sales Prices of Foreign Trade (inv)	1992	3	4	2	2	-10,00	-10,0	5,000	-6	0,569
Sales Prices of Domestic Trade (inv)	1991	3	5	3	1	-1,33	0,0	5,778	0	0,610
Working Hours										
Working Hours in Industry	1994	6	3	1	1	2,00	2,0	2,000	-1	0,858
Number of Employed in Industry	1994	3	3	1	1	-3,00	-3,0	5,000	0	0,810
Number of Manual Workers in Industry	1994	3	4	1		-1,00	1,0	4,667	0	0,816
Earnings										
Gross Earnings in Industry	*1994*	*3*	*2*		*1*	*-8,50*	*-8,5*	*4,500*	*-7*	*0,886*
Gross Earnings in Construction	1994	3	2		1	-6,50	-6,5	0,500	-6	0,864
Money Supply										
M3	1994	3	3	1	1	-17,50	-17,5	3,500	-10	0,692
Current Account Balance										
Monthly Current Account Bal. (inv)	1991	6	7	4	1	-5,67	-3,0	4,222	-1	0,548
Economic Situation in Germany										
Industrial Production in Germany	1990	3	5	1		5,75	5,5	3,750	11	0,639
BUSINESS SURVEY SERIES										
Firm's Current Situation	*1990*	*3*	*6*	*2*		*-4,75*	*-5,0*	*1,250*	*-6*	*0,755*
Current Prod. Compared to Prev. Year	*1990*	*3*	*4*			*-4,25*	*-4,0*	*2,750*	*-5*	*0,754*
Current Prod. Compared to Prev. Quart.	1990	3	6	2		-5,25	-4,5	3,250	-6	0,641
Current Capacity Utilisation	1990	3	4			-0,50	1,0	7,500	-2	0,614
Current Stock Level	1990	3	7	4	1	4,00	3,0	4,667	7	0,718
Prognosis of Firm's Future Situation	*1990*	*3*	*4*			*-13,00*	*-13,0*	*5,000*	*-12*	*0,777*
Prognosis of Firm's Future Sales	1900	3	6	2		-15,50	-12,5	7,750	-13	0,697
Capacity Level Comp. to the Needs (inv)	*1990*	*3*	*4*			*-4,25*	*-4,0*	*6,750*	*-6*	*0,680*
Prognosis of Firm's Domestic Demand	*1990*	*3*	*4*			*-6,00*	*-5,5*	*3,500*	*-11*	*0,716*
Prognosis of the Number of Workers	1990	3	6	2		-9,50	-5,5	7,250	-13	0,734
Prognosis of Own Dom. Sales Prices	1990	3	7	3		-2,75	-3,0	2,750	-3	0,590
Country's Current Situation	1990	3	NO SIGNIFICANT RELATIONSHIP							
Prognose of Country's Future Situation	1990	3	NO SIGNIFICANT RELATIONSHIP							

Table 4

The evaluation of the cyclical indicators in the X-12-ARIMA, phase-average trend method case

	Start date	MCD	No. of turns	Extra turns	Missing turns	Lag at turning points			Cross correlation	
						Mean	Median	Mean dev	Lag	Coeff
NATURAL TIME SERIES										
Exchange Rates										
USD	1991	3	5	1		-11,50	-11,0	4,000	2	0,556
Industry Productions										
Cement	1991	5	5	1		-3,50	-5,5	3,750	0	0,673
Bony Raw Meat (inv)	1991	3	7	3		2,00	0,5	4,000	9	0,293
Price Indices										
Consumer Price Index (inv)	1991	3	5	3	1	-9,00	-4,0	6,667	0	0,373
Current Account Balance										
Monthly Current Account Balance	1991	3	5	3	1	-1,67	0,0	6,889	11	0,567
BUSINESS SURVEY SERIES										
Firm's Current Situation	1990	3	6	2		-8,00	-5,5	4,500	-6	0,339
Current Prod. Compared to Prev. Year	1990	3	4			-7,75	-5,0	4,625	-7	0,168
Current Prod. Compared to Prev. Quart.	1990	3	4			-9,75	-6,5	5,125	-7	0,168
Current Capacity Utilisation	1990	3	4			-2,00	-4,0	4,000	-5	0,153
Current Stock Level	1990	3	5	1		-2,75	-3,0	8,750	3	0,655
Prognosis of Firm's Future Situation	1990	3	4			-14,75	-13,5	6,750	-12	0,268
Prognosis of Firm's Future Sales	1990	3	6	2		-15,00	-16,0	6,000	-18	0,197
Capacity Level Comp. to the Needs (inv)	1990	3	4			-6,25	-4,5	9,750	-9	0,202
Prognosis of Firm's Domestic Demand	1990	3	4			-8,00	-5,5	6,500	-9	0,210
Prognosis of the Number of Workers	1990	3	4			-7,50	-4,0	6,250	-10	0,242
Prognosis of Own Dom. Sales Prices	1990	3	8	4		-6,75	-7,0	7,250	0	0,419
Country's Current Situation	1990	3	NO SIGNIFICANT RELATIONSHIP							
Prognosis of Country's Future Situation	1990	3	NO SIGNIFICANT RELATIONSHIP							

The remaining five selected series are all business survey data. The first one of them is the firm's current situation; though we have two extra turns (corresponding to a minor cycle) again, the correlation coefficient is very high and the mean deviation is small.

The fifth leading indicator is the firm's current production compared to that of the previous year. Again, the selection of this needs no further explanation once we have a look at the business cycle properties of this series.

Next we have chosen the prognosis about the firm's future situation. This series has a longer lead than the evaluation of the current situation, representing the longer time span in the question. The business cycle properties of this series are excellent.

The seventh selected series is the current capacity level compared to needs. The answer to this question indicates whether the firm plans new investments or not, and therefore influences future industrial production.

The last selected series is the prognosis about the firm's domestic demand (this means expected investments and raw material buyings etc.). Although the mean and median lags are much smaller than the cross-correlation lag, the correlation coefficient is relatively high and we have no extra or missing turns. And again, we can give clear economic justification for the selection of this business survey series.

The graphs of the selected series as leading indicators can be seen in Figures 5-12. All series are displayed in seasonally adjusted, de-trended, smoothed (by MCD-smoothing) and normalised form. Where necessary, for presentation purposes, the inverse of the series was also taken.

At this point it is worth mentioning one of the series that was not selected: namely the price index. In fact any of the price indices have low explanatory power for the industrial production. The reason behind this can be that the nature of the Hungarian inflation changed substantially during the 1990s: during the first half of the decade we had a relatively high inflation level (between 15 and 35 percent), and in these circumstances any decrease in the inflation can be regarded as a positive sign for the economy. In this period, therefore, an inverse relationship between prices and economic activity could be observed.

During the second half of the decade, however, the inflation decreased substantially, and nowadays it is approximately 10 percent (relative to the same period of previous year). In such circumstances any further decrease in the inflation rate can reduce the industrial production, as this decrease is not necessarily a good news for the companies. During this period, therefore, the relationship between the inflation and the economic activity is not an inverse one any more.

Figure 5. The inverse of the long-term credit rate (CRRLHPINV) as a leading indicator

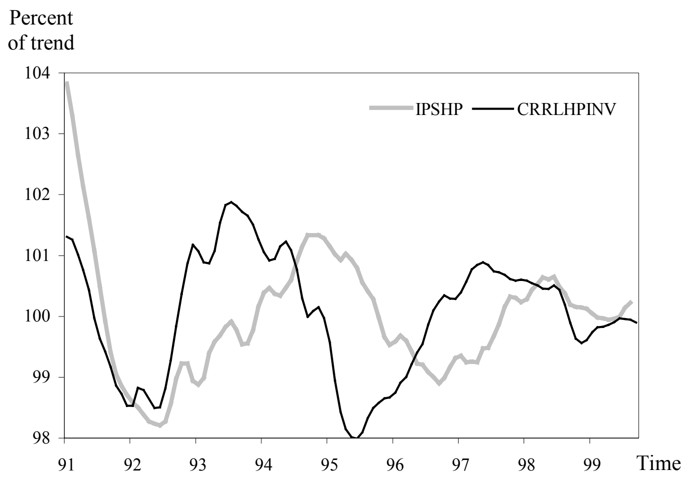


Figure 6. The inverse of the Euro exchange rate (EUROHPINV) as a leading indicator

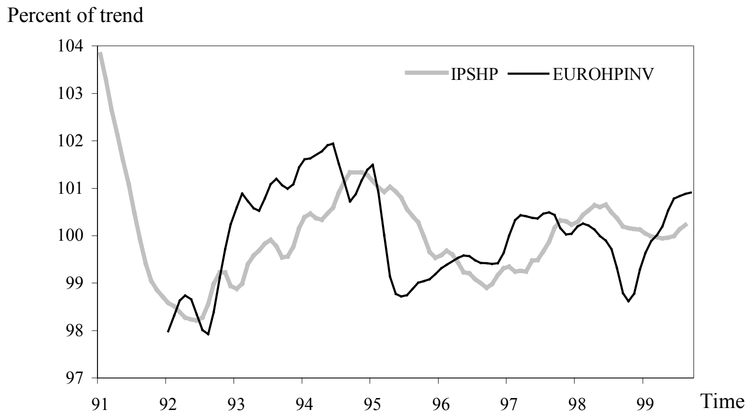


Figure 7. The gross earnings in the industry (EARNINDSHP) as a leading indicator

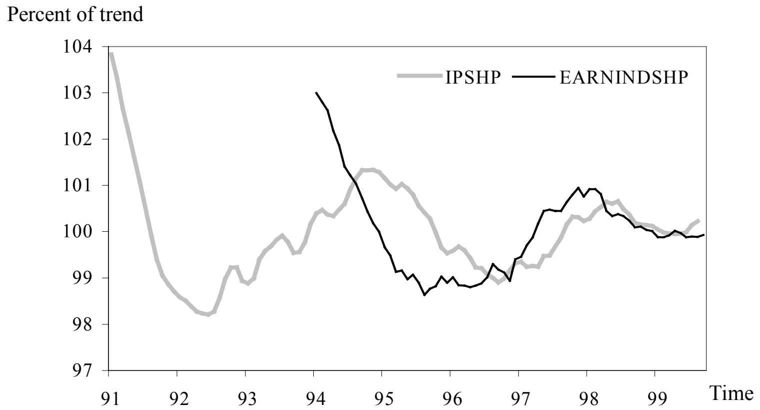


Figure 8. The current situation of the firm (CSSHP) as a leading indicator

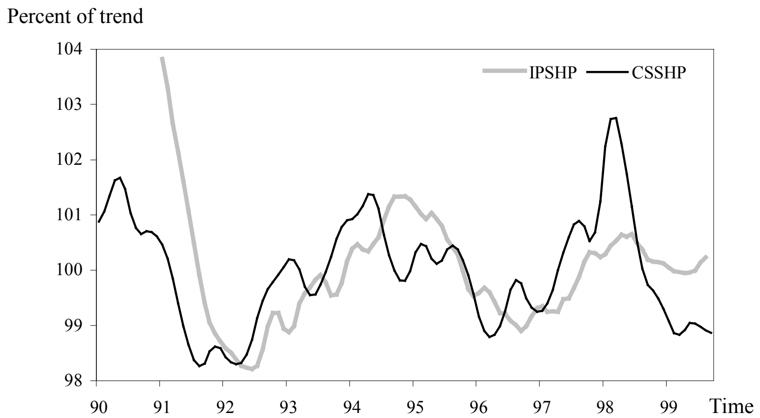


Figure 9. The current production compared to that of the previous year (CPYSHP) as a leading indicator

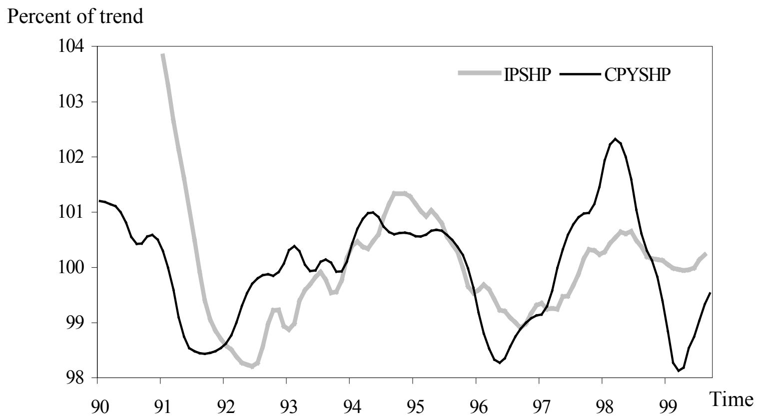


Figure 10. The prognosis of the future situation of the firm (PRSITSHP) as a leading indicator

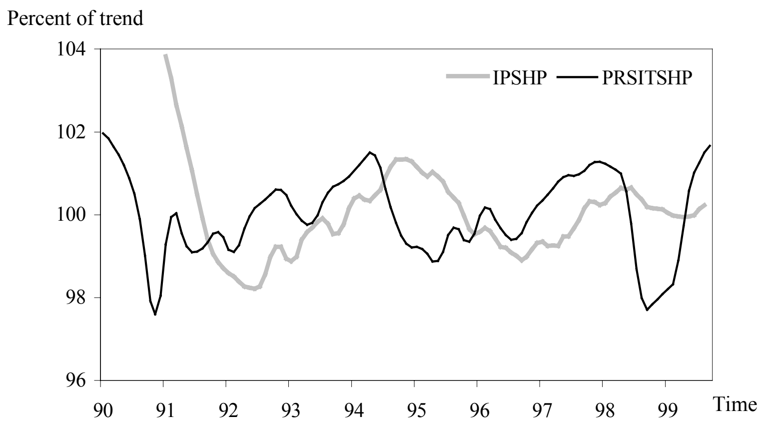


Figure 11. The inverse of the capacity level compared to the needs (PRCAPHPINV) as a leading indicator

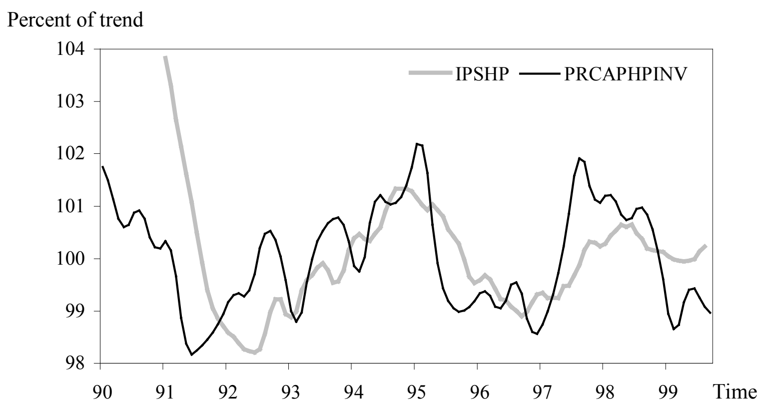
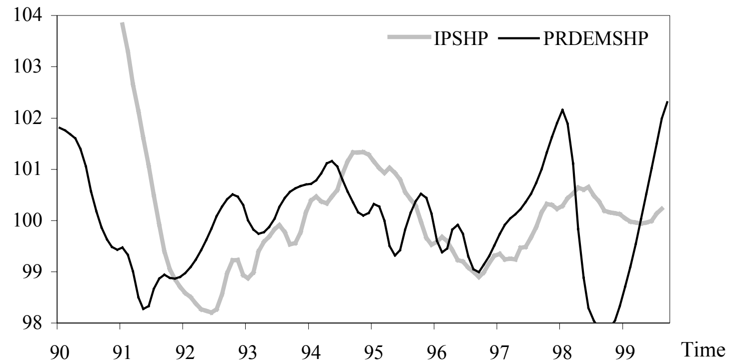


Figure 12. The prognosis of the domestic demand of the firm (PRDEMSHP) as a leading indicator



Finally in Table 4, as there were only limited number of series that could be de-trended by the phase-average trend method and the maximum correlation coefficients were relatively low (compared to the other cases), we decided not to form a composite leading indicator from these data. Perhaps later, when longer time series will be available, it will be possible to construct a leading indicator using this method as well.

3.6. Construction of composite leading indicators

From the series that we have chosen we constructed composite leading indicators. During the computations we used the seasonally adjusted, de-trended, smoothed and normalised data (normalisation is essential here as the elements of the composite indicator must be comparable to each other).

Generally the composite indicators are simply the average of the component series. We thought, however, that the series that have higher correlation coefficients with industrial production should be incorporated with a higher weight to the composite indicator. Therefore, we used the correlation coefficients as weights during our computations.[18]

We computed three different composite indicators. First, we constructed an indicator (LCOMP) from all the selected series.[19] All the series were lagged according to their cross-correlation lag; the reason for this is that it contains more information relative to the mean and median lags at the turning points. (This is obvious: the mean and median

[18] This choice was arbitrary. We could have used the square of the correlation coefficients as weights; the purpose was only to represent the relative weights of the different series. (This does not make too much difference, anyway, as all the correlation coefficients of the selected series were between 0.66 and 0.88).

[19] This type of construction of the composite leading indicator is different from the international practice. In business cycle analysis, researchers generally compute the weighted sum of the latest data points of the indicator series. The advantage of this method is that all the latest data can be used in the calculations. However, as the lags of the component series are typically not identical, this method does not give the 'best' estimate for the future cycles. If we use the exact lags, we can eliminate this problem at the cost that we do not make use of all the latest data.

We computed the short-term and the long-term indicators exactly for this reason: when computing them, we used identical lags; and therefore all the latest data are contained in them. So our 'composite' indicator and the short-term and long-term indicators are not comparable to each other in a strict sense: the former uses the exact lags but does not incorporate all the latest data, while the latters use all the latest data but not the exact lags. According to our experience so far (from May 1999 onwards), the forecasts of the two alternative methods are quite similar.

lags compare the data points at turning points only, while the cross-correlation lag compares all the data points.) For example, the long-term credit rates showed an 11-month lead relative to the industrial production, therefore the data point in September 1999 is assigned to the August 2000 data point in the composite leading indicator. The lags are summarised in Table 5 for all composite indicators.

The second indicator that we computed is a short-term leading indicator (L-6). During its computations we used the indicator series that showed an approximately 6-month lead relative to the reference series. These are: Euro exchange rate, gross earnings in industry, firm's current situation, current production compared to that of the previous year, capacity level compared to the needs. In this case we also used weighted averages and we lagged all the series by 6 months (irrespective of their cross-correlation lags). The rationale behind the same lags is that the leading indicator is available in this way exactly 6 months in advance, and all the latest data can be incorporated; this is not true to the first type of composite indicators as one of its elements has only a five-month lead.

Finally, we also computed a long-term leading indicator (L-12) from the long-term credit rates, prognosis of firm's future situation and prognosis of firm's domestic demand. In this case we lagged all the series by 12 months, and again we used weighted averages.

Table 5

The composition of different indicators, the lags of their components and their weights

Indicator series	X-12-ARIMA, Hodrick-Prescott filter			SEATS, Hodrick-Prescott filter		
	LCOMP	L-6	L-12	LCOMP	L-6	L-12
Long-term credit rates (inv)	10 (12.68%)	- (-)	12 (33.67%)	11 (12.34%)	- (-)	12 (33.82%)
Euro (inv)	6 (14.30%)	6 (22.93%)	- (-)	7 (13.77%)	6 (21.68%)	- (-)
Gross earnings in industry	8 (12.96%)	6 (20.78%)	- (-)	7 (14.33%)	6 (22.57%)	- (-)
Firm's current situation	6 (12.46%)	6 (19.99%)	- (-)	6 (12.21%)	6 (19.23%)	- (-)
Current prod. compared to previous year	4 (11.69%)	6 (18.74%)	- (-)	5 (12.20%)	6 (19.21%)	- (-)
Prognosis of the future situation of the firm	12 (13.16%)	- (-)	12 (34.94%)	12 (12.57%)	- (-)	12 (34.44%)
Capacity level compared to the needs	6 (10.94%)	6 (17.55%)	- (-)	6 (11.00%)	6 (17.32%)	- (-)
Prognosis of the domestic demand of the firm	10 (11.82%)	- (-)	12 (31.39%)	11 (11.58%)	- (-)	12 (31.74%)

It may be instructive to have a look at how these leading indicators performed in the past, and what they tell us about the future. The graphs of the different leading indicators can be seen in Figures 13-15.

It is obvious from the graphs that the composite indicators performed quite well in the past. However, it is questionable, how they will behave in the future; we will have to wait for some time until we can be confident about their ex ante explanatory power as well.

Figure 13. The composite leading indicator (LCOMPSHP) in the SEATS, Hodrick-Prescott filter case

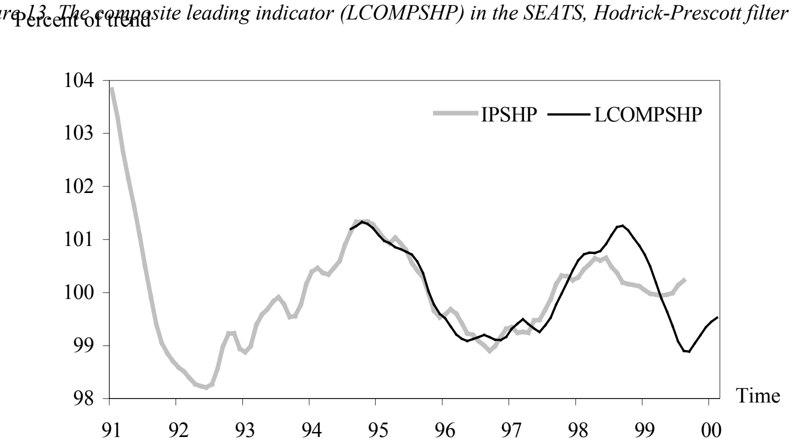


Figure 14. The short-term leading indicator (L6SHP) in the SEATS, Hodrick-Prescott filter case

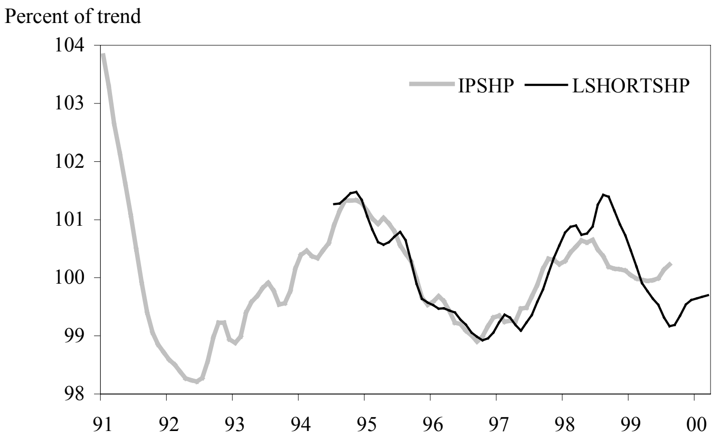
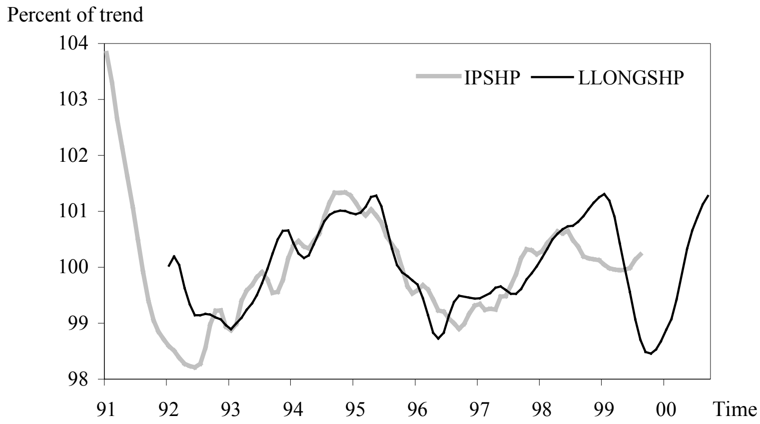


Figure 15. The long-term leading indicator (L12SHP) in the SEATS, Hodrick-Prescott filter case



4. The current state of the Hungarian economy

We can see the present forecasts[20] for the Hungarian industrial production on the graphs in Section 3 (we have a 5-month forecast by the composite indicator, a 6-month forecast by the short-term leading indicator and a 12-month forecast by the long-term leading indicator). We interpreted these results as follows.

1. Probably the most important factor is, that our long-term indicators show that Hungary is likely to experience a continuing expansionary phase during the first half of the year 2000. We have three components in our long-term indicator: the long-term credit rates, the prognosis about the firm's future situation and the prognosis about the firm's domestic demand. From among these two forecast strong expansions (relative to trend): according to Figures 10 and 12, the prognosis of the firms' future situation and domestic demand have increased steadily, which indicates that the industrial production is likely to increase in the next 10 months. The third long-term indicator, the long-term credit rates is also rising (Figure 5) but this increase in not as reliable as the increase of the two other long-term indicators. In the light of this, it is not surprising that our long-term leading indicator forecasts a steady expansion (relative to trend, see Figure 15).

2. As for the short-term indicators, the Euro exchange rate (Figure 6), the current production compared to the previous year (Figure 9) clearly indicate an expansionary phase, while the others (gross nominal earnings in industry at Figure 7, firms' current situation at Figure 8 and capacity levels compared to the needs at Figure 11) seem to be bottoming out. Quite in line with this, our short-term indicator (Figure 14) indicates that we have just entered an expansionary phase (relative to trend), which is likely to continue (especially if we have a look at the long-term indicators).

3. Our composite leading indicator (Figure 13) yields forecasts until February 2000. As five of its components are increasing, three of them seem to bottom out, this composite indicator also shows that we have just entered into an expansionary phase.

[20] Based on the data available in November 1999.

Finally, let us say a few words about the experiences, obtained from the application of our leading indicators so far. We first calculated them in May 1999, then in August, and now the calculation presented here is based on the data available in November 1999.

In May, the general forecast indicated that the recessionary phase was likely to end in short: two of the long-term indicators and one of the short-term indicators forecasted a turning point. In August, all the long-term indicators and some short-term indicators were rising, but on the other hand we had some short-term indicators declining. In November, as we could see, five of our indicators are increasing steadily, and no indicator is declining.

This process seems to be quite intuitive: during our first three calculations we experienced an upward turning point. The first signs came through the long-term indicators in May, then some short-term indicators also indicated a turning point in the near future in August. Finally, in November we can say confidently that we are already in an expansionary phase (relative to the trend).

In the future, we will compute the leading indicators continuously. This way we will be able to say more about the ex ante explanatory power of our indicators.

REFERENCES

BRY, G. – BOSCHAN, C. (1971): Programmed turning point determination. In: Cyclical analysis of time series: selected procedures and computer programmes. *NBER.*

FINDLEY, D. F. – MONSELL, B. C. – BELL, W. R. – OTTO, M.C. – CHEN, BOR-CHUNG (1998): New capabilities and methods of the X-12-ARIMA seasonal adjustment program. *Journal of Business and Economics Statistics,* **16**, (2)

FISCHER, B. (1995): Decomposition of time series. Comparing different methods in theory and practice, *EUROSTAT.*

GREGOIR, S. – LENGLART, F. (1998): Measuring the probability of a business cycle turning point by using a multivariate qualitative hidden Markov model. *INSÉE.* Working Paper, **9848**.

DR. HOÓS, J. (1994): A gazdasági jelzőszámok hasznosításának lehetőségei. *Statisztikai Szemle*, **72,** (3) pp. 225–236.

DR. HOÓS, J. – MUSZÉLY, GY. (1996): A gazdasági jelzőszámok magyarországi meghonosítása. *Statisztikai Szemle*, **74,** (3) pp. 205–217.

DR. HOÓS J. – MUSZÉLY, GY. – NILSSON, R. (1996): Cyclical indicators in Hungary. *OECD.*

KLEIN, P. A. – MOORE, G. H. (1991): Purchasing management survey data: Their value as leading indicators. In: Lahiri and Moore (1991), Chapter 21. *Cambridge University Press*, Cambridge.

KUDRYCKA, I. (1995): Cyclical indicators in Poland. *OECD.*

LAHIRI, K. – MOORE, G. H. (1991): Leading economic indicators. New approaches and forecasting records. *Cambridge University Press*, Cambridge.

DE LEEUW, F. (1991): Toward a theory of leading indicators. In: Lahiri and Moore (1991), Chapter 2. *Cambridge University Press*, Cambridge.

NEFTCI, S. N. (1991): A time-series framework for the study of leading indicators. In: Lahiri and Moore (1991), Chapter 3. *Cambridge University Press*, Cambridge.

NIEMIRA, M. P. (1991): An international application of Neftci's probability approach for signalling growth recessions and recoveries using turning point indicators. In: Lahiri and Moore (1991), Chapter 5. *Cambridge University Press*, Cambridge.

NILSSON, R. (1987): OECD leading indicators. Economic Studies, **9**, *OECD.*

REIFF Á. – SUGÁR, A. – SURÁNYI, É.: Short-term economic forecasts: An application to Hungary. Hungarian Ministry of Economics, Institute for Economic Analysis, Working Paper, (4)

STOCK, J. H. – WATSON, M. W. (1991): A probability model of the coincident economic indicators. In: Lahiri and Moore (1991), Chapter 4. *Cambridge University Press*, Cambridge.

SUGÁR, A. (1999): Szezonális kisimítási eljárások összehasonlítása. Hungarian Ministry of Economics, Institute for Economic Analysis, Working Paper, (5)

WELLS, J. M. (1999): Seasonality, leading indicators, and alternative business cycle theories. *Applied Economics*, **31**, pp. 531–538.

FOREIGN DIRECT INVESTMENT IN THE HUNGARIAN FOOD SECTOR

CSABA JANSIK[1]

SUMMARY

Hungary has been a popular target for foreign investments since the beginning of political and economic reforms. The country has received one-fourth of total FDI inflows that arrived to the Central and Eastern European region. Food processing was one of the first sectors to be privatised in Hungary. Foreign investors have participated very actively in the process since 1990. The share of foreign ownership in the Hungarian food processing sector exceeded 60 percent by 1997.

The main objective of this study is to analyse the major determinants that resulted in an uneven distribution of FDI among the seventeen individual food processing industries in Hungary. The factors that attracted large amount of foreign investment into certain food industries are searched by a regression model and cluster analysis. The paper also includes illustrative case studies of three food processing industries.

The study reviews the fears previously associated with foreign ownership in the food sector; then it weighs them against the results achieved by 1999. Hungarian food industries have accumulated a great deal of experience concerning foreign investments over the period of nearly ten years. The assessment analysis of this experience provides the Hungarian agri-food sector, foreign investors, and Central and Eastern European countries with valuable future reference.

KEYWORDS: Food processing; Sub-sectoral analysis; Concentration.

Shortly after the political changes in the late 1980s, Central and Eastern European countries opened their economies to foreign direct investments[2] (FDI). Although the majority of FDI is traded within the developed regions (Western Europe and North America), Central and Eastern European (CEE) countries have rapidly increased their capital import since the beginning of reforms. Stocks of foreign investments in CEE exceeded USD 80 billion in 1998. There is certainly a historical reason for dynamically growing capital inflows into the former socialist countries. By opening up after decades

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[2] Foreign direct investment (FDI) is a transaction in which an investor based in one country (the home country) acquires assets in another country (the host country) with the intent to manage that particular asset. This management dimension explains the 'direct' aspect of FDI distinguishing it from portfolio investments in foreign stocks, bonds and other financial instruments. (World Trade Organisation, 1996)

of isolation, they suddenly became popular targets of foreign capital. There is a notably uneven distribution of FDI among the CEE countries. Poland, Hungary, the Czech Republic, and Russia have received the overwhelming majority of foreign investments. In terms of cumulative FDI stocks, though Poland slightly overtook Hungary in 1997, the FDI stocks per capita in Hungary is still the highest in the region.

Table 1

Stocks of FDI in the Central and Eastern European countries
(in billion USD and in USD/capita)

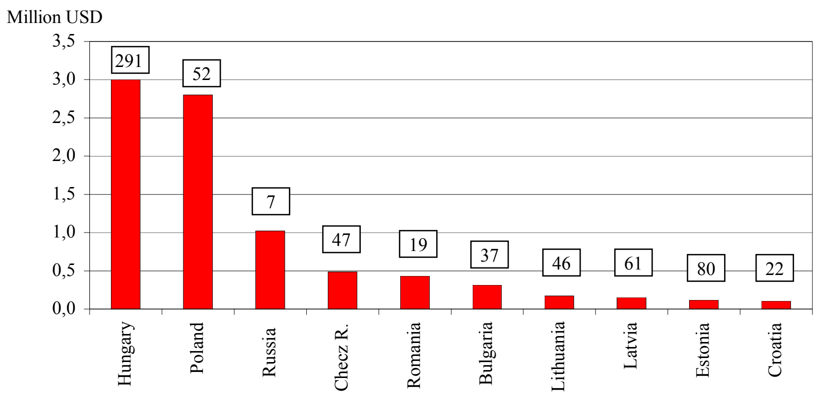
Country	FDI stocks	FDI/capita
Poland	26.6	689
Hungary	22.5	2184
Russia	10.3	70
Czech Republic	7.6	738
Romania	2.8	123
Slovenia	2.4	1200
Croatia	2.1	438
Latvia	1.9	779
Estonia	1.4	966
Slovakia	1.4	259
Lithuania	1.0	270
Bulgaria	1.0	119

Source: Business Central Europe, December 1998, January 1999 p. 65.

Food sector has traditionally played an important role in the economies of all the CEE countries. It has ensured domestic food supply, processed agricultural raw material and in many countries contributed notably to foreign earnings. Restructuring has driven the food sectors into deep crisis in the CEE region. Capital shortage hinders modernisation and productivity improvements. Foreign direct investments are therefore of great importance in the region. Food sector has been a popular target of foreign investors; the shares of agri-food investments of total FDI stocks were between 10 and 20 percent in most of the CEE countries in 1997. Some countries, however, have attracted much more investments to their food sectors than others have. (See Figure 1) Similarly to total FDI stocks, it is relevant to calculate the agri-food FDI/capita figures for each country, since they indicate the magnitude of agri-food investments relative to the size of the population and result in a different order of countries.

Hungary absorbed the largest amount of foreign direct investments into its food sector by 1997. Food processing was one of the first sectors to be privatised. Before 1995, foreign direct investments typically arrived through purchasing state owned food processing companies. Foreigners attained almost half of the registered capital in the privatisation of the food sector that was basically completed by 1996. Investments, continued at the previous intensity also after 1996 primarily in the form of capacity expansion and to a less extent green-field investments. Food processing industries had absorbed nearly 30 percent of capital inflow of all processing industries by 1996, while food industries contributed to the output of processing industries with only 20 percent. Hungarian food sector has received a total of USD 3 billion FDI since 1991. Approximately USD 1.2 billion were spent on acquisitions and the remainder on technology and other general improvements (Eurofood, 1998). The share of foreign ownership in food industries exceeded 60 percent of registered capital in 1997. General motivations of foreign investors have been abundant and cheap raw material, tax incentives and most importantly, an entirely commercial-based privatisation approach.

Figure 1. Cumulative stocks of agri-food FDI in Central and Eastern European countries in 1997



Remark: Figures in the boxes: agri-food FDI capita in USD/capita.
Sources: OECD, (1998) and Business Central Europe, (1999).

This paper consists of three distinct sections. The first section (Chapter 1) focuses on the uneven distribution of FDI among the seventeen food processing industries in Hungary. Foreign investors have apparently preferred certain food processing industries to others. The objective of this study is centred on the question: what factors drove the priority decisions of investors? International experience shows that they favour the same food processing industries throughout Central and Eastern European countries. In order to identify the reasons for the uneven distribution of FDI among the Hungarian food processing industries, a simple econometric model was constructed including the available market power, market size, and sales opportunities and profit rate as explanatory variables.

The second section (Chapters 2 and Chapter 3) includes a cluster analysis in which food industries are grouped into three clusters by their most important characteristics. One food processing industry was selected from each cluster to support the findings of the econometric calculations and illustrate the influence of FDI on a sub-sectoral basis.

The third section (Chapter 4) is a comprehensive assessment of FDI's involvement in the Hungarian food sector. There used to be many fears concerning foreign ownership. Expectations are reviewed in light of the experience accumulated over the past eight years.

1. Priorities of FDI among food processing industries

In many Central and Eastern European countries the shares of foreign ownership in the individual food processing sub-sectors are heterogeneous. This fact is very interesting since the basic FDI encouraging or discouraging environment and public policy directions are the same in a particular host country and its entire food sector.

A question that arises is what drives the decisions of foreign investors to prefer certain food processing sub-sectors to others. Foreign investors tend to prefer the following industries:

– traditionally popular food processing industries in international markets (e.g. confectionery, tobacco, soft drinks, beer),
– industries affected by strict production control in Europe (e.g. primarily sugar and to a less extent dairy),
– 'luxury' high value added, highly processed expensive food articles (e.g. coffee, tobacco, confectionery, soft drinks, spirits, and certain dairy products),
– industries with good or excellent domestic market prospects (usually vegetable oil, tobacco, sugar),
– industries with good export opportunities (export oriented food processing industries vary country by country in the CEE region).

Low foreign interest in individual food processing industries is similarly explained by the following obvious reasons:

– moderate market opportunities (both on the domestic and export markets),
– slow restructuring and privatisation,
– low value added, inexpensive basic foodstuffs,
– administrative obstacles in certain food industries,
– marginal significance within the food sector of the particular host country.

The world-wide phenomenon of globalisation will affect food sectors in Central and Eastern Europe. The same multinational giants have appeared on the food markets of many CEE countries. This process is well-known in sugar, soft drink and tobacco production. It is anticipated to come about also in the confectionery and vegetable oil industries. Slightly smaller but still large European firms will continue to influence the distilling, beer, dairy and meat processing industries.

In order to capture shares on the food markets of CEE countries, foreign firms have either purchased privatised companies or built new production capacity. The share between acquisitions and green-field investments was largely determined by the market prospects and privatisation concept of the particular host country.

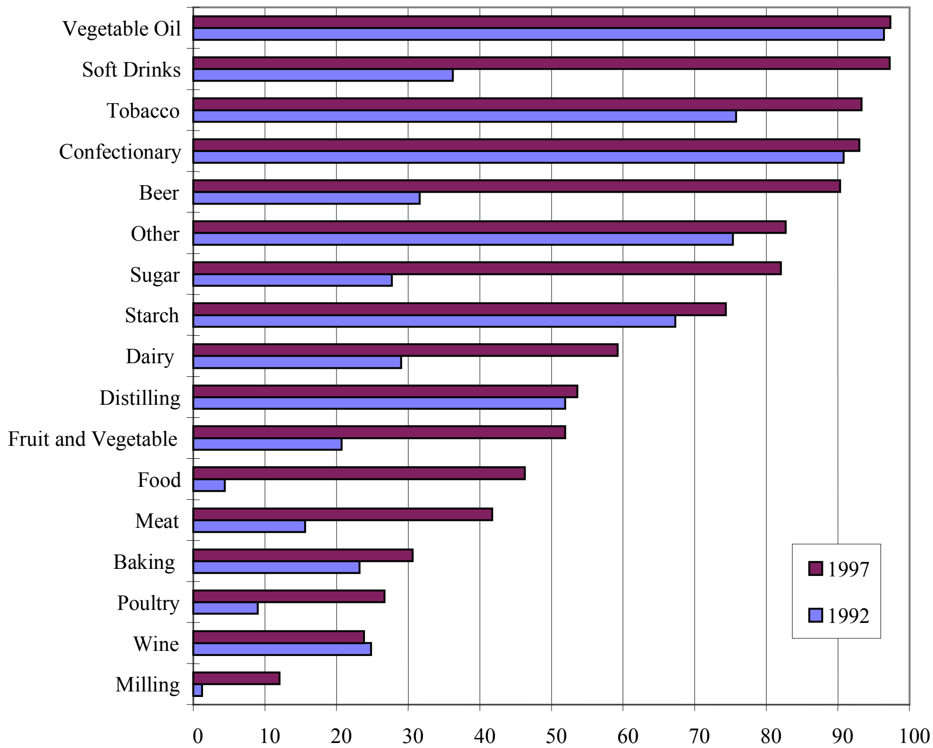
1.1. Distribution of FDI in the Hungarian food sector

Priority considerations of foreign investors related to certain food processing industries have been prominently expressed in the uneven distribution of FDI in the Hungarian food sector. (See Figure 2.) It has apparently followed the general trends that prevail in the CEE countries.

Two phenomena characterise specially the Hungarian food sector. One is the speed of foreign acquisitions. Owing to a rapid start of privatisation, distilling, starch, confectionery and vegetable oil industries were acquired by foreign capital as early as 1992. (See Figure 2.) As a result, foreign investors owned one-third of the entire food sector's registered capital in 1992. The other speciality is the relatively high foreign ownership in even 'less popular' sub-sectors such as meat, fruit and vegetable processing, and feed industry.

The ultimate question is: upon what considerations did foreign firms prefer some food processing industries to others in the Hungarian food sector?

Figure 2. Share of foreign ownership in the registered company capital in Hungarian food processing industries.



Sources: Research Institute for Information and Agricultural Economics, National Association of Food Processors in Hungary.

1.2. Regression analysis

The problem of uneven distribution of FDI among the individual processing industries of the food sector has been pointed out by many studies but has not received much formal analysis. In order to identify the driving forces that resulted in the different levels of foreign ownership, I constructed a regression model.[3] The basic assumptions propound that available market power, market size, sales opportunities and profit rate of each food

[3] The functions in the regression analysis were estimated and tested by E-Views 3.0 software.

industry have affected the amount of foreign investments. The specification of the regression equation is therefore the following:

$$\mathrm{LOG}(FDI) = a_0 + a_1 \cdot \mathrm{LOG}(P) + a_2 \cdot \mathrm{LOG}(NCOS) + a_3 \cdot \mathrm{LOG}(CONC) + \\ + a_4 \cdot \mathrm{LOG}(EXP) + a_5 \cdot \mathrm{LOG}(MS) + \varepsilon$$

where $a_0 \ldots a_5$ are the coefficients of the equation and ε is the error term. Data for 17 individual processing industries were processed in the model. The dependent variable LOG(*FDI*) is the logarithm of foreign ownership share of registered capital in the i^{th} food industry. The applicable explanatory variables were unfortunately restricted by limited data sources. The incorporated variables were the following:

P – profit rate of the i^{th} food industry,
NCOS – number of companies in the i^{th} food industry,
CONC – level of concentration in the i^{th} food industry,
EXP – share of export sales in the total sales of the i^{th} food industry,
MS – share of the i^{th} food industry in the output of the Hungarian food sector.

The impact of market power and market positions was to be captured by the concentration variable. A series of industry-concentration indicators[4] were computed including concentration ratios from CR_1 to CR_{10} and Herfindahl-Hirschman indices. The various indicators were tested in the model and following to the test results CR_4 was selected to be in the final version. Market size was represented by the share of the i^{th} food industry in the Hungarian food sector. Market structure was characterised by the number of companies in the particular food industry. Initially the model was run with 1993 data for explanatory variables and 1997 figures for foreign ownership rates. The reason for such a time-lag was to examine how the 1993 structure and characteristics of food sector affected FDI and contributed to the industry-wise foreign ownership share in the successive four-year period.

Following the 'general to simple' modelling philosophy, insignificant variables were eliminated step by step. Three out of the five assumed explanatory variables turned out to be insignificant. These are quite surprisingly profit rates, number of companies and export shares. The number of companies variable did not carry substantially new information compared with concentration. The initial version of the model resulted in negative coefficient for profit rate, which was due to the erratic profitability performance of the companies under the period of restructuring and privatisation.

The most significant explanatory variable emerged to be industry-concentration followed by market size, which is the share of the i^{th} food industry in the food sector. As a basic conclusion of the model, market power was of highest importance to foreign investors in choosing specific food industrial branches. These results of the model verify such previous assumptions which showed that foreign firms preferred those food industries where concentration level was high and market positions were strong (*Alvincz*, 1994; *Vissi*, 1994).

[4] Appendix I. contains the definitions of CR_k and *HHI* as well as their computed values in the Hungarian food processing industries for 1993 and 1997.

The reduced regression equation was run by using three different functions. All data used in the regression calculation are taken from the data-sets of the Research Institute for Information and Agricultural Exonomics (Agrárgazdasági Kutató- és Informatikai Intézet, AKII). In the case of variables *FDI*, *P*, and *EXP*: AKII 1998a, and in the case of variables *CONC*, *NCOS* and *MS*: AKII 1993 and AKII 1998b. A comparison of the applied functions is presented in Appendix II. After assessing and comparing the results of the various functions, the power function with additive error terms was eventually selected. The results of the model are shown in Table 2. The specification of the equation is:

$$FDI = a_0 \cdot CONC^{a_1} * MS^{a_2} + \varepsilon,$$

where parameters a_0, a_1 and a_2 were estimated by using the non-linear least squares.

Table 2

The results of non-linear least square regression estimation

Variable	Coefficient	Std. Error	*t*-statistic	Probability
C	2.988635	1.73253	1.725012	0.1065
CONC (level of concentration)	1.103067	0.245675	4.489954	0.0005
MS (market size)	0.308789	0.157674	1.958398	0.0704

Basic statistics of the regression:

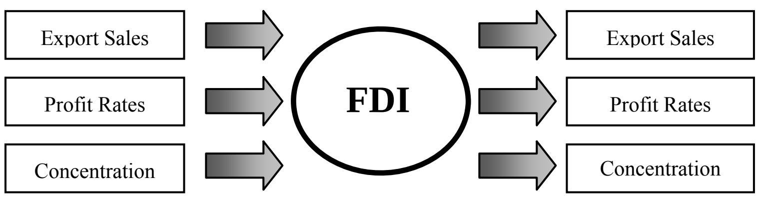
R-squared	0.676825
Adjusted *R*-squared	0.630657
Standard error of regression	0.174801
F-statistic	14.66006
Probability (*F*-statistic)	0.000368

In the case of cross sectional data series, the value of R^2 close to 0.7 is considered very good. The regression model has considerable explanatory power despite the small size of the sample. The *F* test of R^2 is significant at the 1 percent level.

1.3. The effects of FDI in the Hungarian food processing industries

The analysis can not stop at the point of identifying the motives that drive FDI allocation among the food industries.

Figure 3. Analysed impact relations of FDI in the Hungarian food industries.

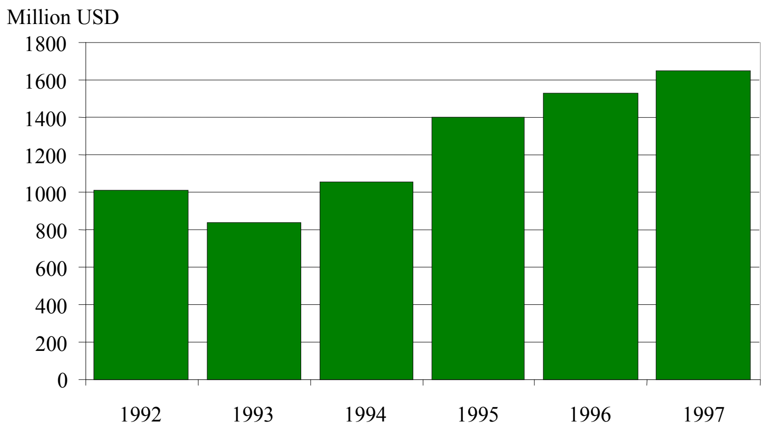


FDI itself has had an impact on the same factors that assumed or proved to determine the share of foreign ownership. FDI is therefore in the middle of an impact flowchart as illustrated in Figure 3. In order to measure the impact of foreign capital, 1993 and 1997 figures of export, profit, and concentration were compared in the food industries.

Exports

Export sales declined considerably in the early 1990s due to severe droughts and the restructuring in agriculture and food industries. Because of rapid and successful privatisation in the food sector, export sales have nearly doubled since 1993. (see Figure 4.) Foreign owned companies greatly contributed to the impressive growth. More than 70 percent of the increase in export sales were generated in food industries that have strong or dominant foreign ownership.

Figure 4. Export sales of the Hungarian food processing sector from 1992 to 1997



Source: Research Institute for Information and Agricultural Economics.

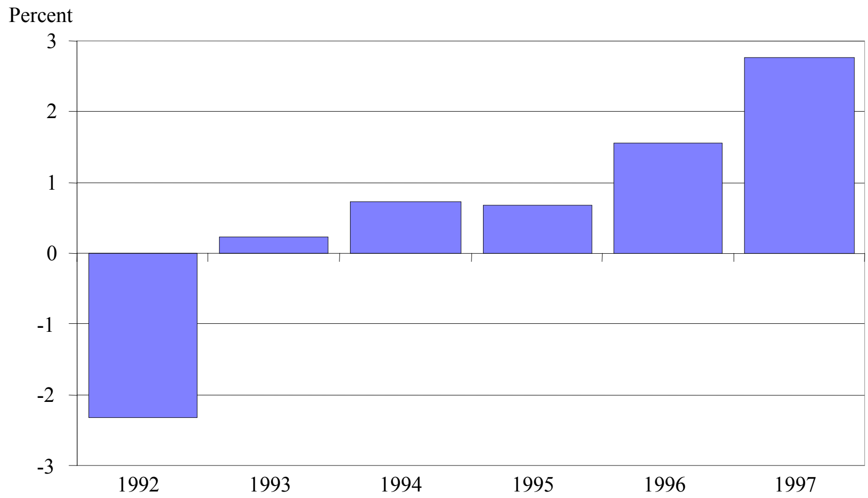
The product structure of exports has not much changed over the past few years. The major exporting industries continue to be poultry, meat, fruit and vegetable processing, and vegetable oil industry. These four industries together accounted for 72 percent of total food exports in 1997. However, the relative importance of exports is also growing rapidly in many foreign capital dominated sub-sectors such as confectionery, beer, soft drinks and tobacco. Export opportunities have grown in relative importance also in the entire food sector, the share of food exports in the total export sales of Hungary increased from 13 percent in 1993 to 21 percent in 1997.

The geographical focus of Hungarian food exports has undergone a distinct shift from East to West over the 1990s. The share of the EU increased to 40-45 percent and the share of CEFTA countries grew sharply from 5 percent in 1993 to over 20 percent in 1998. Exports to the Newly Independent States (NIS) declined to 10 percent by 1998.

Profitability

Profitability in the Hungarian food sector has improved considerably over the past years. High losses of the early 1990s turned to profits in 1993 and have constantly grown since then. (See Figure 5.) The losses at the beginning of the decade and the stable growth of profitability afterwards are attributable to the events of restructuring and privatisation. The reduction of corporate tax rate in 1995 from 36 percent to 18 percent definitely gave an additional impetus to profit growth. Private foreign and domestic ownership propelled the profitability increase. The trend, however, conceals the huge discrepancies of profit rates among individual sub-sectors.

Figure 5. Profit rate of the Hungarian food sector from 1992 to 1997*



* Profit rate = profit before taxes/total sales.
Source: Research Institute for Information and Agricultural Economics.

The majority of industries generated profits in 1997. The impressive 15-20 percent profit rates of vegetable oil and starch industries are obviously due to their monopolistic industry structure. The dominant firms of both the starch and vegetable oil industries are in the hands of foreign investors. Tobacco, coffee and distilling have also healthy profit rates from five to 12 percent. These industries are characterised by strong or dominant foreign involvement. Losses turned to profits of two to five percent in a number of important sub-sectors such as meat, fruit and vegetable processing, feed and confectionery, where foreign participation is also high.

On the other hand, even high foreign ownership has had apparently no positive effects on the profitability of dairy, sugar, beer and soft drink industries. What resulted in an inconsistently varying profitability among the food industries?

1. First, the profit rate of an industry is the sum of profit figures of several companies. The performance of individual companies deviated significantly from average even within the same industry (see Table 4 in the case study of dairy processing).

2. Foreign investors tend to spend a great deal of money on the modernisation of the companies bought through privatisation. Technical, logistic and other developments required a huge amount of additional investments between 1993 and 1997. Many foreign companies expand production capacity and acquire other companies on the market. Investments and company acquisitions might temporarily deteriorate profit performance.

3. Some foreign companies apply ‘hidden profit repatriation’, although they do not admit the fact in public. These companies increase their costs to such a high level that profit earnings fall to zero or even below. In these cases, the beneficiaries of suspiciously high licence and consulting fees for instance often happen to be the foreign parent company of Hungarian subsidiaries.

Present profitability figures are still quite volatile across the industries of the Hungarian food sector. It will supposedly become more transparent as agriculture continues to recover and the investments in the food sector start to affect. A corporate level analysis would certainly enlighten the influence of foreign ownership on profit rates, but company based ownership and profit figures are confidential by nature and they are hard to access to.

Concentration

The change of CR_4 concentration figures between 1993 and 1997 did not follow a uniform pattern among the food industries. Concentration increased in the biggest sub-sectors such as meat, poultry, fruit and vegetable processing, dairy and most prominently in the sugar and beer industries. It did not change in the starch, feed and confectionery industries, and dropped in the rest of other sub-sectors. The primary reasons for declining concentration in particular industries were the following:

– new small companies have been established and so far succeeded to survive in the shade of the giants in the vegetable oil, pasta and soft drinks industries,

– the performance of several big companies within the same industry has been levelled up in the distilling and tobacco industries,

– big companies have lost their importance on the scattered markets of milling, wine and bakery products.

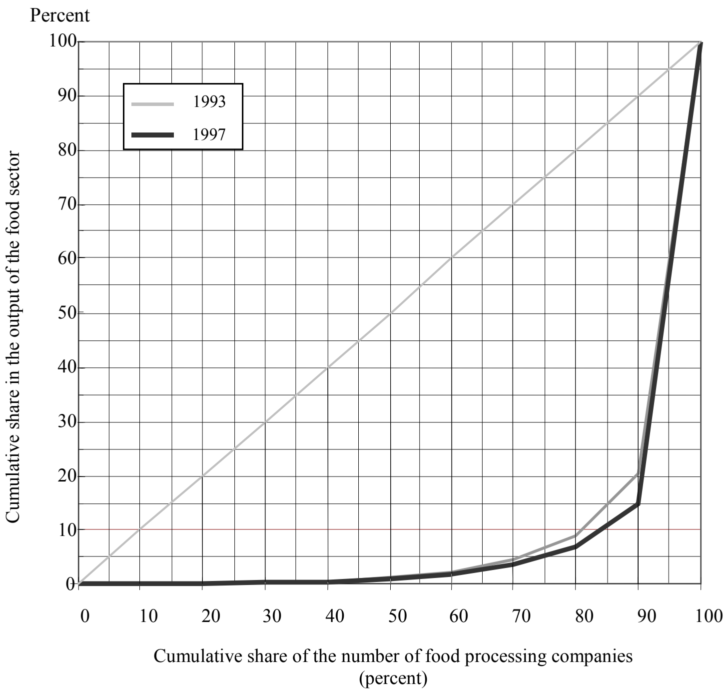
The largest sub-sectors, meat, poultry, fruit and vegetable processing and dairy are subjects to the fiercest competition. These industries are characterised by 10 to 15 medium to big sized firms and many small ones. Big firms are usually in foreign ownership. They manage to aggressively increase market shares at the expense of small or medium size domestically owned firms. Concentration is anticipated to accelerate primarily in the above mentioned large food industries as well as milling and baking industries (*Szabó*, 1997; *Fórián*, 1998).

The change of comprehensive concentration indicator of the Hungarian food sector is illustrated by Lorenz curves and the Gini index.[5] The Lorenz curves in Figure 6 show

[5] The classical application of Lorenz curve and Gini coefficient is an illustration of inequality in income distribution within a certain population. They have been also commonly used to measure market concentration levels. The Gini coefficient (G) is a summary measure of the deviation in the Lorenz curve. It is proportional to the area between the curve and the diagonal line. The value of G ranges between 0 and 1. In the case that all companies have equal market shares, the Lorenz curve is a diagonal line and G=0; in the hypothetical case when one firm controls 100 percent of the market, G=1.

strong inequality among Hungarian food processing companies. As early as 1993, the first decile had a share of 80 percent of total Hungarian food processing, while 90 percent of the companies accounted for only 20 percent of food production. Overall concentration in the food sector increased from 1993 to 1997 thus making the Lorenz curve steeper. The change of the curve indicates a growing market power of the large firms on the expense of the small ones. The Gini coefficient (*G*) verifies and summarises the same trend in one single indicator. The value of *G* has increased from 0.71 in 1993 to 0.75 in 1997 despite the fact that the number of companies grew by 36 percent over the same period. The acquisitions and aggressive growth of foreign owned companies has been a major driving force of increasing concentration of the Hungarian food sector.

Figure 6. The Lorenz curve of the Hungarian food sector in 1993 and 1997



2. Cluster analysis of the food processing industries

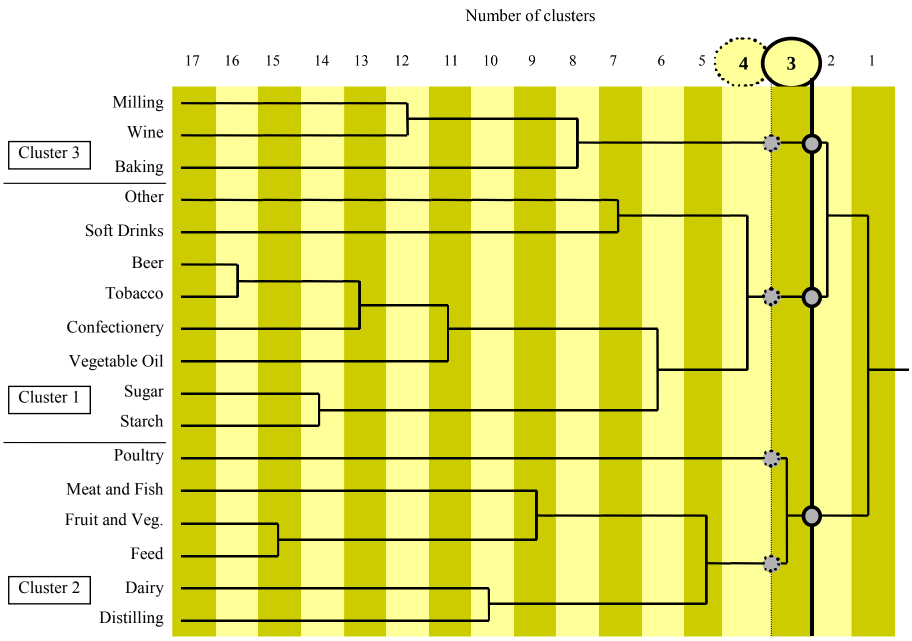
The previously presented regression analysis confirms the assumption that market power has been one of the most important driving forces of foreign investments in the Hungarian food processing sector. We also learned that the share of foreign capital and CR_4 concentration levels of 1997 are strongly correlated with each other. In order to search for further motivations and interests of foreign capital a cluster analysis[6] was carried out based on the 1997 figures of foreign capital share and CR_4 concentration ratios.

[6] The cluster analysis was carried out by using SPSS 7.5 software. The clustering algorithm included hierarchical cluster procedure with average linkage method using Euclidean distances.

Since the number of industries in the analysis is low, the hierarchical cluster procedure was applied.

The tree graph (dendrogram) in Figure 7 was constructed by using the agglomerative method, where each object starts out as its own cluster and the two closest clusters are combined into a new aggregate cluster in subsequent steps. The milling, wine and baking industries connected each other early in the process constituting a tight cluster. Beer, tobacco, confectionery, vegetable oil also formed a tight group in the early phase and incorporated the pairs of sugar and starch, and other processing and soft drinks a few levels later in the cluster combine process. The third cluster consists of meat and fish, fruit and vegetable, feed, distilling and dairy industries with poultry industry joining the group only on the three-cluster level. Poultry processing as an outlier has formed a totally separate cluster long up to the four-cluster level.

Figure 7. Dendrogram of the cluster analysis of Hungarian food processing industries



The following verbal interpretation of clusters demonstrate that three- and four-cluster levels are relevant to the classification of the Hungarian food sector.

Cluster 1. – High foreign ownership and high concentration cluster

Cluster *1* includes highly concentrated industries that attracted over 70 percent of foreign ownership. All of these industries have small shares (one to five percent) in the total food sector. (See Figure 9.) They have either monopolistic (starch, vegetable oil) or oligopolistic (coffee, tobacco, sugar) market structures, or they are characterised by the co-existence of a few large companies and dozens of small-scale enterprises (beer, confectionery, soft drinks, paprika). The majority of Cluster *1* industries produces 'luxury', highly processed and relatively expensive food articles. This advantage coupled with excellent 'inside-industry' market positions resulted in the fact that the industries in Cluster *1* were privatised first and bought by foreign investors rapidly, almost 'in a hurry' before 1993.

Cluster 2. – Average foreign participation and average concentration cluster

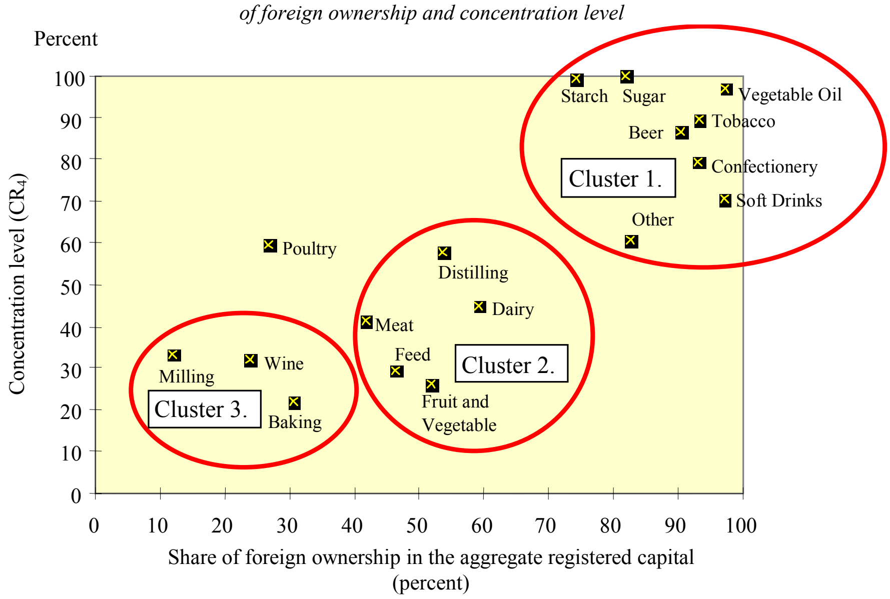
Cluster *2* includes the largest industries that together account for half of the total food production of Hungary. With the exception of distilling, each contributes to the output of the food sector with 8 to 17 percent. These industries consist of several huge processing companies. The output of the industries in Cluster *2* is a range of basic foodstuffs. Since these sub-sectors are involved in first stage processing and rely heavily on agricultural raw materials, they were badly hit by the market crisis of agricultural products in the early 1990s. The companies struggled with over-capacity and outdated equipment. That slowed restructuring and privatisation. Export had always been an important strength of these industries but they needed to be redirected to new markets after losing the traditional eastern ones. Foreign companies therefore cautiously started to invest into these industries. They bought the biggest and healthiest companies gradually between 1993 and 1996. The main factors of FDI motivations in Cluster *2* were large domestic markets and good exporting opportunities. This cluster consists of industries with good growth prospects, therefore foreign capital share is expected to increase which, in turn, will result in strengthening concentration among the companies of these industries.

Cluster 3. Low foreign participation and low concentration cluster

Cluster *3* includes also rather small processing industries, which contribute to the output of the food sector by two to seven percent. The structures of these industries are rather scattered having many processing units of similar sizes. Since baking and wine producing companies are not very big, it was hard for foreign investors to acquire significant market positions in these industries. Baking activities in Hungary usually cover a very small local market with the exception of a few large companies operating on concentrated markets such as Budapest. Winemaking is closely tied to basic agricultural activity. The fact that foreigners are still not allowed to own land in Hungary has hindered their involvement in winemaking. Milling was excluded from foreign investments for strategic and political considerations. The low participation of FDI in Cluster *3* can therefore be explained by the scattered structure of these industries and administrative discouraging reasons.

The clusters are based on the proximity of observation points to one another. (*Hair* et. *al*., 1995) Therefore, the relation and position of cluster members can be illustrated graphically as well. The score of each observation on the two variables are plotted on a chart in order to verify the clusters that were derived from the formal application of cluster analysis. The scatter-plot diagram confirms the relevance of relying on the results of three and four cluster levels. Poultry processing is rather far away from all three clusters and therefore, may constitute its own fourth cluster. On the three cluster levels it connects to Cluster *2*.

Figure 8. Scatter plot of food processing industries by the intensity of foreign ownership and concentration level



Remark: data from 1997.

Table 3

*Summary of characteristic profiles of clusters**

Variables	Cluster 1.	Cluster 2.	Cluster 3.
*n***	8	6	3
Share of FDI in registered company capital (percent)	over 80	40–60	10–30
CR_4 ratio (percent)	over 60	25–60	under 35
Domestic market size (in USD million)	40–260	350–1 000	80–420
Export capability (in USD million)	10–150	50–400	25–72
Labour productivity (in thousand USD/employee)	60–300	40–100	20–70
Number of firms (cluster average in brackets)	7–187 (73)	84–282 (116)	122–594 (303)
Type of products	‘luxury’ items and beverages, high value added	basic food items and intermediary products	basic food items and intermediary products

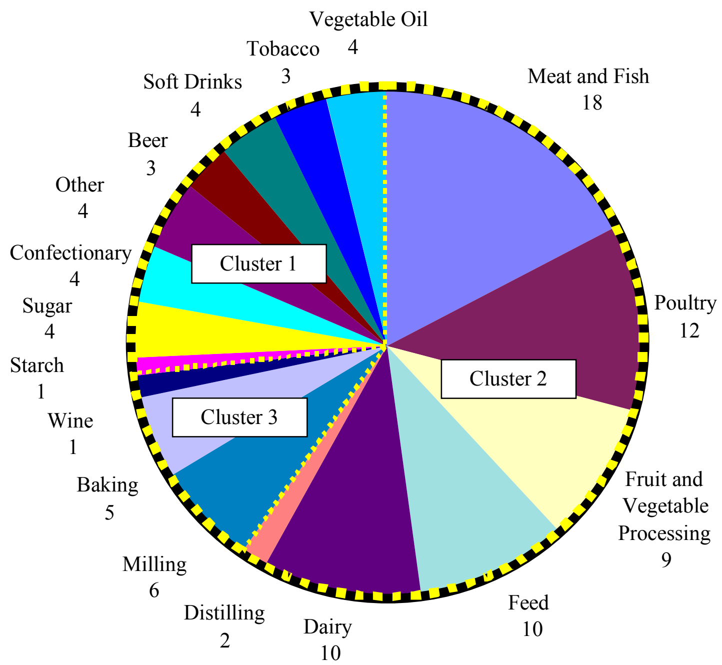
* Data from 1997.
** *n* is the number of sub-sectors in the cluster.

As indicated in the previous verbal interpretation, cluster members show resemblance in many more aspects than the share of foreign capital and concentration level. Table 3 summarises the characteristics of food processing industries on the three cluster levels. Poultry processing industry has most of the characteristic features of Cluster *2*, however, in terms of foreign capital it is closer to Cluster *3*. Distilling industry from Cluster *2* converges towards Cluster *1* in the aspects of market size and types of products. Figure 9 illustrates a combined indicator of domestic market size and export capability showing the shares of cluster members in the output of the Hungarian food sector.

The analysis of the content of the cluster summary table reveals additional interesting phenomena about the behaviour (motivations and performance) of foreign investors. Foreign capital feels most comfortable in relatively small sub-sectors with high level of market concentration and low number of participants. The product groups in Cluster *1* have promised the best prospects for demand growth, once income levels start to grow significantly in Hungary and in other CEE countries. Productivity is far the highest in industries of Cluster *1*, which is a distinct result of rapid modernisation and capital infusion.

Foreign investors are becoming increasingly active also in the industries of Cluster *2*. They take advantage primarily of domestic and export market sizes. Modernisation of these industries has been a slower process partly because privatisation started later and partly because financially strong foreign owned companies account for approximately 50 percent of the production in the cluster.

Figure 9. The share of food processing industries in the output of Hungarian food sector
(percent)



Source: Research Institute for Information and Agricultural Economics.

The example of sub-sectors in Cluster *3* indicates that foreign investors are not particularly interested in capturing companies with modest market shares on small markets. Productivity figures in these industries are among the lowest in the entire food sector.

3. Case studies on selected food industries

The following case studies elaborate the situation of one food industry from each cluster described above. Vegetable oil industry was selected to illustrate Cluster *1*; dairy industry exemplifies Cluster *2*, while milling industry demonstrates Cluster *3*.

3.1. Vegetable oil

Vegetable oil industry probably induced the most serious debates about privatisation procedures. One single monopoly used to dominate the vegetable fats industry. The Hungarian decentralisation policy that split most of the former food processing giants left the vegetable oil processing monopoly intact. Although domestic buyers were very interested to purchase the company, they did not have sufficient resources for the transaction. The monopoly was eventually bought for USD 120 million by Cereol Corp[7] affiliated with the Italian Feruzzi Group. The State Property Agency (SPA) compelled Cereol to use certain amount of domestic raw material and improve the processing lines in technical and environmental terms. The company is presently owned by Eridania-Beghin-Say (EBS).

In 1992, a few sunflower seed producers submitted a complaint to Economic Competition Office (ECO) accusing Cereol of paying unfairly low price for raw material. Although ECO finally disapproved the complaint, Cereol raised its procurement prices to the satisfaction of raw material producers. Cereol is still far the largest firm in the industry accounting for 93.5 percent of total production in 1997. The rest of the companies have all been established within the past ten years. They are small crushing units often specialising in market niches (special oils, bio-products etc.).

Many considered the survival of the vegetable oil processing monopoly and its transfer to foreign ownership as bad strategic mistakes and a dangerous precedent in the privatisation of the food sector. The ECO was not authorised to veto the acquisition, but decided to thoroughly monitor the activities of Cereol based on the Price Act.[8] The dominant firm position was expected to imperil the interests of raw material producers and consumers. Experience did not verify these fears, in fact there are many positive features in the industry. Cereol learned a lesson from the 1992 procurement price incident. The dissatisfaction of raw material producers is not a good business policy, in fact it may endanger its own production. Therefore, Cereol have raised procurement prices that are now close to world market level.

Cereol fully met its development obligations assigned by SPA. It modernised and expanded processing capacities. Bottling capacity grew by over 300 percent after the takeover. The high debts of the former state monopoly were paid and losses were turned to at least 8 to 10 percent profit by as early as 1995. The company accounts for the huge majority of the 400 percent growth of Hungarian vegetable oil exports between 1992 and 1997. Productivity of the Hungarian vegetable oil processing industry jumped sevenfold from 1992 to 1997. On the other side of the coin there is the interest of consumers. They have had to pay higher prices for better quality products and better packaging.

[7] The whole name of the Hungarian subsidiary is Cereol Hungary Co., the case study refers to it by the short version.
[8] The Price Act authorised the ECO to intervene and block the price increases of monopolies between 1991 and 1994.

Cereol apparently intends to maintain good corporate and business relations. In order to ensure raw material supply, it co-ordinates the production of oil-seed producers. Vegetable oil industry and indirectly Cereol offers the second highest wages among the food industries. The rate is twice as much as the average wage level in the Hungarian food sector. Some of the fears about letting foreign investors have a food processing dominant firm did not prove to be real. However, Cereol firmly takes advantage of its dominant position.

3.2. Dairy

Dairy industry provides one of the most colourful and illustrative cases of foreign ownership in the Hungarian food sector. The structure of the dairy industry was rather plain in the 1980s. There were only some co-operative processors besides the Dairy Trust Company, which controlled 85-90 percent of the market. Through the restructuring process, the state monopoly was decentralised into 16 units out of which some were split even further. SPA decided to involve domestic milk producers and other domestic investors into the privatisation. They offered compensation coupons and tried to use favourable credit lines to buy dairy processing companies. Foreigners, however, were more successful in the bidding process and managed to grasp the biggest and most prosperous processing units.

Dairy companies have traditionally focused on the domestic market in Hungary. Processing facilities are geographically scattered and cover the entire area of the country. Foreign firms aimed to buy dairy factories close to Budapest. They have invested huge amounts into quality improvements, packaging, marketing distribution and logistics. At present, there are five big foreign firms in the Hungarian dairy industry: Parmalat, Danone, Bongrain, Nutricia and Gala Italia. One big group, Baranyatej–Mizo was in domestic ownership until 1999. Besides the biggest firms, dairy industry consists of over 60 companies of various sizes. In the severe competition for market share, the companies have no other choice than growth. Many of the dozens of domestically owned companies are financially weak and operate with outdated equipment. They often have poorly organised raw material supply and old fashioned product-mix. The small factories are easy prey for the expanding strong ones that usually buy them for their market share.

The performance of the big firms is not homogeneous. They all have their own strategic leading product group (UHT milk, fresh milk, fruit yoghurts, desserts, cheese, milk powder and baby foods). Although total assortment of the companies is wide, there is a relatively small overlap among the strategic products (*Szabó*, 1996). Another big difference can be found in their marketing strategies. Some put emphasis on promotion, others on distribution or pricing. The altering strategies, price margins, marketing orientation and investment schedules have resulted in an enormous discrepancy among the profitability of the companies. Table 4 shows data for 1996. The performance of individual companies might vary from year to year, yet the table illustrates the phenomenon of having substantially different profit rates even within the same industry.

Concentration in the dairy industry started in 1995 and has speeded up since 1998. The CR_4 measure of concentration (the market share of the four biggest companies) has increased significantly. CR_4 was as low as 29 percent in 1995; it grew to 36 percent in

1996. In these years the most active buyers were the French Bongrain S. A. and Hungarian-owned Baranyatej.[9] CR_4 jumped to 45 percent in 1998 and approached 52 percent by the end of 1999. Recently Gala Italia and Dutch-owned Nutricia have stimulated concentration growth. Nutricia acquired a number of smaller companies in its surrounding area, while Gala Italia purchased Avonmore in 1999. CR_4 is expected to reach 65 percent by 2002. Concentration will primarily grow through acquisitions, but some of the big ones might expand by reinforcing their present corporate premises. The six biggest firms are anticipated to further generate the growth of concentration.

Table 4

The performance of major dairy processing companies in Hungary in 1996

Company	Majority ownership	Total sales (in USD million)	Profit/loss (in USD million)	Share of profit/loss to sales (percent)
Danone	French	57.8	5.54	9.6
Tolnatej	Hungarian	34.7	2.16	6.2
Répcelak-Bongrain S.A.	French	24.6	1.10	4.5
Avonmore	Irish-Dutch	24.0	0.49	2.0
Szabolcstej	Hungarian	43.2	0.77	1.8
Zalkatej	Hungarian	11.8	0.17	1.4
Ceglédtej	Hungarian	16.0	0.12	0.8
Veszprémtej-Bongrain S.A.	French	33.9	0.18	0.5
Északtej	Hungarian	22.4	0.01	0.03
Fejértej-Parmalat	Italian	65.3	0.01	0.02
Hajdútej-Nutricia	Dutch	74.2	-0.03	-0.04
Baranyatej	Hungarian	53.1	-1.00	-1.9
Győrtej	Hungarian-Austrian	47.1	-1.01	-2.1
Class Tej	Hungarian	12.9	-0.61	-4.7
Szegedtej-Gala Italia	Italian	34.1	-1.99	-5.8
Zalatej-Bongrain S.A.	French	21.1	-2.67	-12.6

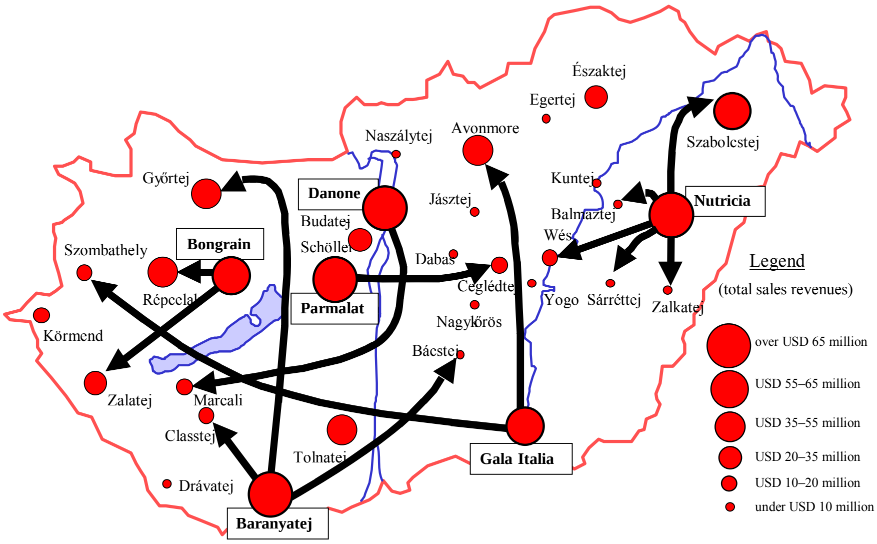
Source: Heti Világgazdaság, August 16, 1997. p. 116.

The Hungarian dairy industry still suffers from redundant capacity. At present, about one-third of the dairy processing capacity is not utilised. Big companies, therefore, will supposedly close down some of the purchased companies to secure their own market growth. Besides big multinationals currently present on the market, one or two more foreign companies might possibly enter the market by purchasing well-managed Hungarian middle scale companies such as Tolnatej. There are dozens of small dairy companies, the annual revenues of which stay under USD 10 million and their share is predicted to total a bare 15 percent of the Hungarian dairy market by 2002 (*Szabó*, 1998). Many of these small dairy companies will eventually fall in the intensifying competition. Yet some of them might survive, provided they concentrate on market niches and speciality products, make co-operation agreements with large supermarket chains or are located in

[9] The Dutch-based concern Friesland Coberco Dairy Foods received one-third of the shares in Baranyatej in the summer of 1999 by validating its formerly acquired collateral rights. The Dutch company, however, is reluctant to get the controlling package of the indebted company. Friesland Coberco is expected to entirely withdraw from Baranyatej-Mizo and most probably let the company fall.

geographically unimportant segments of the market (e.g. by the country border). Figure 10 illustrates the process of concentration growth in the Hungarian dairy industry. The six biggest companies are highlighted on the map. The sizes of the companies refer to total sales revenues in 1996 and 1997.

Figure 10. Company acquisitions in the Hungarian dairy industry 1995-1999
(the arrows indicate the directions of purchases)



3.3. Milling

The milling industry is an illustrative example of Group 3, where both the level of industrial concentration and foreign ownership are very low. Before privatisation, the milling industry included 20 grain trading companies (one in each county of Hungary) that encompassed large mills with extensive storage capacities. There were also about a hundred small and middle-scale mills in the industry.

Due to the strategic importance of grain production in the Hungarian agri-food sector, SPA followed a line of privatisation strategy different from that of other food industries. Large processing units were decentralised and mills were offered to domestic agricultural producers and private investors mostly for compensation coupons. It was quite an exceptional phenomenon in the food sector that privatisation strategy directly favoured domestic investors, although foreign capital also showed interest. Privatisation resulted in an atomised production structure and low foreign participation.

At the beginning of the 1990s, the milling industry lost its eastern markets. The oversized processing capacity and outdated equipment in the industry has brought up fundamental problems in the recent three years. Due to overproduction, the depressed flour prices did not cover processing expenditures. The small mills cannot push down expenditures any longer. Dozens of them will be driven into bankruptcy in the very near future.

During the beginning of the privatisation process, in 1993 and 1994, agricultural producers (mainly farmers' co-operatives) acquired the majority of the milling industry. Ownership structure has changed rapidly since then. Agricultural producers suffer from the lack of working capital; therefore they prefer short-term financial remedies. Agricultural producers could not handle the conflict of raw material suppliers and owners of mills at the same time. In the tight financial situation many have preferred high grain prices and disregarded owner-minded long-term considerations. In order to ease financial problems and improve liquidity, agricultural producers quickly sold their shares to other domestic private investors. Despite a thoroughly designed privatisation strategy, vertical co-ordination lead by agricultural producers did not last long in the milling industry. Hungarian investors that have bought mills recently are not strong enough to be the main initiators in the grain sector, either. Foreign capital is almost imperceptibly penetrating the grain chain from another end that has not been controlled by privatisation policies. Foreigners have purchased many grain trading companies, which have traditionally handled the huge amount of Hungarian grain exports. These companies have already started to make acquisitions in the milling industry and the next target is going to be the baking industry. They are financially strong to become the main actors of the grain chain in the next years. The increase of foreign capital will be accompanied by a rising concentration level in the milling and baking industries.

4. Assessment of FDI in the Hungarian food sector

Taking into account the analyses and the case studies of the former sections a general evaluation of the Hungarian food sector can be given.

4.1. Fears and concerns

Privatisation and foreign ownership constituted a controversial issue in Hungary in the early 1990s. It generated a lot of fears and resistance. Foreign capital implied a great deal of uncertainty for both agricultural producers and consumers. Most of the fears assumed foreign capital to act unfairly.

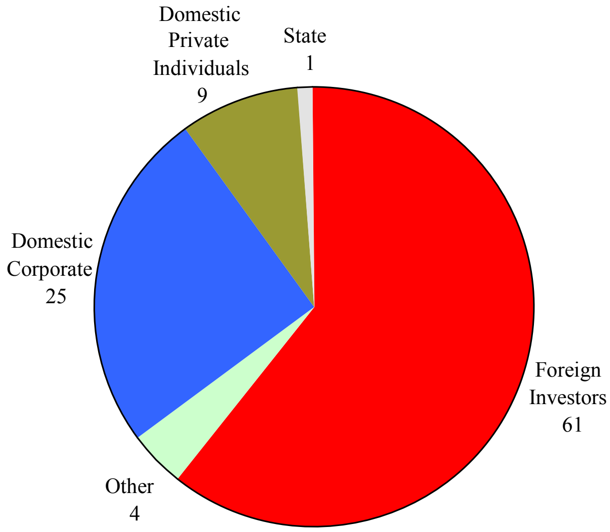
An extreme political direction accused SPA and the Hungarian State of selling and wasting domestic property by letting it out of domestic hands. Some analysts apprehended about short-term objectives and possible profit repatriation of the foreign companies.

Privatisation and foreign acquisitions in the Hungarian food industry started as early as nine years ago. By the end of 1996, privatisation of the food sector was completed leaving an insignificant portion of registered capital in state ownership. (See Figure 11.)

During the relatively long presence of foreign capital in Hungary, considerable experience has been accumulated, so it is time to make an assessment on the behaviour of foreign investors. Has the anxiety regarding foreign capital investments proved true in the Hungarian food sector?

Hungarian commercial type privatisation indirectly promoted foreign investments. Agricultural producers and other domestic corporate and private investors could obviously not compete with large financially strong companies in the bidding process. SPA has often been blamed for sacrificing long-term domestic interests for short-term state budget revenues. Generally, domestic investors have received little administrative and financial support in the Hungarian privatisation. Nor have they been granted a strongly demanded 'positive discrimination'. Agricultural producers and domestic investors managed to acquire some shares in the milling, dairy, poultry, canning and frozen food industries, but they were entirely excluded from the privatisation of several important food industries. Foreign firms purchased big chunks of the food processing capacity and started to concentrate market power by fusions and more acquisitions. The ownership structure of registered capital in the food sector will shift towards the growth of foreign ownership on the expense of domestic owners in the future.

Figure 11. Ownership structure in the Hungarian food sector at the end of 1997
(percent)



Source: National Association of Food Processors in Hungary.

Foreign direct investments implied risks for agricultural producers, domestically owned food processing companies and consumers.

1. FDI involves benefits and risks for *agricultural producers* at the same time. On one hand, foreign-owned food processing companies constitute purchasing power for agricultural produce. On the other hand, agricultural producers have no influence and control over vertical relations. Being subordinates to the processing and trading companies makes agricultural raw material producers rather vulnerable in the chain. Benefits, however, surpass risks considerably. Sure markets and financially strong buyers have contributed to the survival of many agricultural producers. One of the biggest risks for raw material producers is hidden in the EU membership of Hungary. Whether foreign-owned food processing firms will continue to procure Hungarian raw material or will look for foreign substitutes on the homogenous European market is yet uncertain. International experience suggests that multinational food processing firms rarely make their decisions on national or emotional basis. They always purchase raw material from the most competitive sources. Hungarian producers will certainly have comparative advantages in many cases. Hungarian producers themselves can reduce and/or eliminate this risk by improving the efficiency of agricultural production by the time of Hungary's accession to the EU.

2. Another risk concerns the subsistence of *domestically owned food processing companies*. There is a considerable technological gap between foreign and domestically owned companies. The survival of the small and medium-scale processing firms will be subject to their development in technological terms, management attitude and the availability of alternative capital sources. Many of them will go bankrupt that will contribute to the growing concentration of a number of food industries. Competition will, however strengthen the vital ones and prepare them for the EU markets.

3. The fears related to more expensive and new food consumption patterns have partially proved real. *Consumers* had to pay the expenses of modernisation in the case of numerous food articles. Traditional low-price domestic substitutes were squeezed out of the market (e.g. carbonated soft drinks), but many foreign companies have continued to take advantage of the popularity of well-known domestic brands (e.g. tobacco, confectionery).

Foreign companies definitely have long-term objectives on the Hungarian market. After privatisation, they invested an additional USD 1.2 billion into the Hungarian food processing sector. Many companies have invested large amounts using a lot of external capital. At the same time, some profit has already been taken out of the country. The amount is not significant and the phenomenon of profit repatriation is a normal business activity in international capital trade.

The industry-based case studies illustrate the major dilemma of the privatisation of the Hungarian food sector. *Márton Szabó* best expressed the dilemma: 'privatisation strategy had to make its choice of two options, either to have weak but Hungarian food companies or strong but foreign ones' (*Szabó*, 1997).

Vegetable oil monopoly, for instance, would have certainly been a food industrial gold mine for the Hungarian State, but it would not have had sufficient resources to modernise the industry for several years. The examples of dairy and milling sectors prove the weakness of domestic agricultural producers as potential investors. It would be preferable to let agricultural producers build vertical relations and own up- and downstream companies like in Western Europe; but at least presently, Hungarian agricultural producers fight for their very survival and struggle with financial difficulties.

Recession and restructure of the Hungarian agriculture in the 1990s had decimated producers. Many food processing companies were financially very weak before privatisation. The entire agri-food chain was badly hit by capital shortage. In such a crisis, the only feasible solution was the involvement of external resources. Foreign direct investments have conveyed the desired capital injection into the Hungarian agri-food chain, their overall influence on the Hungarian food sector is definitely positive.

4.2. Results

Foreign investors are the primary contributors to the stabilisation of the Hungarian agri-food chain. Having captured the processing and trading segments, they have a growing impact on other elements of the food chain such as trading.

Food processing industries have highly benefited from FDI. Financial vitality and technology level of the companies has improved significantly. The overall labour productivity of the Hungarian food sector increased by 65 percent from 1992 to 1997. Domestic food supply and exports became stabilised. Modernisation resulted in improved competitiveness on international markets.

Secondary benefits are of no less significance. Large food processors provide predictable and continuous market for agricultural raw material producers. Strong foreign companies force small and medium size processors to keep up with competition. New management, marketing, information, logistic and financial methods have been introduced by foreign companies. These management concepts have spread out and have been adapted by other domestic food processing companies. Average wages in foreign capital dominated food industries have also grown rapidly. They are two to four times bigger than the average Hungarian wage level.

5. Conclusions

The anticipations concerning Hungary's accession to the EU represent a mutual section of interests and benefits. On one hand, foreign investors already envisage a homogeneous and unified market where market shares acquired in Hungary will be added to the total share of EU market. This expectation definitely applies to food products. Severe competition prevails on the saturated food markets of the EU and output is strictly controlled by quotas or other measures. On the other hand, Hungary considers FDI as an essential contributor to the improvement of the food industries. A developed food sector is a fundamental requirement on the way to the EU membership and only a competitive food sector will be able to succeed on the EU market.

Considerations that motivated foreign investments in the transitional economies differ to some extent from the regular corporate and country specific advantages that usually drive FDI among the developed countries. *The major motivations of FDI to Hungary enlighten some of the country's comparative advantages* compared to the food sectors of other CEE countries. These primary driving forces were the following: *1*) rapid corporate restructuring, *2*) privatisation of companies on a commercial basis, *3*) rapid legal reforms, *4*) availability of inexpensive and abundant production inputs: agricultural raw material, labour and food processing capacity, *5*) tax breaks and tax exemptions.

The high share of FDI in the Hungarian food sector has been mutually beneficial both to foreign investors and to the Hungarian food sector. Multinational companies have often struggled with a problem of growth on the mature developed markets. Spreading to new emerging markets coupled with the cost efficient production opportunities was a strategic necessity for many companies in their 'growth-squeeze'. Investments have recently started to pay off; sales and profit are in a growing phase in the Hungarian food sector. As for the Hungarian food sector, FDI was both a necessity and an opportunity. The deep crisis at the beginning of the 1990s could not be resolved without the involvement of outside resources.

The dilemma of having weak but domestically owned or strong but foreign owned food processing companies is an issue to be resolved in all Central and Eastern European countries. The Hungarian example proves that the latter one is a rapid remedy for the structural agricultural crisis with no significant adverse symptoms. CEE countries that aspire for EU membership on the short or middle run are forced to upgrade their food industries and increase competitiveness of the entire agri-food sector. Within the given time span, there seem to be no other relevant options to overcome capital shortage and modernise food industries than attracting foreign investments.

The empirical section of this study confirms that concentration level is the most significant determinant in explaining the uneven distribution of FDI among the various food industries in Hungary. Market prospects, primarily domestic and secondarily export opportunities and the absolute size of the particular sub-sectors explain the attracting power of individual food industries. In other words, the price of food industrial modernisation was letting foreign investors have control over domestic food markets. The results of the regression model uncover the fact that profit rates prior to the acquisitions in the various industries did not affect the preference of investments. Foreign investments, however, have contributed to the growth of profit and export sales of the food sector over the recent years.

Studies that examine the experience of high foreign involvement in the Hungarian food sector will be worthwhile for both investors and CEE countries. Investors can use the findings to decide about continuing their capital expansion to other Central and Eastern European countries. By using the positive and negative lessons learnt from the Hungarian case, CEE countries on their behalf may modify or reinforce their attitudes to FDI that specifically targets the food sector.

The empirical research can be expanded to a direction of profit rate and export analysis based on individual company data. The construction of such an econometric model is highly dependent on the availability of corporate information. It would certainly enlighten the real role of profit and export in motivating FDI tendencies. Such studies would provide additional information to other CEE countries as well.

APPENDIX I

Concentration indicators

a) CR_k ratios

The formal specification of the CR_k concentration ratios is the following:

$$CR_k = \frac{\sum_{i=1}^{k} X_i}{\sum_{i=1}^{n} X_i}$$

where:

X_i is the total revenue of company i, /the revenues of individual companies ($X_1, X_2, \ldots X_n$) are arranged in descending order/,

k is the coverage of concentration ratio,

n is the total number of firms in the particular industry.

CR_k ratios are the most widely used indicators for measuring the strength of market concentration in the international economic literature. Commonly calculated ratios are CR_3 , CR_4 , CR_8 , and CR_{10} , out of which CR_4 has been applied in several research studies (*Shepherd*, 1990, pp. 109-111). CR_4 may also be used to conclude whether a market has oligopolistic structure. CR_4 is widely used also to measure food industrial concentration levels (*Hyvönen* and *Kola*, 1998; *O-Nagy* and *Szabó*, 1996).

b) Herfindahl–Hirschman index (HHI)

HHI index is determined by summing the squares of the market share percentage (*MS*) of each participant company on the particular market:

$$HHI = \sum_{i=1}^{n} MS_i^2$$

The value of *HHI* can vary from 1/*n* to 10 000 points. The higer value of *HHI* indicate a higher degree of (relative) concentration, however, this indicator is sensitive to the number of units. If the number of agents (firms) is large enough, the values of *HHI* can be assessed as follows. Competition prevails on the market when *HHI* is under 800. If *HHI* rises above 1 000 points, the market is imperilled by over-concentration (*Kopányi*, 1993). The particular market is considered highly concentrated when *HHI* exceeds 1 800 points.

Concentration indicators in the Hungarian food industries in 1993 and 1997*

Food processing industries	1993				1997			
	CR_3	CR_4	CR_{10}	*HHI*	CR_3	CR_4	CR_{10}	*HHI*
Meat and Fish	25.8	31.0	53.9	428	29.1	35.3	60.6	507
Poultry	40.1	46.9	81.5	841	48.5	60.1	84.2	1 074
Fruit and Vegetable	19.4	24.5	48.4	317	20.9	26.3	51.0	342
Vegetable oil	98.8	99.1	99.8	9 360	97.3	97.7	99.1	8 865
Dairy	26.7	33.0	59.9	470	32.2	39.7	70.9	627
Milling	35.0	43.2	74.0	684	26.6	34.5	63.6	501
Starch	99.6	99.9	100.0	9 044	99.3	99.6	100.0	9 459
Feed	23.7	29.3	52.4	371	23.0	29.6	54.8	385
Baking	20.8	25.3	41.3	277	19.0	21.9	32.5	197
Sugar	43.1	54.4	95.9	1 074	100.0	100.0	100.0	3 855
Confectionery	74.1	79.5	91.2	2 448	75.0	78.3	89.6	2 375
Other	70.7	77.1	92.0	2 077	54.4	60.8	83.4	1 312
Distilling	61.4	70.3	91.3	2 003	50.0	57.7	79.7	1 059
Wine	37.2	42.5	63.8	799	26.3	32.2	52.2	398
Beer	60.1	69.6	95.8	1 593	78.6	86.6	98.4	2 352
Soft Drinks	78.7	81.9	92.7	3 420	70.4	76.7	91.1	2 055
Tobacco	93.7	97.3	100.0	2 993	82.8	89.7	100.0	2 641

* CR_k ratios are given in percentage form.

APPENDIX II.

The specification and results of the applied functions in the regression analysis

The initial form of the regression function is:

$$FDI = a_0 + a_1P + a_2NCOS + a_3CONC + a_4EXP + a_5MS + \varepsilon$$

After variables *P*, *NCOS* and *EXP* have been removed, the specifications of the applied functions/methods have taken the following forms:

– linear:

$$FDI = a_0 + a_1 CONC + a_2 MS + \varepsilon$$

– double logarithmic:

$$\ln(FDI) = a_0 + a_1 \ln(CONC) + a_2 \ln(MS) + \varepsilon$$

– power function (with additive error term):

$$FDI = a_0 * CONC^{a_1} * MS^{a_2} + \varepsilon$$

The table includes the main results of the regression analysis:

Function/Method	Linear			Double logarithmic			Power		
Variables/Statistics	*C*	*CONC*	*MS*	*C*	*CONC*	*MS*	*C*	*CONC*	*MS*
Coefficient	-0.133	1.052	2.322	1.420	1.176	0.420	2.989	1.103	0.309
Standard Error	0.218	0.238	1.559	0.895	0.340	0.235	1.733	0.246	0.158
t-statistic	-0.613	4.416	1.489	1.588	3.461	1.789	1.725	4.490	1.958
Probability	0.550	0.001	0.159	0.135	0.004	0.095	0.107	0.001	0.070
R-squared	0.6287			0.4808			0.6768		
Adjusted *R*-squared	0.5757			0.4066			0.6307		
St. Error of Regression	0.1874			0.4662			0.1748		
F-statistic	11.8533			6.4824			14.6601		
Probability of *F*-statistic	0.0010			0.0102			0.0004		

REFERENCES

ALVINCZ, J. (1994): Az élelmiszergazdaság privatizációja különös tekintettel a külföldi tőke bevonására. PhD thesis, Budapest.

ALVINCZ, J. – TANKA, E. (1997): The change of the proprietary structure in Hungarian agriculture and food processing during 1990-1995. Paper presented in Sacramento, USA, August 1997.

A MONOPÓLIUMOK felbontása és a privatizáció. *Privatizációs Kutatóintézet*, Budapest. 1993.

AKII (1993): Élelmiszeripari szervezetek név- és címjegyzéke 1993. *Agrárgazdasági Kutató- és Informatikai Intézet*, Budapest.

AKII (1998a): A mezőgazdasági és élelmiszeripari szervezetek gazdálkodásának főbb adatai 1993–1997. *Agrárgazdasági Kutató- és Informatikai Intézet* (Research Institute for Information and Agricultural Economics), Budapest.

AKII (1998b): Élelmiszeripari szervezetek név- és címjegyzéke 1997. *Agrárgazdasági Kutató- és Informatikai Intézet*, Budapest.

BUSINESS Central Europe: Statistics – Monthly Update, 1995–1999.

COOK, J. – KAPOOR, M. – NICHOLLS, A. (1998): Friendly invaders – Foreign investment survey in business Central Europe.

CSÁKI, C. – NASH, J. (1998): The agrarian economies of Central and Eastern Europe and the Commonwealth of Independent States. *The World Bank*, Washington D.C.

DEBATISSE, M. (1998): Hungary – A Successful agriculture and food economy in constant search for higher competitiveness. *The World Bank*, Washington D.C.

DICZHÁZI, B. (1997): A külföldi tőke szerepe a privatizációban. *ÁPV Rt*. (State Property Agency), Budapest.

EUROFOOD (1998): Issue. **29,** p. 9

FÉLIX, P. (1997): Tejbedara – Új élelmiszeripari mammutcég. *Heti Világgazdaság*, August 16.

FÓRIÁN, Z. (1998): Gondolatok élelmiszergazdaságunk kilátásairól az EU csatlakozás során. *Rabobank Hungária*, Budapest.

GOW, H. – SWINNEN, J. (1997): Agribusiness restructuring, foreign direct investment and hold-up problems in agricultural transition. Paper presented on the 54th. Seminar of the EAAE, Halle (Saale) Germany.

HAIR, J. – ANDERSON, R. – TATHAM, R. – BLACK, W. (1995): Multivariate Data Analysis, *Prentice-Hall International*, Inc. Fourth Edition, New Jersey.

HUNGARIAN Foreign Trade Statistics (1998). *Hungarian Central Statistical Office*, Budapest.

HYVÖNEN, S. – KOLA, J. (1998): New policies, new opportunities, new threats: the Finnish food industry in the EU in Competitiveness in the food industry (Edited by Traill, B. – Pitts, E.) pp. 253–85.

INVESTMENT and Business Guide to Hungary (1998). *Hungarian Chamber of Commerce and Industry*, Budapest.

JANSIK, C. (1999): Foreign direct investment in the Hungarian food sector – What makes certain food industries attractive? Proceedings of the 66th EAAE seminar/NJF seminar No. 301, Helsinki. pp. 67–94.

JANSIK, C. – MÄKIMATTILA, M. (1999): Vegetable oil industry and its effects to oil crop production in Poland and in Hungary – a comparative case study. Proceedings of the 66th EAAE seminar/NJF seminar No. 301, Helsinki. pp. 159–180.

KADERJÁK, P. (1996): A hazai közvetlen külföldi befektetéseket meghatározó tényezőkről – egy kvantitatív elemzés. *Közgazdasági Szemle*, **XLIII,** pp. 1072–87.

KOLA, J. (1997): The relationship between food economy and public policy – theoretical frameworks and applied results in Vem styr förädlingsindustrin? Nordisk kurs i lantbrukspolitik i Finland 1996.

KOPÁNYI, M. (ed.) (1993): Mikroökonómia. *Budapesti Közgazdaságtudományi Egyetem*, Budapest.

KÜLFÖLDI működőtőke befektetések Magyarországon. 1994. *Privatizációs Kutatóintézet*, Budapest.

LAKNER, Z. (1994): A versenyképesség és a külföldi tőkebevonás néhány összefüggése a magyar élelmiszeriparban. *Ipar-Gazdaság*, December.

LEHOTA, J. – SZŰCS, J. (1998): Multinacionális cégek működési sajátosságai a magyar élelmiszergazdaságban. *Gazdálkodás*, (2) pp. 29–37.

MESKÓ, A. (1997): Foreign direct investment in Hungary 1995–1996. *Hungarian Central Statistical Office*, Budapest.

MONTHLY Bulletin of Statistics 1998/9. *Hungarian Central Statistical Office*, Budapest.

ORBÁNNÉ-NAGY, M. – SZABÓ M. (1996): A hazai versenypolitika kezdeti tapasztalatai az élelmiszergazdaságban. *Agrárgazdasági Kutató- és Informatikai Intézet*, Budapest.

SHEPHERD, W. (1990): The economics of industrial organisation, Third Edition *Prentice-Hall*, Inc., New Jersey.

SZABÓ, M. (1996): Külföldi befektetők a magyar tejiparban. *Tejipari Hírlap*, (5)

SZABÓ, M. (1997): Food industries in transition economies: Current state and options for improvement. Paper presented on the 54th Seminar of the EAAE, Halle (Saale) Germany.

Szabó, M. (1998): Hogyan koncentrálódik a hazai tejipar? *Magyar Nemzet,* August 31.

TRAILL, B. (1996): Globalisation in the food industries? The Proceedings of the Eighth Congress of EAAE in European Review of Agricultural Economics, (3–4) pp. 390–410.

TRAILL, B. (1997): Foreign trade versus foreign direct investment in the food sectors of transition economies. Paper presented on the 54th Seminar of the EAAE, Halle (Saale) Germany.

VISSI, F. (1994): A külföldi működőtőke beruházások és a verseny. *Közgazdasági Szemle,* **XL,** (4) pp. 349–59.

WORLD Development Report (1996). From plan to market, *The World Bank*, Washington D.C.

WORLD Trade Organisation (1996): Annual Report Vol. 1, Trade and foreign direct investment, *WTO*, Geneva.

TRANSITION TO SELF-EMPLOYMENT: HISTORICAL CONTINUITIES AND DISCONTINUITIES*

PÉTER RÓBERT[1]

SUMMARY

The paper investigates entry into self-employment in a dynamic historical perspective, focusing on the changing influence of social origin, educational credentials and Communist Party membership. Interrupted bourgeoisie theory, concept of investment into human and cultural capital as well as social capital investment theory provide the framework for the empirical analysis. The analysis is carried out on a person period file where social origin is a time-constant measure, education and party membership are time-dependent measures. The model is estimated for different historical periods and findings are interpreted as historical effects on the changing conditions of social determination for becoming entrepreneurs in Hungary. Historical continuities and discontinuities are investigated by the spline regression method.

Results reveal a *U*-curve for the impact of social origin on becoming self-employed, while returns to educational investments seem a reversed *U*-curve which is more marked for human capital investments than for cultural capital investments. Accumulated political capital plays larger role in predicting entry into self-employment than simple party membership. But conversion of political capital into economic one is not a post-communist phenomenon, it started much earlier already under the communist era.

KEYWORDS: Employment; Social mobility; Spline regression.

In the paper, entry into self-employment is investigated in Hungary in the perspective of long-term historical changes. Considering the last four-five decades of Hungarian history, structural mobility and period effects played an important role in the process of stratification first after the communist take-over in 1949, and recently after the collapse of communism (*Andorka*, 1978, 1983; *Róbert*, 1998). Focusing on the latter event – when an economy dominated formerly by state ownership and central planning system moves into an economy dominated by market relations and private initiatives – the increase of self-

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employment and entry into entrepreneurship belong to the most interesting research issues to be investigated.[2] The common feature of most of the previous analyses, however, is that they apply a mobility approach by comparing two distinct time-points: a date from the late 1980s and another date from the 1990s. This perspective is rather narrow and does not provide an appropriate view of the formation of post-communist self-employment with respect to long-term economic, political and historical changes in these societies. Educational expansion, industrialization process, stronger or weaker inclusion of market elements in economy as well as varying value and use of political connections and credentials have to be considered for explaining the historically changing pattern of recruitment into entrepreneurship in these societies. Moreover, all these processes vary according to the different periods one can distinguish within the last four-five decades. This is why this research approaches its topic in a longer historical perspective, going back even to the times before World War II and the communist take-over, rather than the usual 5–10 year period of time between 1989–1990.

The research question, as formulated by *Osborn* and *Slomczynski* (1997 p. 248.), puts the topic into the relevant historical context: 'Are those people who started their business after 1989 a new breed of entrepreneurs? Or, are they similar to those who started their business in the 1950s, 1960s, 1970s, and 1980s?' The authors investigate the topic in the light of evolutionary versus revolutionary theories of *Campbell* and *Pedersen* (1996). The evolutionary theory assumes that the new entrepreneurial class has strong roots in the communist era when they were able to accumulate appropriate social, cultural and material assets. Foundations even from the pre-communist times like habitus, ambition and material capital for self-employment matter in this respect as well. The revolutionary theory, however, expects more radical changes after 1989 and stronger break with the past. Evolutionary and revolutionary elements probably coexist in historical change but one of them may have a stronger dominance. Distinguishing three historical periods (1949–1968, 1969–1988, 1989–1993), Osborn and Slomczynski found more support for the evolutionary theory in Poland.

First the paper, provides a conceptual background for research. Second, the main hypotheses are summarized. Third, data, measures and methods are described. Fourth, the results of the statistical models are presented. Finally, the paper summarizes and discusses the findings.

1. Conceptual background of the research

When investigating entrepreneurship two approaches can be followed. Research can focus on the social composition of those who are entrepreneurs in different periods or can focus on becoming self-employed. Since our main analytical interest lies in the periodical effects, in the changing role of the different determinants of the emergence of self-employment in the different historical periods, we analyze the transition to self-employment in Hungary. The state of being self-employed and the social characteristics of these people can differ from various historical periods; however, becoming an entre

[2] Several contributions can be referred to focusing on this topic either from the perspective of emerging new economic elite (*Szelényi* and *Szelényi*, 1995; *Böröcz* and *Róna–Tas*, 1995; *Szelényi–Wnuk-Lipinski* and *Treiman*, 1995; *Kolosi* and *Sági*, 1998) or from the viewpoint of recruitment of new entrepreneurs (*Róna–Tas*, 1994; *Róbert* and *Sági*, 1997; *Róna–Tas* and *Lengyel*, 1997).

preneur and social factors of this career mobility process provide a better insight into the periodical and historical changes of different eras.

When estimating statistical predictors for this process we intend to consider the role of social origin; that of human, cultural and social resources accumulated by educational investments or during previous work experience before moving into self-employment; and that of political credentials. In the subsequent paragraphs we provide the conceptual basis for each of these determinants.

Inheritance: impact of father's self-employed position

In their large monograph, *Erikson* and *Goldthorpe* distinguish four effects influencing social fluidity. These effects: hierarchy, inheritance, sector, affinity 'can be associated with desirability, advantages, and barriers within a structure of class positions' (*Erikson* and *Goldthorpe*, 1992. p. 123.). The interpretation of inheritance effect is that individuals can be found in a destined position being equal to their origins. The likelihood of this effect is especially high for certain classes like service class, entrepreneurial class, or farmer class. For entrepreneurs, the argument means that fathers are able to provide direct support to their offsprings to a larger extent and endow them with the necessary capital to remain and keep their position in petty bourgeoisie. On the contrary, mobility into the entrepreneurial class can be more restricted from other class positions like from service class or from semi- and unskilled manual worker class in line with hierarchy effects. Inflow mobility into petty bourgeoisie is also restricted from farmer and agricultural manual worker classes due to the sector effect which produces a sectorial cleavage between proprietors and workers in agriculture and members of other classes. Finally, affinity effects play their role in recruitment into self-employment as well. Although sector provides strong division between petty bourgeoisie and farmers, they have something common in affinities namely that both are 'independent' and both can have similar entrepreneurial habits. Likewise, there is a positive affinity effect between service class and petty bourgeoisie on the grounds that both can have similar professional and managerial habits to a certain degree.

Due to the nationalization after 1949, the proportion of entrepreneurs fell to about 3 percent of the labour force in Hungary. Partly in consequence of the shrinking of the high-inheritance categories like farmers or self-employed, marked outflow mobility from petty bourgeoisie could be observed during the period of 1938–1973 (*Simkus*, 1984). Even after 1968, when the Hungarian economy became more liberal, market elements and private initiatives were better tolerated, and a dual system developed in the society (*Kolosi*, 1988; *Szelényi*, 1986–1987), inheritance in self-employment was relatively low.

Human and cultural capital investments

The concept of human and cultural capital investment is based on *Becker's* (1975) as well as on *Bourdieu's* (1984) theories. In general, for successful status attainment on the labor market one needs to accumulate different kinds of skills, knowledge and expertise. Becker states that human capital investments are indicators of higher ambitions and result in better market capabilities. Bourdieu emphasizes the importance of cultural capital for achieving higher status. The accumulation of both human and cultural capital can be done – at least partly – by education. According to the industrialization thesis of *Treiman's* (1970), the significance of this accumulation process for socio-economic success is increasing.

During education one can accumulate practical skills and knowledge as well as general competence and adequacy. Formerly, a school system provides partly vocational training, partly academic qualification. Accordingly, investments into education can be divided into two parts: following vocational track where mostly concrete labor-related expertise can be accumulated or following academic track where mostly general capabilities can be acquired. For entrepreneurs, this distinction is based on the assumption that higher participation in vocational training is associated with knowledge connected to the general industrialization and modernization tendencies. Higher participation in academic education, on the other hand, is associated with the emerging need of entrepreneurial capabilities like calculating, risk taking, building contacts, collecting the necessary information about market.

Human and cultural assets have always been of great importance for status attainment under communism. Communists were not able to nationalize these capitals or were able to control and redistribute them to a lesser degree than other (e.g. material) resources (*Róbert*, 1984, 1991; *Ganzeboom*, *Graaf* and *Róbert*, 1990).

Previous work experience before entrepreneurship

Considering previous work experience as a determinant of becoming an entrepreneur has definite conceptual grounds. Before starting an occupational career as self-employed, people in employee status accumulate appropriate assets they can utilize later when they enter entrepreneurship. These resources can be of two kinds: *1*. technical skills, knowledge, know-how; *2*. relational assets, contacts, 'know-how' acquired in employee status that can be used later in self-employed position. For these latter types of resources the term of social capital can also be applied in the sense as meant by *Coleman*: structural and interpersonal relations people can use to increase socio-economic (in this case entrepreneurial) success (*Coleman*, 1990).

Consequently, previous work experience indicates a kind of embeddedness in the labor force. The longer time one spends in labor market, the stronger their embeddedness can be, the more expertise they can accumulate, the more contacts they can make, etc. On the other hand, previous studies on career mobility proved that most of the mobility occurred at young age (*Blossfeld*, 1986; *Lujikx* et al., 1998). Consequently, longer time spent in the labour market in employee position decreases the chance of entry into entrepreneurship.

Political credentials

The fourth form of assets to be considered in this analysis as an influential factor of entry into entrepreneurship is political capital. By this capital, we practically mean Communist Party (CP) membership between 1949 and 1989 which could have an impact during this period as well as thereafter. In fact, there are two components of political creden tials we intend to distinguish. First, CP membership could be a sign of loyalty with the political system and – as such – this had to be rewarded.[3] Second, party membership was a field where social capital could be accumulated in the sense as defined by Coleman (1990) and as discussed before. This is the strict meaning of political capital: as being a party member one could build structural and interpersonal relations to be used for upholding individual interest. Consequently, party membership also represents a kind of embeddedness, a way to get informed, to learn about the right persons for certain problems to be solved etc., and the longer time one spent in the Communist Party, the more political capital he was able to accumulate.

This research question is especially interesting for the period of post-communism, from the viewpoint of the debate of political capitalism. The core of the debate on political credentials was based on two hypotheses: elite circulation versus elite reproduction (*Szelényi* and *Szelényi*, 1995; *Szelényi–Wnuk-Lipinski* and *Treiman*, 1995). The advocates of elite reproduction argued that members of former political elite (the *Nomenclature*) would be able to use their accumulated political assets to maintain their advantageous social positions and would be able to convert their political capital into economic one (*Hankiss*, 1990; *Staniszkis*, 1991; *Stark*, 1990). This postulate is associated with the capital accumulating function of CP membership and, by this hypothesis, party membership would positively affect transition to entrepreneurship after 1989. By the alternate thesis of elite circulation, the impact of CP membership turns out to be insignificant or may be negative. This postulate is associated with the loyalty component of party membership that is not rewarded any more, but perhaps even penalized after the collapse of communism.

Osborn and *Slomczynski* (1997) found a negative effect between 1949 and 1988 for party membership in Poland and the impact for the last period of 1989-1993 turned out to be insignificant. Both *Mateju* (1993) for Czech Republic and Róna-Tas (1994) for Hungary found a significant impact of Communist Party membership on socio-economic success after 1989 but the effects disappeared when they were controlled for education. This means that human and cultural capital outweigh political assets. However, investigating social determinants of new entrepreneurship in six post-communist countries in 1993, Róbert and Sági (1997) found that CP membership in 1988 had a small effect even if it was controlled for other predictor variables.

2. Hypotheses: historical effects and over-time changes in influencing transition to petty bourgeoisie

Dividing the last four-five decades of Hungarian history into intervals and defining periods is a crucial part of the analysis. In this analysis five periods are distinguished: *1*. the pre-communist era before 1949; *2*. the orthodox communist era (or the long fifties) between 1950 and 1968; *3*. the period of reform-socialism between 1969 and 1979; *4*. the period of the decline of communism between 1980 and 1988; *5*. the transformation period between 1989 and 1992.

[3] On the relationship of status allocation, socio-economic success and CP membership under communism where some were 'more equal than the others', see e.g. *Parkin* (1969), *Connor* (1979) or in particular for the Hungarian context *Szelényi* (1987), *Tőkés* (1996).

The variation among these periods with respect to historical processes is the central assumption of the analysis. We posit discontinuity in transition to entrepreneurship between 1949 and 1950 (due to communist take-over), 1968 and 1969 (due to the introduction of System of New Economic Management), 1979 and 1980 (due to the start of decline of communist regime), as well as 1988 and 1989 (due to the formal collapse of communism).

As far as the concrete predictors of becoming self-employed are concerned, the first set of hypotheses relates to the impact of father's occupation:

*H*1.1. Inheritance of entrepreneurial position decreases first but increases later, i.e. it forms a U-shaped curve over time.

*H*1.2. Intergenerational mobility from service as well as from intermediate (skilled manual and service worker) classes into entrepreneurship increases over time but these effects are less pronounced as compared to inheritance of self-employment.

The second set of hypotheses relates to the impact of education:

*H*2.1. The effect of vocational track type of schooling on entry into entrepreneurship increases gradually over time.

*H*2.2. The increase of the effect of an academic type of schooling on entry into entrepreneurship becomes sharper only in the more recent periods.

The third set of hypotheses relates to the impact of political credentials:

*H*3.1. Communist party membership implying political loyalty affects entry into entrepreneurship negatively for the early period of communism but this impact becomes insignificant (maybe positive) for the most recent period of post-communism.

*H*3.2. The length of Communist Party membership implying accumulated political capital affects positively the transition into self-employment and this impact increases over time.

3. Operationalization

Data from the 1992 Social Mobility and Life History Survey of the Hungarian Central Statistical Office are used for the analysis. The survey is based on a household sample of the Hungarian population where all members aged over 14 have been interviewed (*N*=29 006). Methods of the survey were standardized questionnaires and face to face interviews. The analysis is restricted to male population, aged 18 and above (*N*=12 150).

Variables, measures, data-transformation

The dependent variable of the analysis is a dichotomous one indicating if someone entered into self-employment in a certain period. Only entry into non-agricultural entrepreneurship is considered since inflow mobility into farming has been very rare in Hun gary. Although the number of cases is relatively large in the data-set, the event investigated did not occurre very frequently. Consequently, the dependent variable is quite skewed. (See Appendix 1.) It is also important to note that information on entry into self-employment is based on retrospective job history data. This means that some biases in the data cannot be rejected, especially for older cohorts. This problem is discussed in more details when interpreting the results.

The independent variables are as follows:

1. Father's class is defined by dividing the EGP scheme (*Erikson* and *Goldhorpe*, 1992 p. 36.) into five categories: Service (Class I+II); Intermediate (Class IIIa+b, Class V+VI); Petty bourgeoisie (Class IVa+b); Farmers (Class IVc); Unskilled (Class VIIa+b) (reference category). [*ORIG*]

2. For education a vocational track and an academic track have been defined. Secondary vocational training, secondary technical school diploma, college degree are parts of the former one, while grammar school and university degree belong to the latter one. Those without qualification (completed primary education) belong to the reference category. [*EDU*]

3. Age is measured by years. [*AGE*]

4. Relative labour force experience up to becoming entrepreneurs is computed as a percentage of number of years spent in labour market related to the total number of years between completion of highest educational level in day-course education and year of entry into self-employment. [*EXPE*]

5. Political credentials are measured by Communist Party membership. It is partly a dummy variable (1=member, 0=non-member) [*PLOY*]; partly a continuous variable indicating the proportion of time one spent in the Communist Party related to the duration of total relative labor force experience (up to entry into self-employment). [*PCAP*]

All independent variables (except father's class) are time-varying, i.e. they change their value from year to year according to the actual state of the variable. Father's class is a time-constant measure. Descriptive statistics of variables are given in Appendix 1.

The individual data-set has been transformed to an event history file following the method by *Blossfeld*, *Hamerle* and *Mayer* (1989). First, all jobs in the occupational history were considered as separate episodes. Second, the method of episode splitting was applied, the job episodes were divided into years, the smallest time unit in the data-set. The unit of observation was changed from the individuals to the spells (years) derived from the job episodes. All analyses are carried out on this person-period (in this case person-year) file (see also *Yamaguchi*, 1991). For more details on data transformation, see Appendix 2.

Causal models

Since we investigate the probability of becoming entrepreneur as well as various determinants of this event, and we have a dichotomous dependent variable indicating whether this event did or did not occurre, logistic regression is applied as a main analytical tool. Models are built in a hierarchical way, direct effect models are defined, first es timating the impact of social origin (Model 1/*a*) as well as of education (Model 1/*b*) on entry into self-employment for the given historical periods separately:

$$\ln \frac{p_{ik}}{1-p_{ik}} = \alpha + \sum_{l=1}^{L-1} \beta_f ORIG_{il} \qquad \text{Model } 1/a$$

Here p_{ik} indicates the probability of the event when the *i*-th person becomes self-employed in the *k*-th historical period. *ORIG* means the effect of social origin measured by an *L-1* (here four) category bipolar variable where the *L*-th category (here unskilled worker) is the reference. The second baseline model is defined similarly where the direct effect of education is investigated:

$$\ln \frac{p_{ik}}{1-p_{ik}} = \alpha + \sum_{m=1}^{M-1} \beta_g EDU_{im} \qquad \text{Model } 1/b$$

In addition to the influence of social origin and education, the effect of embeddedness is also important. Consequently, the extended model contains the impact of age and work experience (Model 2).

$$\ln \frac{p_{ik}}{1-p_{ik}} = \alpha + \sum_{l=1}^{L-1} \beta_f ORIG_{il} + \sum_{m=1}^{M-1} \beta_g EDU_{im} + \beta_h AGE_i + \beta_j EXPE_i \qquad \text{Model 2}$$

Finally, the influence of communist party membership – operationalized in two ways – is investigated. First, the model contains only the direct effects without any control variables (Model 3/*a*):

$$\ln \frac{p_{ik}}{1-p_{ik}} = \alpha + \beta_p PLOY_i + \beta_r PCAP_i \qquad \text{Model } 3/a$$

Second, all variables of Model 2 are involved as control variables in the final model of the analysis (Model 3/*b*):

$$\ln \frac{p_{ik}}{1-p_{ik}} = \textit{Model } 2 + \beta_p PLOY_i + \beta_r PCAP_i \qquad \text{Model } 3/b$$

In the logistic regression equations described before two categorical variables have been included (*ORIG* and *EDUC*). They are coded as indicator variables. The design matrix below shows the parameterization of these measures.

Father's class:				
service	1	0	0	0
intermediate	0	1	0	0
self-employed	0	0	1	0
farmer	0	0	0	1
unskilled-agricultural labourer	0	0	0	0

Educational track:		
academic track	1	0
vocational track	0	1
no qualification	0	0

In the paper, when presenting results of logistic regression models, unstandardized (metric) coefficients (*B*), standard errors (*SE*) and the so-called odds (Exp(*B*)) will be shown in the tables. The latter one is used for a substantive interpretation of the findings. Exp(*B*) is based on the following formula of logistic equation written in terms of odds:

$$\mathrm{Exp}(B) = \frac{p(\text{event})}{1-(p(\text{event})} = e^{B_0} e^{B_1 X_1} \dots e^{B_p X_p}$$

Here *e* raised to the power of B_i is the factor by which the odds (the probability divided by 1 minus the probability) change when the *i*th explanatory variable increases by one unit. If B_i is positive, this factor is greater than 1, which means that the odds are increased; if B_i is negative, the factor is less than 1, which means that the odds are decreased.

Investigating historical trends – spline regression analysis

The central issue in the research is how the effect of the predictor variables varies over historical periods defined above. In order to test these changes, a multilevel analysis is performed (see *DiPrete* and *Grusky*, 1990). The last and most complete model (Model 3/*b*) is estimated for each historical year between 1940 and 1992, and the unstandardized regression coefficients (weighted by the reciproque of their standard error) serve as dependent variables for estimating trends in the impact of social origin, education and political capital. Since we assume discontinuity in the effect of independent variables for the different periods (i.e. determinants of entry into entrepreneurship vary over historical periods), the spline regression method is applied. This makes it possible to fit data on various lines or curves from different time periods and the separate functions of predictor variables are displayed for the successive time periods.[4]

The research design will be the following: first, spline regressions are calculated for the different periods assuming continuity. These models – spline models with knots – will serve as baseline. Second, we calculate the spline regressions without knots, i.e. dummy variables representing interruptions are added to the model, assuming discontinuity for all breaks between the periods. If this second model turns out to be significantly worse than the first one, the hypothesis of discontinuity over historical periods is false. If the second model turns out to be significantly better than the first one, we continue to search for an even better model testing the various possible combinations of continuity and discontinuity, fitting various spline models with different numbers of dummies representing interruptions. Since spline models are, in fact linear regressions, deciding on the best model (i.e. selection of the variables) is based on *F*-statistics (with different degrees of freedom) and the adjusted R^2 values.

4. Causal models for transition to self-employment

In the following section of the paper the results of model-based computations will be presented.

[4] For additional discussion and the mathematical background of the method see *Smith* (1979 pp. 57–62.) and *Greene* (1993 pp. 235–238); for previous applications see *Deng* and *Treiman* (1997) and *Luijkx* et al. (1997). A statistical appendix at the end of the paper written by *Erzsébet Bukodi* provides more insight into the method (see Appendix 3.)

The basic models: direct effects

The basic models of transition to entrepreneurship focus on the effect of social origin and education. For such types of models where one has these two predictor variables investigating their impact in historical perspective, the industrialization thesis by *Treiman* (1970) provides an obvious framework for interpretation.

Table 1

Direct effects of social origin and education on the odds of entry into self-employment
(logistic regression estimates)

Model (variable) statistics	Period of entry into self-employment				
	x–1949	1950–68	1969–79	1980–88	1989–x
Father's class [a]					
Service class					
B	.1032	.0896	- .2333	.4203	.3126
S. E.	(.5335)	(.4774)	(.4302)	(.2539)	(.2026)
Exp(*B*)	1.1087	1.0937	.7919	1.5225	1.3670
Intermediate class					
B	- .2401	- .0582	- .0477	.4045*	.3910*
S. E.	(.5331)	(.4131)	(.3086)	(.2008)	(.1540)
Exp(*B*)	.7865	.9434	.9534	1.4985	1.4785
Self-employed class					
B	1.8738***	1.2180***	.3794	.5274	.7051**
S. E.	(.2316)	(.2577)	(.3189)	(.2728)	(.2227)
Exp(*B*)	6.5132	3.3804	1.4614	1.6946	2.0240
Farmer class					
B	- .2772	.0721	- .6933*	- .3810	-1.5319**
S. E.	(.2657)	(.2411)	(.3085)	(.2594)	(.4174)
Exp(*B*)	.7579	1.0747	.0623	.6440	.2161
Constant	-5.291***	-6.845***	-7.481***	-6.788***	-5.732***
	(.1040)	(.1240)	(.2000)	(.1741)	(.1402)
Log-likelihood ratio test	94.09	22.36	8.66	13.02	44.08
Significance	.0000	.0000	.0702	.0112	.0000
Educational track [b]					
Vocational track					
B	1.0532***	.9136***	1.4541***	1.2481***	.9583***
S. E.	(.1995)	(.1905)	(.2303)	(.1953)	(.1578)
Exp(*B*)	2.8669	2.4932	4.2806	3.4836	2.6072
Academic track					
B	- .4255	- .1470	.4357	1.0389***	.5871*
S. E.	(.7157)	(.5148)	(.4548)	(.2794)	(.2415)
Exp(*B*)	.6535	.8633	1.5461	2.8260	1.7987
Constant	-5.457***	-6.7881***	-6.553***	-6.011***	-5.136***
	(.1830)	(.1667)	(.1349)	(.1080)	(.0863)
Log-likelihood ratio test	24.28	22.32	48.79	50.80	43.55
Significance	.0000	.0002	.0000	.0000	.0000

[a] Reference category: unskilled agricultural worker.
[b] Reference category: no qualification.
Note. In Tables 1–3 the log-likelihood ratio has been calculated as: -2 log (L_1 / L_0), where L_1 refers to the log-likelihood value of the model with predictor variables and L_0 refers to the log-likelihood value of the intercept model without any predictor variables. Significance: * p < .05; ** p < .01; *** p < .001.

Due to modernization and industrialization, this thesis assumes that influence of social origin tends to decrease while that of education tends to increase.

Table 1 displays the direct effects of father's class and education, separately. For intergenerational mobility, service class origin does not increase the odds of entry into entrepreneurship significantly compared to the unskilled manual and agricultural worker class origin positions. By terms of *Erikson* and *Goldthorpe* (1992), this means that hierarchical effects are stronger than positive affinity effects. Sector effects turn out to be also stronger than positive affinity effects as we can observe a negative impact of farmer class origin on the odds of becoming self-employed artisans or shopowners. The intermediate class origin improves the probability of entry into entrepreneurship significantly only for the recent two periods after 1980.

For social origin, father's self-employment position is the strongest predictor. The trend of ascription indicates a decline over time as expected, however, we can observe a return in the inheritance of entrepreneurial position for the post-communist era. According to the odds, having a self-employed father increases the chance to become self-employed 6 and half times before 1949 compared to the case of having a father in unskilled manual or agricultural labourer position. The same odds are a bit more than 3 for the long fifties. Then the estimates are insignificant for the two subsequent periods in the 1970s and 1980s. Finally, the odds of reproduction of self-employed position are again 2 times larger for the post-communist era compared to the reference category.

As expected, the influence of education on becoming self-employed turns out to increase over the periods though the trend is not monotonous. Vocational skills matter a bit less in the long fifties and their importance tends to decline for the 1980s and the post-communist period. The highest odds for vocational education are 4 times larger compared to the state without any qualification and we can observe them in the reform-socialist period. Academic education, however, plays the strongest role for becoming self-employed precisely during the decline of communism, in the 1980s when the odds are nearly 3 times larger compared to the reference category.

The role of age and work experience: controlled effects

By the multivariate analysis in Table 2, for social origin, father's self-employed position is the only significant predictor of entry into entrepreneurship. If controlled for the other independent variables (education, age, work experience), service, intermediate or farmer class origin do not increase or decrease the odds of becoming self-employed compared to unskilled manual and agricultural labourer class origin. The characteristic *U*-shaped curve pattern of the reproduction of self-employment, however, persists: the effect of father's self-employed position declines first and increases thereafter over periods. In fact, the impact of father's self-employment becomes even stronger for the post-communist era than what it was without controls.

The growing influence of education on becoming self-employed also persists. The multivariate model reveals a reversed *U*-shaped curve for the vocational track of education. Compared to the pre-communist era, this was what new entrepreneurs needed to an increasing extent under the orthodox and reform-socialist period, in the 1950s, 1960s, and 1970s. For the time during the decline of communism, in the 1980s, the academic track turns out to be a significant predictor. For the post-communist era, when the influence of self-employed class origin starts to return, the relative significance of education declines.

Table 2

Controlled effects of social origin and education on the odds of entry into self-employment
(logistic regression estimates)

Model (variable) statistics	Period of entry into self-employment				
	x–1949	1950–68	1969–79	1980–88	1989–x
Father's class [a]					
Service class					
B	.0437	- .1121	- .3671	.2463	.1559
S. E.	(.5508)	(.4893)	(.4375)	(.2610)	(.2080)
Exp(*B*)	1.0446	.8930	.6928	1.2793	1.1687
Intermediate class					
B	- .3443	- .2316	- .2690	.2072	.1873
S. E.	(.5365)	(.4168)	(.3108)	(.2026)	(.1564)
Exp(*B*)	.7087	.7932	.7641	1.2303	1.2060
Self-employed class					
B	1.7750***	1.1230***	.6016	.6947*	.9158***
S. E.	(.2364)	(.2618)	(.3253)	(.2769)	(.2248)
Exp(*B*)	5.9001	3.0741	2.0031	1.8250	2.4987
Farmer class					
B	- .1987	1834	- .0382	.2268	- .8249
S. E.	(.2666)	(.2446)	(.3244)	(.2761)	(.4252)
Exp(*B*)	.8198	1.2012	.9625	1.2545	.4383
Educational track [b]					
Vocational track					
B	.8666***	.9103***	1.2182***	.9199***	.4957**
S. E.	(.2370)	(.2243)	(.2703)	(.2180)	(.1684)
Exp(*B*)	2.3788	2.4850	3.3811	2.5089	1.6417
Academic track					
B	-1.0775	- .0482	.5226	.7180*	.2103
S. E.	(1.0135)	(.5343)	(.4791)	(.3088)	(.2640)
Exp(*B*)	.3404	.9529	1.6864	2.0502	1.2340
Age (time-varying)					
B	- .0525**	.0005	- .0432***	- .0335***	- .0500***
S. E.	(.0198)	(.0110)	(.0120)	(.0084)	(.0067)
Exp(*B*)	.9488	1.0005	.9577	.9670	.9512
Labour force experience (time-varying)					
B	- .4871	- .1792	.2303	.5894	.5989*
S. E.	(.3462)	(.4053)	(.4936)	(.4674)	(.2887)
Exp(*B*)	.6144	.8360	1.2590	1.8029	1.8200
Constant	-4.003***	-6.944***	-6.183***	-6.029***	-4.243***
	(.5126)	(.4385)	(.5501)	(.4863)	(.3427)
Log-Likelihood ratio test	118.88	40.13	67.23	69.84	129.72
Significance	.0000	.0000	.0000	.0000	.0000

[a] Reference category: unskilled agricultural worker.
[b] Reference category: no qualification.

In the multivariate perspective, the effect of age is significantly negative indicating that entry into entrepreneurship occurred at young age. This result is more pronounced for the pre- and post-communist periods. Relative labour force experience is significant only for the post-communist era when embeddedness into labour force and capital accumulation matter the most.

The effect of political credentials

As outlined in the conceptual part of the paper, we state that political credentials involve two parts. Members of Communist Party, on the one hand, can be rewarded (later perhaps penalized) for the fact that they signed up to the party and expressed a true (or hypocritical, we do not know) political loyalty to the communist system in this way. CP members, on the other hand, can use their membership to accumulate political capital, join to networks, gather and mobilize information, etc. This dual character is displayed in Table 3.

The upper panel of Table 3 displays the direct effects of political loyalty (a dichotomous measure for party membership) and that of accumulated political capital (measured by the ratio of years spent in the party and years of relative labour force experience upto entry into self-employment). The pattern reveals that the two kinds of operationalization have, indeed, different impacts on the odds of becoming entrepreneurs. Party membership has no significant effect on the transition to self-employment in the period of long fifties. A positive influence would have been a big surprise but our data do not indicate a negative effect either as we expected. The fact of CP membership (political loyalty), however, was already rewarded for entry into self-employment after 1968, in the reform-socialist period in Hungary. The time, however, one spent in the party (social/political capital accumulation) affects negatively the transition to entrepreneurship. This means, CP members who started their own business flying on the wings of the new economic reforms in Hungary were freshmen in the party but not orthodox communists who were already party members since the 1950s. In the reform-socialist period, entry into self-employment was partly an individual economic decision but it was a difficult administrative procedure as well. People had to apply for different permissions and party membership could be helpful. The situation changed for the 1980s when the nomenclature system disintegrated and a shift occurred from the politically rewarded selection of entrepreneurs to stronger market circumstances in respect of starting private business. Political loyalty for transition to entrepreneurship was not so important any more but the duration of party membership is also insignificant for this period. The accumulated political capital begins to be paid back and has a positive impact on entry into self-employment in the post-communist era. For this period, it is already obvious that the longer time one's labour force career is connected to party membership, the higher the probability is of becoming an entrepreneur. Accordingly, the simple fact of party membership was not enough for capital conversion but accumulated knowledge, information, network membership connected to the length of time one spent in the party turned out to be significant for starting private business after 1988. (In fact, the estimation for political loyalty in the most recent period is negative: reward is replaced by penalty, but it is not statistically significant.)

The lower panel of Table 3 displays the same effects, controlled (but not shown) for social origin, education, age and relative work experience. The pattern described earlier persists, moreover, the effects for the period of reform-socialism are even stronger. The influence of accumulated political capital for the post-communist era cuts back to less than half but it remains weakly significant.

Table 3

Effects of political credentials on the odds of entry into self-employment
(logistic regression estimates)

Model (variable) statistics	Period of entry into self-employment				
	x–1949	1950–68	1969–79	1980–88	1989–x
Direct effects					
Political loyality [a]					
B	–	.3201	.3652*	.2578	- .1733
S. E.	–	(.6797)	(.1755)	(.4917)	(.4103)
Exp(*B*)	–	1.2628	1.4408	1.2940	.7726
Accumulated political capital [b]					
B	–	- .4550	-1.7852*	- .7464	1.5841*
S. E.	–	(1.0052)	(.7705)	(.6988)	(.6584)
Exp(*B*)	–	.6345	.1678	.4741	4.4362
Constant	–	-6.527***	-6.582***	-5.901***	-5.004***
		(.0954)	(.0997)	(.0782)	(.0629)
Log-Likelihood ratio test	–	2.24	4.25	0.73	10.45
Significance	–	.2921	.0471	.3834	.0009
Controlled effects [c]					
Political loyality [a]					
B	–	.0706	.8127*	.0323	- .1862
S. E.	–	(.6849)	(.3998)	(.5131)	(.3950)
Exp(*B*)	–	1.0732	2.2539	1.0328	.8301
Accumulated political capital [b]					
B	–	-1.2953	-2.7754*	- .4400	.6810*
S. E.	–	(1.1352)	(1.3386)	(.7267)	(.3399)
Exp(*B*)	–	.2738	.0623	.6440	2.0571
Constant	–	-6.978***	-6.346***	-6.094***	-4.335***
		(.4376)	(.5581)	(.4911)	(.3479)
Log-Likelihood ratio test		44.07	73.77	71.05	134.71
Significance		.0000	.0000	.0000	.0000

[a] It is a dummy variable indicating whether one is the member of Communist Party or not (time-dependent variable), for the period 1989–1992 it means the party membership in 1988.
[b] It is measured by the ratio of time interval one spent in the Communist Party to the duration of cumulated work experience.
[c] For age, work experience, education, and social origin.

Trends for historical differences: continuities and discontinuities

Models estimated for the different historical periods brought results on varying strength of the explanatory variables on the odds of transition into self-employment. The spline models add to these results further information on the continuity and discontinuity of trends over historical periods, i.e. how the determination of entry into entrepreneurship varies from one period to the next one.

Table 4

Selection among different spline models
(Best models are shaded)

Model description	*F*-statistics	Degree of freedom	Adjusted R^2
Effect of self-employed origin			
continuity (model with knots)	3.90*	5	34,2
discontinuity (all breaks between the periods)	1.99	9	24,2
Effects of academic track			
continuity (model with knots)	25.74*	5	70,4
discontinuity (all breaks between the periods)	15.69*	9	71,8
discontinuity in 1968	35.78*	6	74,2
Vocational track			
continuity (model with knots)	1.49	5	4,5
discontinuity (all breaks between the periods)	6.07*	9	12,6
Political loyalty [a)]			
continuity (model with knots)	0.66	4	1,3
discontinuity (all breaks between the periods)	1.10	7	1,7
discontinuity in 1968	3.52*	5	5,8
Political capital [a)]			
continuity (model with knots)	18.42*	4	62,3
discontinuity (all breaks between the periods)	21.01*	7	74,9
discontinuity in 1968	28.01*	5	79,1

Significance: * $p < .05$
[a)] The pre-communist era is omitted from the models. This is the reason why the degree of freedom for the baseline models is 4 and not 5.

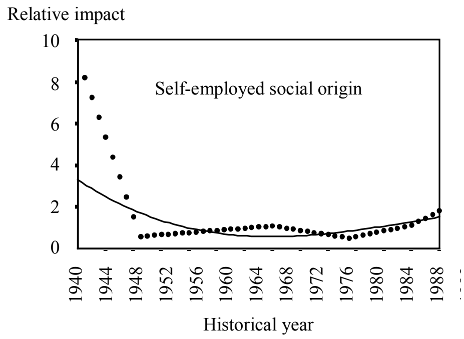
Table 4 informs about the various spline models fitted on the data testing whether the changes are continuous or discontinuous. For self-employed origin, the model assuming continuity turned out to be the best. This does not mean, of course, that there is no change in the effect of social origin on entry into entrepreneurship over time. However, the changes are more gradual, evolutionary and the assumption of strong discontinuity between the periods is not supported. In all other cases of independent variables, the model supposing historical discontinuities between the periods fits better than the model of continuous change. With the exception of the impact of vocational training, the changes in the effect of the other explanatory variables on the odds of becoming an entrepreneur turned out to be discontinuous only for the break between the second and third periods, in 1968.

Results of second level analysis with spline regressions are displayed in Figures 1-3. The dotted lines on the figures display the trends for the different historical periods as calculated by the method, the continuous line is a fitted curve for the whole interval between 1940 and 1992, the period that our data cover in the research. The effects displayed in the figures are, controlled for the other explanatory variables.

F-statistics in Table 4 indicate that changes in the effect of self-employed origin are not discontinuous. This holds for the break between the first and second period too representing the communist take-over in 1949.[5]

[5] Assuming discontinuity for time-point in 1949 results in a model with *F*-statistics of 3.16 with 6 degree of freedom (significant at .5 level) but the adjusted R^2 value is 31.7, smaller than 34.2 percent of the model of continuity.

Figure 1. Historical changes in the effect of self-employed origin on entry into self-employment



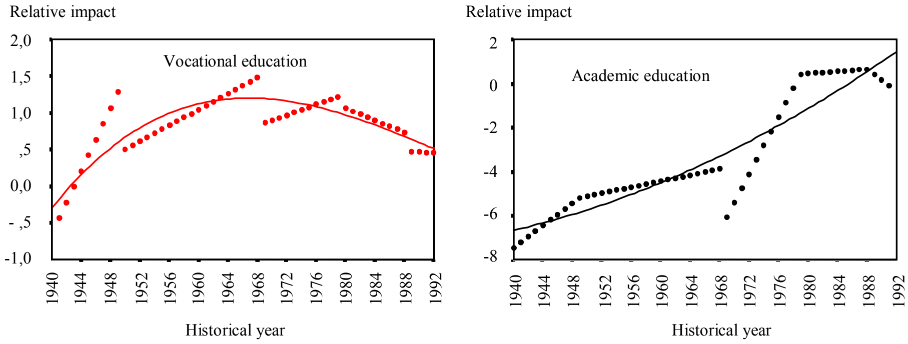
Indeed, Figure 1 reveals a surprising finding; the reproduction of self-employment has steeply dropped during the 1940s, in the era before and during World War II. Accordingly, it is not the communist take-over in 1949 that produced a dramatic change in the inheritance of self-employment. Instead, we are probably faced here with a strong historical effect of World War II, perhaps also a consequence of historical events that happened to Jews at that time, regarding that Jews were overrepresented among entrepreneurs in Hungary in the pre-communist era. Most probably, there are different demographic effects in the background of this finding as well: mortality caused by the war; selective mortality influencing our sample (retrospective job history data of a population sampled in 1992 are used); and an impact of out-migration which occurred between 1946 and 1949.[6]

The effect of father's self-employed position on entry into entrepreneurship became weak throughout the subsequent periods after 1949 but a slight fluctuation can be observed. It seems that the impact started to increase already in the 1980s and this tendency continued in the post-communist period. Thus, the long-term trend displays the *U*-shaped curve mentioned before but the inheritance of entrepreneurship is far from being so strong as what it used to be 50 years ago.

Figure 2 show the results of spline regression analysis with respect to education. Vocational track and academic track differ in respect of historical continuity. The previous one is completely discontinuous; its effect varies strongly over periods as the best model reveals in Table 4. Academic track, however, displays less discontinuity; changes between periods are mostly continuous with the exception of the one in 1968. The impact of vocational training on becoming self-employed has increased in the first three periods. The rise was definitely steeper in the pre-communist era and the growing trend is less steep for the second and third periods. The analysis reveals the expected discontinuity for 1949 and 1968. The effect of vocational education reached its maximum at the end of the 1960s. The discontinuity between the 1970s and 1980s is smaller. By the time communism started to decline, the 1980s, however, the effect of vocational education had already decreased and the relative influence of human capital investments is even smaller for the post-communist era. Accordingly, the long-term trend fitted on the data displays a reversed *U*-curve.

[6] Since our analysis is based on retrospective job histories collected in 1992, results regarding the historical period before 1949 should be handled with large caution.

Figure 2. Changes in the effect of vocational and academic education on entry into self-employment



As far as the impact of academic education on entry into self-employment is concerned, a really strong rise can be observed during the reform-socialist period after 1968. In the earlier two periods, accumulated cultural capital was not a requirement for becoming self-employed. In fact, the relative impact of academic education was negative in the first two periods. A significant discontinuity can be observed for 1968. The steep rising trend in the 1970s, however, did not continue in the 1980s when the effect of academic education became stable but weak. In addition, data indicate even a slight decline in the influence of academic education in the post-communist era. The relative decrease in the effect of education can relate to the increase of the impact of social origin. These latter changes, however, are rather continuous. Thus, the long-term trend that fits the data indicates a growing tendency for the influence of academic education on the transition to self-employment.

Figure 3. Changes in the effect of political loyalty and self-employed social origin on entry into self-employment

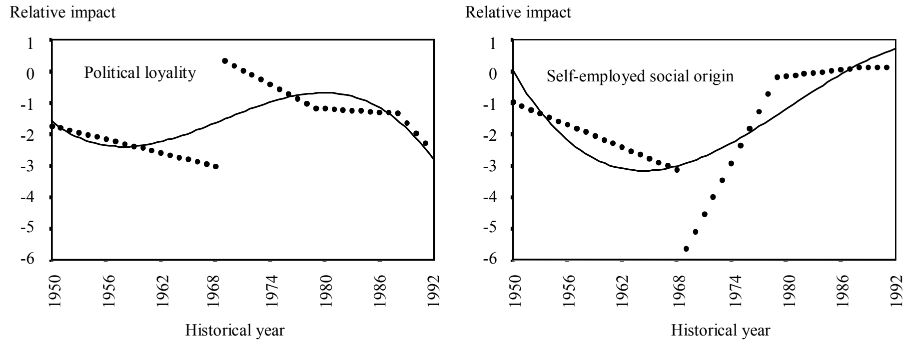


Figure 3 display the historical trends for the two types of political credentials. (The pre-communist era is omitted from the models.) In both cases, the spline regression method revealed significant discontinuity only for 1968, while the changes are milder and continuous for the other break points between the periods. The effect of political loyalty on transition into entrepreneurship was negative in the long fifties, party mem bership decreased the odds of entry into self-employment and this impact even increased during the period. Results indicate strong discontinuity between the periods before and after 1968. In the beginning of the reform-socialist era political loyalty influenced entry into self-employment positively but the trend declined during the period and turned to negative. In the 1980s the effect of party membership controlled by the other predictors was weak and negative. Finally, the influence of (former) party membership drops for the post-communist era, political loyalty decreases the probability of becoming self-employed to a great extent. Consequently, the curve of the long-term trend for political loyalty reveals a lying *S*-shape: a decline is followed by an increase and followed by a decline again.

Just like in the case of political loyalty, the effect of accumulated political capital on becoming self-employed is negative and this impact increased during the era of orthodox communism in Hungary. The discontinuity in 1968 is sharp in this respect as well. The influence of the duration of time spent in the party on transition to entrepreneurship showed steep rise in the reform-socialist period after 1968. The accumulated information, connections in the party became positive predictors of self-employment for the 1980s, though the increase of their influence was not so steep anymore during the decline of communism. The impact of accumulated political capital on entry into self-employment continues to grow slightly for the post-communist period, between 1989 and 1992. All in all, the long-term trend displays a *U*-shaped curve, a decline is followed by an increase.

5. Conclusion

The paper analyzed transition into entrepreneurship in Hungary in a historical perspective. Five historical periods have been specified separately assuming that they express certain discontinuities in Hungarian history and consequently social composition and selection mechanisms of entrepreneurs differ for these intervals.

The research supported most of the hypotheses. In the light of Treiman's (1970) industrialization thesis, the intergenerational reproduction of entrepreneurship (ascription) displays the expected declining tendency, while the effect of education (achievement) shows an increase until the beginning of the 1980s. Thereafter, however, a return can be observed producing a *U*-shaped and a reversed *U*-shaped curve, respectively. In case of the effect of education, this reversed *U*-curve is more pronounced for human capital investments (vocational track) than cultural capital investments (academic track). Distinguishing between vocational and academic tracks made it clear that returns to investment into education varied for the different historical periods in the sense of what kind of skills, knowledge, expertise and capabilities someone could accumulate and utilize. The *U*-shaped curve of intergenerational reproduction of self-employment seems to support the interrupted embourgeoisement thesis by Szelényi (1988) and Szelényi and Manchin (1989), and is in line with the previous findings on the topic by Ganzeboom, Luijkx and Róbert (1991).

As far as political influences are concerned, Communist Party membership (as an indicator of political loyalty and as a basis for rewards) affects entry into self-employment less than expected. The negative impact of CP membership found by Osborn and

Slomczynski (1997) in their analysis is not present in Hungary. However, we found more marked influence of accumulated political capital in line with Coleman's (1990) theory on social capital which means in this particular case knowledge, information and network assets accumulated in the party.

The spline method verified our main assumption about discontinuity among historical intervals for becoming self-employed in Hungary. The pattern of determination of transition into entrepreneurship varied from period to period. One of the most important findings in historical perspective shows that a considerable decline in the reproduction of self-employed position occurred during World War II, and not after the communist take-over. Another meaningful result of the analysis is the radical increase in the effect of cultural and political assets on entry into entrepreneurship after 1968. Comparing Figures 2 and 3 we can observe a very similar pattern of these effects. For the reform period of communism, an academic type of education became an increasingly important precondition of transition to self-employment, and – at the same time – new entrepreneurs started to use party membership as a stepping-stone to a greater extent. The results of the analysis contribute to the debate on the political capitalism thesis, the reconversion of political capital into economic one (Hankiss, 1990; Staniszkis, 1991), and show that accumulated assets connected to party membership can be utilized for starting private business after the collapse of communism. However, it is an even more important lesson from this study that this process started already at the end of the 1970s and became general in the 1980s in Hungary.

Separation of political loyalty and accumulated political capital helped to display a more refined picture about the influence of party membership. Consequently, our results differ in this respect from those of other studies which measured only political loyalty using a dummy variable for CP membership and found smaller impact of party membership. With respect to the effect of political capital on becoming self-employed, the change of mechanism over time reveals the following shifts: *1*. Party membership as the expression of loyalty started to influence entry into entrepreneurship in the 1970s but the role of political loyalty had a decreasing trend, while that of accumulated political capital had an increasing trend during the period of reform-socialism. *2*. Both accumulated cultural and social capital (academic educational track and duration of party membership) turned out to be crucial predictors of transition into self-employment during the decline of communism, in the 1980s while political loyalty seemed to be less substantial. *3*. Former political loyalty seemed to be somewhat penalized in the post-communist era after 1988 for new entrepreneurs while both their cultural and political investments continued to have returns.

Opening a broader focus on transition to self-employment rather than investigating only the era of post-communist transformation is another important feature of the analysis. This provides an opportunity to answer the question on the evolutionary versus revolutionary character of historical changes raised at the beginning of the paper. Based on long-term trends derived from the research design applied, we can conclude that the evolutionary theory fits better the Hungarian situation than the revolutionary one. In fact, on the basis of our results from the spline regression analysis, we state that changes that occurred in 1968 were 'more revolutionary' for entry into self-employment than those in 1989.

APPENDIX I

Descriptive statistics for individuals becoming self-employed in different historical periods

Variables	Period of entry into self-employment					Total
	x–1949	1950–68	1969–79	1980–88	1989–92	
Father's occupational class (percent)						
service	3.5	4.3	6.4	11.0	11.5	8.5
intermediate (routine non-manual, skilled worker)	3.5	5.3	12.8	19.8	24.1	16.0
self-employed	42.1	24.5	12.8	8.1	7.9	16.1
unskilled, agricultural manuals	26.3	35.1	55.2	49.5	52.5	45.8
farmers	24.6	30.8	12.8	11.6	4.0	13.6
total	100.0	100.0	100.0	100.0	100.0	100.0
Educational track (percent)						
no qualification	73.2	60.8	26.5	25.0	24.2	37.5
vocational track	25.2	36.3	70.6	67.2	69.7	57.6
academic track	1.6	2.9	2.9	7.8	6.1	4.9
total	100.0	100.0	100.0	100.0	100.0	100.0
Age at becoming self-employed (mean)	23.5	30.1	29.2	33.0	32.0	30.2
Relative labour-force experience (mean)	.56	.61	.74	.77	.78	.71
Communist Party membership before entry into self-employment (percent)	–	4.9	5.9	8.9	2.7	4.6
Proportion of time spent in the CP related to the duration of the total relative labour-force experience (mean)	–	.58	.53	.58	.60	.58
Number of persons entering into self-employment	127	102	102	180	264	775

APPENDIX II.

In general, survey data are recorded in a rectangular file format in which rows represent the *subjects* and columns indicate *variables* related to subjects. In order to use event-history methods this rectangular file must be converted into a special data-file, the name of which is *person-period file*. In such a file the observation unit is not the individual any more but the discrete-time points at which the individuals are at risk of experiencing the event of interest. Since this analysis investigates events which can be experienced during the whole occupational history, every discrete-time point between entry into labour force and the time of survey is included in the data-file. There are two kinds of variables: *1*) time-constant variables (their values do not vary over time) and *2*) time-varying variables (their values are functions of time). In the following a simplified illustration of the structure of the data-set is presented.

Idnum	Year	Age	Education	Self
1	1985	25	2	0
1	1986	26	2	0
1	1987	27	2	0
1	1988	28	2	0
1	1989	29	2	1
1	1990	30	2	.
1	1991	31	2	.
1	1992	32	2	.

The example shows records of one individual identified by number 1. This respondent is observed for 8 years from 1985 to 1992. The natural starting point of the analysis is the year of his entry to the labour market. At this time the individual was 25 years old and the value of the variable expressing age is increasing as he gets older. Respondent's highest educational attainment is university (academic track). He became self-employed in 1989. This variable has a value of 0 as long as the person is not self-employed and it turns to 1 in the year when he enters into self-employment. The variable has no value during the years when respondent is self-employed because during this period he is not at risk of becoming self-employed.

APPENDIX III.

Statistical appendix to the application of spline regression methods

To assess how the effect of different attributes of individuals on the odds of becoming self-employed varies over time, a fixed-effects model of trends is estimated (*Smith*, 1979; *Greene*, 1993). This model posits discontinuities in the effect of individuals' traits at the different points in the last decades.

To represent this pattern of trend, the following model is estimated:

$$b_0 = \begin{cases} \alpha^0 + \beta^0 \text{ YEAR, if YEAR} < 1950, \\ \alpha^1 + \beta^1 \text{ YEAR, if YEAR} >= 1950 \text{ and YEAR} < 1968, \\ \alpha^2 + \beta^2 \text{ YEAR,if YEAR} >= 1969 \text{ and YEAR} < 1979, \\ \alpha^3 + \beta^3 \text{ YEAR,if YEAR} >= 1980 \text{ and YEAR} < 1988, \\ \alpha^4 + \beta^4 \text{ YEAR, if YEAR} >= 1989, \end{cases} \qquad /1/$$

where b_0 is the single-year estimates of the impact of origin on the likelihood of becoming self-employed, and YEAR is the single historical year. The thresholds (knots) which represent the discontinuities of historical trend can be defined by using dummy variables:

$d_1 = 1$, if YEAR >= t_1 otherwise it sets 0,
$d_2 = 1$, if YEAR >= t_2 otherwise it sets 0,
$d_3 = 1$, if YEAR >= t_3 otherwise it sets 0,
$d_4 = 1$, if YEAR >= t_4 otherwise it sets 0,

where $t_1 = 1950$ and $t_2 = 1969$ and $t_3 = 1980$ and $t_4 = 1989$.

Combining the above outlined equations:

$$b_0 = \beta_1 + \beta_2 \text{ YEAR} + \gamma_1 d_1 + \delta_1 d_1 \text{ YEAR} + \gamma_2 d_2 + \delta_2 d_2 \text{ YEAR} + \\ + \gamma_3 d_3 + \delta_3 d_3 \text{ YEAR} + \gamma_4 d_4 + \delta_4 d_4 \text{ YEAR} + \varepsilon. \qquad /2/$$

The slopes of the five time segments are as follows: β_2, $\beta_2 + \delta_1$, $\beta_2 + \delta_1 + \delta_2$, $\beta_2 + \delta_1 + \delta_2 + \delta_3$ and $\beta_2 + \delta_1 + \delta_2 + \delta_3 + \delta_4$.

To make this function continuous, the segments are required to join at the knots:

$\beta_1 + \beta_2 t_1 = (\beta_1 + \gamma_1) + (\beta_2 + \delta_1)\, t_1$, and
$(\beta_1 + \gamma_1) + (\beta_2 + \delta_1)\, t_2 = (\beta_1 + \delta_1 + \delta_2) + (\beta_2 + \delta_1 + \delta_2)\, t_2$, and
$(\beta_1 + \gamma_1 + \gamma_2) + (\beta_2 + \delta_1 + \delta_2)\, t_3 = (\beta_1 + \gamma_1 + \gamma_2 + \gamma_3) + (\beta_2 + \delta_1 + \delta_2 + \delta_3)\, t_3$ and
$(\beta_1 + \gamma_1 + \gamma_2 + \gamma_3) + (\beta_2 + \delta_1 + \delta_2 + \delta_3)\, t_4 = (\beta_1 + \gamma_1 + \gamma_2 + \gamma_3 + \gamma_4) + (\beta_2 + \delta_1 + \delta_2 + \delta_3 + \delta_4)\, t_4$.

These are the linear restrictions on the coefficients. Collecting these terms:

$$\begin{aligned} &\gamma_1 + \delta_1 t_1 = 0 \Rightarrow \gamma_1 = -\delta_1 t_1, \\ &\gamma_2 + \delta_2 t_2 = 0 \Rightarrow \gamma_2 = -\delta_2 t_2, \\ &\gamma_3 + \delta_3 t_3 = 0 \Rightarrow \gamma_3 = -\delta_3 t_3, \\ &\gamma_4 + \delta_4 t_4 = 0 \Rightarrow \gamma_4 = -\delta_4 t_4. \end{aligned} \qquad /3/$$

Inserting these in equation /2/:

$$b_0 = \beta_1 + \beta_2 \text{YEAR} + \delta_1 d_1 (\text{YEAR} - t_1) + \delta_2 d_2 (\text{YEAR} - t_2) + \delta_3 d_3 (\text{YEAR} - t_3) + \\ + \delta_4 d_4 (\text{YEAR} - t_4) + \varepsilon. \qquad /4/$$

Because discontinuities are assumed in the effect of origin on individual's chance to become self-employed over historical time, the dummy variables representing interruptions are added to this model. Thus, the final equation is:

$$b_0 = \beta_1 + \beta_2 \text{YEAR} + \gamma_1 d_1 + \delta_1 d_1 (\text{YEAR} - t_1) + \gamma_2 d_2 + \delta_2 d_2 (\text{YEAR} - t_2) + \gamma_3 d_3 + \\ + \delta_3 d_3 (\text{YEAR} - t_3) + \gamma_4 d_4 + \delta_4 d_4 (\text{YEAR} - t_4) + \varepsilon. \qquad /5/$$

The identical models are constructed to estimate a historical trend of the effect of other characteristics of individuals on the odds of becoming self-employed.

The coefficients formulated this way indicate how the effects of individuals' attributes change over time. This sort of model is known as the spline model, and its estimates are derived from the OLS regression (detailed discussion of this method can be found in *Smith*, 1979). The most interesting property of this approach is that it can represent the successive time segments by separate functions, thus if the data are believed to behave in a different way in the different time periods, we can fit several possibly different lines or curves to the data.

REFERENCES

ANDORKA, R. (1978): Tendencies of social mobility in Hungary: Comparisons of historical periods and cohorts. In: Social mobility in comparative perspective. Ed.: Wesolowski, W. – Slomczynski, K. – Mach, B. *Ossilineum,* Wroclaw, pp. 305–319.

ANDORKA R. (1983): Age, cohort and historical factors influencing inter- and intragenerational social mobility of men and women in Hungary. In: Research in social stratification and mobility 2. Ed.: Treiman, D. J. and Robinson, R. V. *JAI Press Inc*, Greenwich, pp. 197–248.

BECKER, G. S. (1975): Human Capital. A theoretical and empirical analysis with special reference to education. *University of Chicago Press,* Chicago.

BLOSSFELD, H-P. (1986): Career opportunities in the Federal Republic of Germany: A dynamic approach to the study of life course, cohort and period effects. *European Sociological Review,* **2.** pp. 208–225.

BLOSSFELD, H-P. – HAMERLE, A. – MAYER, K.U. (1989): Event history analysis. *Erlbaum,* Hilsdale.

BOURDIEU, P. (1984): Distinction. A social critique of the judgement and taste. *Harvard University Press*, Cambridge, Mass.

BÖRÖCZ, J. – RÓNA-TAS, A. (1995): Small leap forward. The emergence of new economic elites. *Theory and Society,* **24.** pp. 751–781.

CAMPBELL, J. L. – PEDERSEN, O. K. (1996): The evolutionary nature of revolutionary change in post-communist Europe. In Legacies of Change: Transformations of Post-Communist European Economies. Ed.: Campbell, J. L. – Pedersen, O. K. *Aldine de Gruyter*, New York, pp. 207–249.

COLEMAN, J. S. (1990): Foundations of social theory. *Harvard University Press,* Cambridge.

CONNOR, W. (1979): Socialism, politics, and equality: Hierarchy and change in Eastern Europe and the USSR. *Columbia University Press,* New York.

DENG, Z. – TREIMAN, D. J. (1997): The impact of cultural revolution on trends in educational attainment in the People's Republic of China. *American Journal of Sociology,* **103.** pp. 391–428.

DIPRETE, T. A. – GRUSKY, D. B. (1990): The multilevel analysis of trends with repeated cross-sectional data. In: Sociological Methodology. Ed.: Clogg, C. C. *Jossey-Bass.* San Francisco, pp. 337–368.

ERIKSON, R. – GOLDTHORPE, J. (1992): The constant flux. *Clarendon Press,* Oxford.

GANZEBOOM, H. B. G. – DE GRAAF, P. M. – RÓBERT, P. (1990): Reproduction theory on socialist ground: Intergenerational transmission of inequalities in Hungary. In: Research in Social Stratification and Mobility. Ed: Kalleberg, A. L. *JAI Press Inc*, Greenwich.

GANZEBOOM, H. B. G. – LUIJKX, R. – RÓBERT, P. (1991): Trends in intergenerational occupational mobility in Hungary between 1930 and 1989. Working Paper Series 58, Tilburg University, Tilburg.

GREENE, W. H. (1993): Econometric analysis. Macmillan Publ. Co., New York.

HANKISS, E. (1990): East European Alternatives. Oxford University Press, Oxford.

KOLOSI, T. (1988): Stratification and social structure in Hungary. In: Annual Review of Sociology, Ed.: Scott, W. R. – Blake, J. *Annual Review, Inc.* Palo Alto.

KOLOSI T. – SÁGI M. (1998): System change and social structure. Social Report 1998, *TÁRKI*, Budapest, pp. 41–78.

LUIJKX, R. – RÓBERT, P. – DE GRAAF, P. M. – GANZEBOOM, H. B. G. (1997): Family background, educational attainment, and labor force entry in Hungary between 1910 and 1992. The effects of industrialization and political change. Paper presented at the semi-annual meeting of ISA RC28 on Social stratification, Tel Aviv.

LUIJKX, R. – RÓBERT, P. – DE GRAAF, P. M. – GANZEBOOM, H. B. G. (1998): From ascription to achievement: The status attainment process in Hungary from 1910 to 1991. In: Conference Transformation Processes in Eastern Europe. Part 2. Social stratification, Ed: Nieuwbeerta, P. – Ganzeboom, H. B. G., NWO/ESR, The Hague, pp. 93–119.

MATEJU, P. (1993): Determinants of economic success in the first stage of the post-communist transformation. The Czech Republic 1988–1992. Working Paper, *Academy of Sciences of the Czech Republic, Institute of Sociology*, Prague.

OSBORN, E. A. – SLOMCZYNSKI, K. M. (1997): Becoming an entrepreneur in Poland, 1949–1993: Recruitment patterns and professionalization processes. *Polish Sociological Review*, **3.** pp. 249–265.

PARKIN, F. (1969): Class stratification in socialist societies. *British Journal of Sociology*, **20.** pp. 355–374.

RÓBERT, P. (1984): A multidimensional approach to social mobility. In: Stratification and inequality, Ed: Kolosi, T. – Andorka, R., Hungarian Sociological Association, Budapest, pp. 223–244.

RÓBERT, P. (1991): The role of cultural and material resources in the status attainment process: The case of Hungary. In: Beyond the great transformation, Ed.: Tóth, A. – Gábor, L., *Research Review on the Hungarian Social Sciences*, Budapest, pp. 145–171.

RÓBERT, P. (1998): Transformation processes in Eastern Europe: Social stratification. In: Conference Transformation processes in Eastern Europe. Part 2. Social stratification, Ed.: Nieuwbeerta, P. – Ganzeboom, H. B. G., *NWO/ESR*, The Hague, pp. 211–226.

RÓBERT, P. – SÁGI, M. (1997): The social basis of newly developed market economies: entrepreneurship in East-European societies. In: Stability and change in post-communist Europe: Winners and losers, Ed: Treiman, D. – Mateju, P. – Szelényi I. (forthcoming).

RÓNA-TAS, Á. (1994): The first shall be last? Entrepreneurship and communist cadres in the transition form socialism. *American Journal of Sociology,* **100.** pp. 40–69.

ENTREPRENEURSHIP in Eastern Europe I-II. Ed.: Róna-Tas, Á. – Lengyel, Gy. *International Journal of Sociology*. 1997. **27.** (3.) and (4.)

SIMKUS, A. A. (1984): Structural transformation and social mobility: Hungary 1938–1973. *American Sociological Review,* **49.** pp. 291–307.

SMITH, P. L. (1979): Splines as a useful and convenient statistical tool, *The American Statistician,* **33.** pp. 57–62.

STANISZKIS, J. (1991): The Dynamics of breakthrough in Eastern Europe. *University of California Press*, Berkeley.

STARK, D. (1990): Privatization in Hungary: From plan to market or from plan to clan. *East European Politics and Societies,* **4.** pp. 351–392.

SZELÉNYI, I. (1986-87): The prospects and limits of the East European new class projects – autocritical reflections on The intellectuals on the road to class power. *Politics and Society*, **15.** pp. 103–144.

SZELÉNYI, I. (1988): Socialist entrepreneurs. Embourgeoisement in rural Hungary. University of Wisconsin Press. Madison.

SZELÉNYI, I. – MANCHIN, R. (1989): Interrupted embourgeoisement: Background and life history of family agricultural entrepreneurs in socialist Hungary. In: Research In Social Stratification and Mobility 2. Ed.: Kalleberg, A. L. *JAI Press Inc.*, Greenwich.

SZELÉNYI, I – SZELÉNYI, SZ. (1995): Circulation or reproduction of elites during the postcommunist transformation of Eastern Europe. *Theory and Society,* **24.** pp. 615–638.

SZELÉNYI, I. – WNUK-LIPINSKI, E. – TREIMAN, D. J. (1995): Circulation vs. reproduction of elites during the postcommunist transformation of Eastern Europe. *Theory and Society,* **24.** pp. 615–802. (Special Issue)

SZELÉNYI, SZ. (1987): Social inequality and party membership: Patterns of recruitment into the Hungarian Socialist Workers' Party. *American Sociological Review,* **52.** pp. 559–573.

TŐKÉS, R. (1996): Hungary's negotiated revolution. Economic reform, social change, and political succession, 1957–1990. *Cambridge University Press,* Cambridge.

TREIMAN, D. J. (1970): Industrialization and social stratification. In: Social stratification, research and theory for the 1970s, Ed: Laumann, E. O. *Bobbs-Merill*, Indianapolis. pp. 207–234.

YAMAGUCHI, K. (1991): Event history analysis. *Sage Publications*, Newbury Park.

RECIDIVIST CRIMINALITY IN HUNGARY

KATALIN KOVACSICS[1]

SUMMARY

The paper deals with two surveys made by Hungarian penal authorities in 1983 and in 1998. The aim of the surveys was to study the demographic factors of the imprisoned criminals. Additional object was to measure the characteristics of criminal life-style. In order to this, author calculates indices of homogeneity and the density of recidivism. Both indices are measuring the criminal career, the first of them is measuring the characterristics of the series of committed crimes, the other the dangerousness of the committer.

KEYWORDS: Recidivism; Prison-statistics; Criminal careers.

This paper presents an analysis of criminality in Hungary. In the introductory part I show the long run time series of Hungarian criminality characterised by various index numbers, referring to the distribution of penalties in order to demonstrate the ratio of persons sentenced to inprisonment. The following chapters of the study are based upon the data of two prison statistical surveys. Chapter *2* describes the demographical characteristics of persons held in custody, while Chapters *3* and *4* present methods that serve to measure the whole criminal carriers of offenders. Chapter *5* contains some concluding remarks.

1. Main trends of Hungarian criminality

In Hungary there are two sorts of observations on operative criminal statistics: uniform police-prosecution criminal statistics and court statistics. They exist collaterally to and independently from each other. For the previous one the unit of observation is on the one hand the crime discovered and on the other hand the offender of the crime. For the latter one the unit of observation is the convict definitely sentenced.

In the following a table and a graph show the most prominent data of both observations in a nearly thirtyfive-year span (See Table 1, Figure 1).

As it can be seen the growth was slow from 1975 on, but from 1989 there has been a rapid growth as far as the number of crimes are concerned. As for the number of offend

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ers, the growth has been of a smaller degree which indicates that the numbers of unknown offenders and crimes committed by the same person have increased.

Table 1

The dynamics of delinquency

Year	Number of the discovered indictable crimes	Number of the discovered indictable crimes for 10 000 inhabitants	Number of offenders of the discovered indictable crimes	Number of offenders of the discovered indictable crimes for 10 000 inhabitants	Number of convicts definitely sentenced	Number of convicts definitely sentenced for 10 000 inhabitants
1965	121 961	120.3	90 713	89.5	61 187	60.4
1970	122 289	118.5	84 863	82.2	46 330	44.9
1975	120 889	115.0	81 045	77.1	59 422	56.5
1980	130 470	121.9	77 154	72.1	56 334	52.6
1985	165 816	155.6	91 216	85.6	58 313	54.7
1990	341 061	328.7	118 046	113.8	46 555	44.9
1991	440 370	425.3	129 641	125.2	64 365	62.2
1992	447 215	432.6	140 405	135.8	76 212	73.7
1993	400 935	388.9	122 621	125.9	73 338	71.1
1994	389 451	379.0	119 494	123.1	78 324	92.3
1995	502 036	490.0	121 121	125.1	85 746	100.6
1996	466 050	456.4	122 226	126.4	83 293	97.9
1997	514 403	505.6	130 966	136.4	88 073	103.7
1998	600 621	592.6	140 083	145.7	97 285	114.8

Source: Tájékoztató a bűnözésről (Information about criminality). Belügyminisztérium, Budapest, 1999.

Figure 1. The dynamics of delinquency

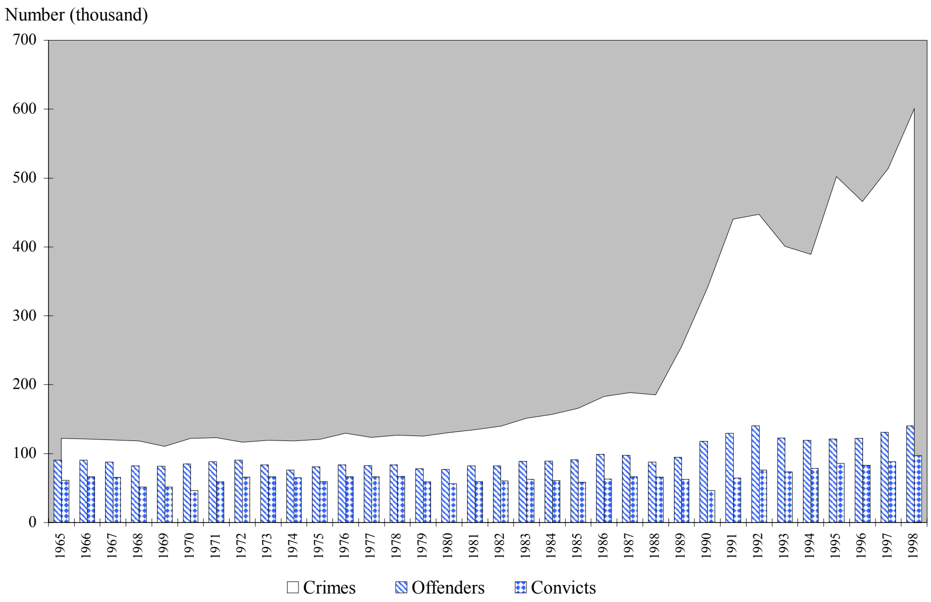


Table 2

Distribution of the convicts definitely sentenced according to the types of penalties

Year	Number of convicts definitely sentenced	Percentage share of			*Total*
		imprisoned	fine	other penalty or masures	
1970	50 978	57.8	26.5	15.7	*100.0*
1980	59 913	44.4	44.5	11.1	*100.0*
1986	65 809	46.8	35.7	17.5	*100.0*
1987	68 591	42.8	39.5	17.7	*100.0*
1988	68 197	36.5	40.1	23.4	*100.0*
1989	64 720	33.6	40.7	25.7	*100.0*
1990	47 694	37.5	39.6	22.9	*100.0*
1991	65 647	34.4	42.9	22.7	*100.0*
1992	77 481	32.6	43.8	23.6	*100.0*
1993	74 481	31.1	45.4	23.5	*100.0*
1994	78 324	30.2	45.4	24.4	*100.0*
1995	85 746	29.2	45.4	25.4	*100.0*
1996	83 293	30.3	43.9	25.8	*100.0*
1997	88 073	31.3	43.9	24.8	*100.0*
1998	96 552	32.1	43.9	24.0	*100.0*

Source: Statistical yearbooks, Central Statistical Office, Budapest.

Table 3

Number of criminals kept imprisoned

Year	Number of criminals kept imprisoned	Number of convicts (from the number of criminals kept imprisoned)
1986.12.31.	23 678	16 060
1987.12.31.	22 543	15 950
1988.12.31	20 821	15 078
1989.12.31	15 928	12 632
1990.12.31	12 319	8 819
1991.12.31	14 810	10240
1992.12.31	15 913	11 424
1993.12.31	13 196	9 390
1994.12.31.	12 697	8 944
1995.12.31	12 455	8 928
1997.01.01.	12 763	8 986
1998.01.01	13 405	9 408
1999.01.01	14 366	10 171

Source: Büntetésvégrehajtás Országos Parancsnoksága (National Headquarters of Penalty Enforcement), Budapest.

I don't want to go into details as far as the characteristics of statistics are concerned about crimes and criminals. Here I would like to mention only one group of questions in the following table wich is the division of convicts according to penalties imposed.

From the groups of convicts mentioned before I would like to study here the ones sentenced to imprisonment. As it can be seen from the comprehensive prison statistics, the number of criminals kept in custody and the number of convicts changed in the following way in the last thirteen years.

The difference of the two columns refers to the criminals confined under remand and others kept in remand of reformatory homes. There is a further number of criminals who are kept under compulsory medical treatment.

In the last years, the number of those kept imprisoned[2] has been continuously decreasing, apart from some insignificant fluctuations, despite the fact that both the number of crimes committed and of those convicted by final judgement have increased. The decrease in the number of criminals kept imprisoned is the result of the reduction of the capacity of facilities.

In order to understand this it should be taken into account that earlier the number of persons that prisons could accommodate was about 20 thousand. Today, though capacity has not changed, that number has been reduced to 12 thousand, in accordance with EU standards. While the number of crimes committed and that of persons legally convicted have increased, the capacity of penal enforcement institutions has been reduced. As a consequence, courts pass relatively fewer sentences of imprisonment. Nevertheless, the waiting time before the penality is enforced has also increased.

2. Demographic factors of convicts

Further on I would like to report about the two surveys I made at Hungarian penal authorities in 1983 and in 1998.

In the case of the 1983 survey I had a chance to analyse the data of 1000 persons which probably amounted to about 1-2 percent of all persons with a criminal record (that is those who had been held in custody). The selection was made from the records of 13 institutions (out of 32). The criterion of the selection was that all types of institutions (prisons, penitentiaries of different security level) be proportionately represented, namely in proportion to the number of persons it can hold. The selection of persons was random. Tha data were transferred onto the questionnaires from the official registry sheets, which are kept under strict control. In the 1998 survey I was able to use the data of 520 persons. The selection of this sample was made from the same 13 institutions as in the earlier survey, also in proportion to the size of the institutions. Unfortunately, it was not possible to conduct a longitudinal study of the life-line of the earlier 964 persons, as both 1983 and in 1998 the questionnaires had to be anonymous, in 1983 due to the secrecy of data, in 1998 due to data protection reasons.

The 1983 survey had three main goals:

– preparation for the computer-registration of convicts,
– study of the demographic data of the criminals kept imprisoned,
– study of the recidivists using new methods.

The aim of the 1998 survey was:

– study of the demographic and crime data of the criminals kept imprisoned
– analysis of the changes over 15 years.

[2] Criminals kept imprisoned include not only those convicted by final judgement, but also those held in e.g. pretrial detention.

Age and sex of criminals

The 1983 survey encompassed 3645 receptions[3] of 964 persons. From the surveyed persons there were 876 males (90.9%) and 33 females (9.1%). From among the number of the convicts included in my study 298 persons were received for the first time at the age of 14-17, the further 419 persons at the age of 18-24, that is the first reception of the persons observed was before the age of 25 (74.4 percent). Only 25.6 percent of them were received over the age of 25. Supposedly they had already been sentenced to other sorts of penalty before and for most of them the reception was not the result of their first crimes.

These numbers definitely show that criminal career starts at an early age and it points out the importance of prevention among young people. Since this layer of youngsters serves as a supply for the adult delinquency, the repression of juvenile delinquency should be of great importance.

It can clearly be seen from the survey of a criminal way of life that at the first reception (imprisonment) 75 percent of the convicts were less than 24 years old and at the time of the latest reception only 35 percent of them were under this age. (See Table 4) But it remains a future question whether the latest reception will also be their last one, or it is just the reflection of a given period of time. The proportion of those above 40, increased from 2.5 percent up to 17.4 percent between the first and the latest receptions.

The 1998 survey included 520 persons, 118 of which were between 14-17, an 268 between 18-24 years of age at the time of their first admission, meaning that 74.2 percent of the sample were sentenced to enforceable imprisonment before the age of 25. The ratio of juvenile offenders (aged 14-17) has been reduced to 22.7 percent from 30.9 percent over 15 years, while the total ratio of convicted young offenders has increased by 27 percent, which suggests that the ratio of sentences involving imprisonment is decreasing.

Table 4

Age of criminals kept imprisoned at the first and the latest receptions

Order of reception	Age (year)					
	14–17	18–24	25–29	30–39	40 and above	total
			1983			
First reception	298	419	121	102	24	964
Last reception	48	285	208	255	168	964
First (percent)	30.9	43.5	12.5	10.6	2.5	100.0
Last (percent)	5.0	29.6	21.6	26.5	17.4	100.0
			1998			
First reception	118	268	59	43	32	520
Last reception	14	145	107	164	90	520
First (percent)	22.7	51.5	11.3	8.3	6.2	100.0
Last (percent)	2.7	27.9	20.6	31.5	17.3	100.0

[3] Reception is a legal administrative procedure that criminals go through when entering prison. In the course of this procedure their data are entered into the central database of the institution. The exact date of the received person release is calculated, the sector where they are confined is notified, they undergo a health examination, and they are registered in labour, meal and warehouse (clothes and other articles) records. The number of receptions does not coincide with the number of adjudicated sentences, partly because in the course of one instance detention the serving of several sentences may occur, and, on the other hand, because the received criminal may be set free from pretrial detention, and then admitted again after a final judgement has been passed.

Marital status of criminals

There is a striking regularity concerning the change in marital status of criminals. (See Table 5.) In 1983 at the first reception the number of single males and females was 618 (64.1 percent), at the second one it was 488 (54.2 percent) and at the latest the proportion of singles was 39.2 percent. The proportion of married at the first reception was 25.1 percent, it increased till the sixth reception and reached 37.1 percent. At the latest reception it was 33.4 percent. It doesn't mean that the number of receptions was bigger in every case, but there are some cases when the first and the latest receptions mean the same. The number of divorced at the first reception was 75 (7.8%). This proportion increased till the eighth reception up to 41.4 percent and later on it decreased. The number of widows and widowers was very low. After the ninth reception it grew over 5 percent. The proportion of life partner category (not married but live together) was also very low. It fluctuated between 1.8 and 5.7 percent. Possibly these low numbers are the results of the insufficiency of data supply. Supposedly the proportion of this category was considerably bigger. This assumption was supported by the fact that when comparing the marital status and the age, it was obvious that the proportion of single males and females over 18 was bigger than it was in the total population and the proportion of the married was much lower than it was in the total population.

In 1998 I had the opportunity to look at the marital status only at the moment of the last reception. 244 persons were single (46.9%), 103 (19.8%) were married. The number of divorced persons was 66 (12.7%), the number of widow(er)s was insignificant (2.1%), however, the category of those living together but not married increased substantially amounting to 18.5 percent.

Table 5

The marital status of criminals kept imprisoned according to ages

Order of reception	Proportion of unmarried of age (year)		
	18–24	25–29	30–39
	from among them (percent)		
		1983	
At 1st reception	76.1	38.0	49.0
2nd	78.2	46.4	49.3
3rd	76.6	51.5	48.6
4th	75.0	64.2	47.2
5th	83.3	65.2	56.5
In the total population of 1st January 1980	56.6	22.8	15.3
		1998	
At the last reception	88.9	70.1	75.6
In the total population of 1st January 1997	82.5	41.6	28.0

The data in Table 5 indicate that a criminal lifestyle goes hand in hand with unsettled family relations. The ratio of single people is higher even among the 18-24 year olds among than the respective share of the total population. This discrepancy increases with age, even though the share of people has increased in the total population as well over the past 15 years, due to the changes in social customs.

Criminologists say that marriage restrains people from crime, however, my opinion is contrary to their belives. I find that criminality holds criminals back from marriage, as the data in Table 5 show. These data support the connection between a criminal-like lifestyle and disorderly family relations.

Education of criminals

The study of qualifications has provided the following results: qualifications and education of criminals kept imprisoned are very poor especially in comparison with similar age groups in the total of the population. The number of illiterates was at the first reception 58 (6.0%) in 1983, out of this number 23 people had learnt to write and read until the latest reception. In the 1998 sample the number of illiterate people was only 4. The proportion of those who finished their elementary education fell in the survey of 1983 from 42 percent to 20 percent in the order of the receptions. At the latest reception this proportion was over 50 percent. Before the first reception 16 people had taken their final exam of secondary education (GCSE), 9 people had started their secondary studies. Two persons had gone to university or college, one of them was in prison, four times the other one six times. Those who had finished university were not present among the observed criminals.

According to the survey of 1998, 283 finished the eight years of primary school (54.4%), 132 persons graduated from technical, industrial or secondary schools (25.4%), 3 persons had college or university degrees. It must be added that the evaluation of the educational levels registered in the records of the penitentiary institutions is based on the detainees' statements and not on official certificates.

If we compare the age of criminals with the level of their education, it is obvious that at older age the level of education is lower than that of the average. On the basis of the first five receptions, the proportion of the illiterate was 2.8 percent of those at the age of 14-17 and the proportion of those who finished elementary school was 39.9 percent.

In the age group of 18-24, the proportion of the illiterate was 4.6 percent and the proportion of those who finished elementary school was 49.5 percent. The older the people in an age group were the higher the proportion of the illiterate was. In the age group of 40-49, it was already 7.2 percent and the proportion of those who finished elementary education gradually decreased, in the same group it was less than 30 percent.

In 1998 illiteracy was 0 percent in almost every age group, the percentage of those who finished primary school was higher than 50 percent in every age group, except among those under 17 and those over 50. The highest ratio was among those aged between 25 and 29 (65.4%). The percentage of those who finished industrial school is high among the 30-49 year-olds, 28.1 percent, while among those between 18-29 it amounts to only 15.1 percent.

If we compare the proportion of those who finished elementary or higher education at the moment of their latest reception with the appropriate data of the total population we can state that failure to complete one's education is a very important criminological factor. Thus at the prevention of delinquency the most important tasks are the reduction or ceasing of the number of drop-outs and keeping to the rules of compulsory education.

Table 6

The proportion of those with finished primary or higher education in the various age groups among convicts and the total of the population
(percent)

Age group (year)	Convicts		Population	
	1983	1998	1st January1980	1st January 1990
14–17	65.5	35.7	84.6	84.8
18–24	67.4	73.1	95.0	96.7
25–29	74.5	86.0	95.6	96.5
30–39	72.1	85.7	91.0	96.3
40–49	54.1	94.0	71.3	93.0

Employment and qualification of criminals

The number as well as the proportion of skilled workers was very low in 1983. Their proportion fluctuated between 15 and 25 percent at the time of each reception. From among them the number of those who were skilled in engineering, iron, metal industry and construction was the highest.

The proportion of skilled workers was low mainly at young ages. At higher ages it increased slightly. Based on the data of the first five receptions, the mentioned proportions were the following:

Age-groups (year)	Share of skilled workers (percent)
14–17	2.3
18–24	13.5
over 25	over 25

If compared with the relevant data of the total population we can state that in the total of the population the proportion of skilled workers (from among active manual workers) was 47.1 percent. The remaining 52.9 percent did not have any qualification.

In 1998 the data referring to professional education were somewhat better: 18.3 percent of those aged 18–29, and 35.4 percent of those over 30 had professional training. The highest occurrence is that of industrial training, which amounted to 41.2 percent of those with professional training. The data of the occupation of criminals kept imprisoned were also worth considering.

The number of unemployed, casual and unskilled workers was already very high in 1983. The proportion of the unemployed at each reception was between 25–50 percent. The proportion of casual workers was between 10–30 percent and in case of unskilled workers it was between 10–35 percent, whereas the porportion of semi-skilled and skilled workers was less than 10 percent at each reception. The proportion of non-manual workers was less than 2 percent.

In 1998 the ratio of those without occupation was 61.5 percent; the ratio of occasional hands was 12.7 percent, that of factory hands 4.2 percent, the proportion of self-employed amounted to 2.5 percent, and the percentage of other, white collar workers was 1.3 per cent. What plays an important role in the increase of the number of persons without occupation is the growth of unemployment. Ex-convicts are more sensitive to it than any other strata of the population, as they have smaller chances of getting a job than their counterparts with a clean criminal record.

I had the possibility to observe the changes in occupation between only two admissions in the 1983 survey. It is worth studying the change of occupations between the receptions. At the second reception 424 out of 900 had the same jobs as before. By the time of the second reception 133 persons had occupations out of the 279 who had been unemployed at the first reception. Out of 93 casual workers 21 became unskilled and 5 skilled workers. Out of 252 unskilled workers 27 became semi-skilled or skilled, 18 became jobless, 7 became casual workers and 9 unskilled.

The occupational level between the first and the last reception remained unchanged in the case of 40.2 percent of the admitted, it rose among 34 percent and decreased among 25.8 percent. In Table 7, the rise, constancy and fall of the level of occupation are shown at the various receptions. We have an increase when an unemployed becomes a worker or when a casual worker becomes unskilled, semi-skilled or skilled, or other manual or non manual worker. In the opposite case we have a decrease.

Table 7

Changes of the level of occupation (1983)
(percent)

Period (between receptions)	Level of occupation			*Total number of admitted*
	constant	increased	decreased	
1st and 2nd	47.1	26.8	26.1	*100.0*
2nd and 3rd	43.0	27.5	24.5	*100.0*
3rd and 4th	47.5	29.2	23.3	*100.0*
4th and 5th	50.0	27.2	22.8	*100.0*
1st and latest	40.2	34.0	25.8	*100.0*

The efficiency of penal authorities is shown in the second column. It shows that the same occupation was kept at almost 50 percent. In the case of 26–30 percent of criminals the level of occupation rose. It implies that some qualifications were either acquired or previously received qualifications were used. The third and fourth columns of the table show the criminological features of the mobility of occupations.

3. Measuring the homogeneity of criminal careers

In this section I try to descibe the criminal careers. First I group the crime and based on this grouping a new indicator of the homogeneity will be introduced. Using this proposed measure of homogeneity the types of crime-series will be analysed.

Grouping of crimes

The official criminal statistics divides the groups of convicts according to their most typical and most serious, thus crimes thus focusing only on one crime in each case. I have made an effort to measure all the crimes committed by the criminals in their criminal careers. I have tried to determine the homogeneity or the inhomogeneity of their careers.

In order to do that first I had to work out a nomenclature of different crime groups, regarding the fact that the nomenclature of the Hungarian Criminal Code would have been too detailed for this study and it would be useless to talk about an inhomogeneous criminal way of life in the case of a criminal who commits fraud and then embezzlement.

When dividing the crimes into groups, I considered the relevant definitions of the Criminal Code which referred to the statement of special recidivism and served as a source for the consideration of similar crimes (Criminal Code Section 166 entry 5th and Section 333 paragraph 4th). I used the governing principle number 14 of the Supreme Court about the valuation of the repetition of crimes.

On the basis of these two sources of law I formed eight groups of crimes which contain majority of the most typical crimes. I also chose some relatively rare ones apart from these eight categories, like drunk–driving, negligence of alimentation and ruffianism. The reason was that the offenders of these crimes often commit only one crime. Finally, I grouped the crimes according to the main groups given by the Criminal Code. Thus 20 groups have been formed.

Methodology of measuring homogeneity

For studying the homogeneity of criminal careers I grouped the criminals on the basis of the occurence of one, two or more crimes on the list of crimes committed by them.

The homogeneity is obviously 100 percent in the case of those convicts who committed only one kind of crime during their criminal way of life. If a_i means the frequency of the only crime group:

$$h_1 = \frac{a_i}{a_i} = 100\% \qquad (i = 1,2,\ldots 20)\ .$$

In the case of those criminals who committed two kinds of crimes, I regard the proportion of the frequency of the more frequently occuring crime compared to the whole number of crimes as the degree of homogeneity. That is if a_1, a_2, ... a_{20} mean the frequencies of occurence at different crime groups in order of their frequency, the degree of homogeneity is

$$h_2 = \frac{a_i}{a_i + a_j}\ ,$$

if $i, j = 1,2,\ldots 20$, $i \neq j$ and $a_i \geq a_j$.

With those criminals who committed three kinds of crimes, the situation is more complicated, because if I compare the total amount of frequency of the most frequently occuring crime groups with the whole number of the committed crimes $\frac{a_i + a_j}{a_i + a_j + a_l}$, I will get the same degree of homogeneity as with those criminals who committed only one kind of crime. The degree of homogeneity though is obviously not the same. That is why the previous quotient should be multiplied by a correcting factor which means the relative frequency of the more frequently occuring crimes between the two main ones. Thus the degree of homogeneity is:

$$h_3 = \frac{a_i + a_j}{a_i + a_j + a_l} \cdot \frac{a_i}{a_i + a_j + a_l},$$

where $i, j, l = 1,2,\ldots 20$, $i \neq j \neq l$ and $a_i \geq a_j \geq a_l$.

This method can be continued and the degree of homogeneity could be defined in general for any case where k (k = 1, 2, ... m, ... 19) is the number of the occuring crimes. In this case:

$$h_m = \prod_{k=1}^{m} \frac{\sum_{i=1}^{k} a_i}{\sum_{i=1}^{m} a_i}$$

If k, however, is more than 5 or 6, the degree of homogeneity is very low. The index here would be of little importance. I would like to add that in the cases where the survey expands up to more than 1000 persons – to a considerably higher number – it is not worth considering all the crimes that occurred once or twice when calculating the degree of homogeneity.

I have made a survey – with the use of the same method – with nearly 500.000 persons registered by the penal registry[4]. In these cases I found a flood of crimes, so I had to define the dominant ones. I considered those dominant which occurred more than twice during a criminal's career. I ignored those which occurred only once or twice when determining the degree of homogeneity. Even this way the degree of homogeneity was less than 10 percent, that is, a criminal way of life was inhomogeneous if out of the twenty crime groups 5 or 6 were dominant (occurred more than twice).

Analysis of homogeneity indices

In the prison-statistical samples there was a great number of criminals at each reception who committed only one crime. But how do the proportions change if we consider the whole lifespan of a criminal? Whether they stick to one crime or the circle of crimes expands or they become specialised in a certain field is still a relevant question.

The following table serves as a summary of the number of the types of committed crimes. It cannot be stated that the number of the types of crimes committed would show correlation with the number of receptions. 58.6 percent of the criminals who committed 5 or more types of crimes were recived not more than six times and only

[4] The research conducted in the Criminal Registry Office of the Ministry of the Interior refers to the whole population studied. The data were surveyed at the end of the year 1981, and their processing has been carried out by the National Bureau of Data Processing.

one of them was received more than 9 times. As opposed to that, among the criminals who were received 10 or more times 78.9 percent did not commit more than four types of crimes.

Table 8

Distribution of criminal careers based on the number of the types of crimes committed (1983)

Number of the types of the committed crimes	At each reception (percent)	During the whole criminal way of life
1	77.6	24.2
2	18.2	34.2
3	3.6	25.1
4	0.5	10.5
5 or more	0.1	6.0
Altogether	*100.0*	*100.0*

The next table shows the distribution by the degree of homogeneity.

Table 9

Distribution of criminals kept imprisoned according to the degree of homogeneity (l983)
(percent)

Degree of homogeneity	Proportion of criminals kept imprisoned
100	24.2
70-99	19.4
40-69	35.6
10-39	18.2
less than 10	2.6
Total	*100.0*

It is obvious that the homogeneity of those who committed only one crime is 100 percent. For the criminals who committed two crimes it is either 100 or 50 percent. For those who committed three crimes it is 100, 66.6 or 22.2 percent.

With the number of receptions the degree of homogeneity decreases inevitably. While at the first reception the 100 percent homogeneity was 82.8 percent, at the second reception the proportion of entirely homogeneous criminals was only 33.5 percent. At the third and the further receptions the 100 percent homogeneity was only 14.2 percent, but these kinds of criminals also occur among the ones received 12 or more times (12.5%).

It was, however, very rare to have low homogeneity with those criminals who were kept imprisoned many times. Only 16 percent of those who were received more than five times belong to those criminals whose ways of life show less than 10 percent homogeneity.

Consequently frequent recidivists who were received many times were among the specific recidivists.[5]

Types of crime-series

If we want to analyse the series of crimes not only according to their homogeneity but also their content, a group of 20 crimes seems too numerous, so I tried to form 4 groups out of the 20.

Main types of crimes are

– Crimes against property,
– Crimes of violence,
– Crimes of irresponsible, parasitic lifestyle,
– Crimes against the state, social and economic systems.

On the basis of these four groups a criminal way of life can be placed into the following combined groups. Criminal career contains crimes

– only against property,
– only crimes of violence,
– only crimes of irresponsible, parasitic lifestyle,
– only crimes against the social and economic systems.
– crimes against property and crimes of violence,
– crimes against property and irresponsible, parasitic lifestyle,
– crimes against property and crimes against the social and economic systems,
– crimes of violence and irresponsible, parasitic lifestyle,
– crimes of violence and crimes against the social and economic systems,
– irresponsible, parasitic lifestyle and crimes against the social and economic systems,
– undistinctive (three types, or all four types).

Table 10

Distribution of crime-series in criminal carreers

Crime types	1983 (persons)	1983 (percent)	1998 (persons)	1998 (percent)
Only against property	223	23.1	56	10.8
Only crimes of violence	188	19.5	149	28.7
Only else	234	24.3	4	0.8
Crimes against property and crimes of violence	68	7.1	172	33.1
Crimes against property and else	101	10.5	43	8.3
Crimes of violence and else	45	4.7	9	1.7
Crimes against property and crimes of violence and else	105	10.8	87	16.7
Total	*964*	*100.0*	*520*	*100.0*

[5] A *specific recidivist* is one who commits the same or similar crime twice. A *multiple recidivist* is one who is sentenced to imprisonment prior to committing a deliberate crime, and less then 3 years pass even before the person is even be sentenced to imprisonment. The above concepts are penal low categories, while the expression *crime repeater* is a criminal-statistical notion, and refers to a previously convicted person who does not fall into any of the mentioned categories.

The most frequent type of crime is that against private property. In the 1983 survey, 51.5 percent of convicts committed crimes against private property in the course of their lives, while in the 1998 survey that number rose to 68.9 percent. The difference between the two periods can be seen in the fact that in the earlier survey 23.1 percent of detainees committed only crimes against private property, while in 1998 the ratio of this homogeneous group dropped to 10.8 percent, and the proportion of those committing crimes both against private property and violent crimes increased. The ratio of other crimes decreased significantly, due to the fact that now economic crimes, drunk driving and failure to pay child maintenance are only fined, whereas earlier they used to be the most frequent ones crimes. (See Table 10.)

4. Measuring the danger of criminal careers

Police record. When grouping convicts, criminal record of a convict is an important aspect. The criminal code in effect at present differentiates between the following categories according to criminal record:

– recidivist,
– special recidivist,
– multiple recidivist.

As not all persons with a criminal record correspond to the legal concept of recidivist, criminal statistics uses the term crime repeaters for those who have a criminal record but are not recidivist, and if we analyse the distribution of the criminals by recidivsm, the first crime offenders are to be into account.

The distribution by the mentioned categories of the 964 and 520 persons surveyed respectively is illustrated in Table 11.

Table 11

Categories of recidivists in 1983 and 1998

Categories of recidivism	1983 (person)	1983 (percent)	1998 (person)	1998 (percent)
First crime criminal	53	5.5	169	32.5
Crime repeater	603	62.5	6	1.2
Recidivist	68	7.1	100	19.2
Special recidivist	215	22.3	98	18.8
Multiple recidivist	25	2.6	147	28.3
Total	*964*	*100.0*	*520*	*100.0*

The changes in the distribution by categories can be explained by two factors:

– the law providing for the previous grouping was enforced on July 1, 1979. At the time of the 1983 survey the majority of detained convicts were already convicted before the enforcement of the law, therefore no such classification could be present in their criminal sentence;

– the last 15 years have been characterised by the softening of sentences, thus only a tiny proportion of so-called crime repeaters are sentenced to imprisonment. Therefore on the one hand prisons are mostly filled with recidivist, special recidivist and multiple recidivist convicts, on the other hand the proportion of those committing their first crime has also increased, as the growing of criminality has resulted in the broadening of the criminal sphere.

Order of recidivism

In the foregoing the convicts were grouped according to the fact whether they had previous criminal record or not, or they were regarded as recidivists in legal terms, and if yes, which category of recidivist.

We have not yet analysed the number of penalties of criminals who had already been convicted once, twice, three or several times previously. I call this number the *order of recidivism*. It is to be noted that the order of recidivism is not determined according to the number of penal sentences, but according to the number of admissions which can be either greater or smaller than the number of sentences.

Table 12

Distribution of criminals kept imprisoned according to the number of receptions

Number of receptions	1983 (person)	1983 (percent)	1998 (person)	1998 (percent)
1	64	6.6	225	43.3
2	260	27.0	47	9.0
3	215	22.3	67	12.9
4	149	15.5	45	8.7
5	98	10.2	48	9.2
6	67	6.9	18	3.5
7	41	4.3	32	6.1
8	30	3.1	14	2.7
9	21	2.2	10	1.9
10	7	0.7	3	0.6
11	2	0.2	3	0.6
12 or more	10	1.0	8	1.5
Total	*964*	*100.0*	*520*	*100.0*

However, we must add that the number of criminal sentences does not necessarily coincide with the number of receptions, partly because it often happens that a convict serves several sentences in the course of a single reception. For example, in these terms, the distribution of the 520 convicts of the 1998 survey can be seen in Table 13.

Nevertheless, there can be several receptions in the case of one sentence, because e.g. the reception takes place based on the order of pretrial detention, then the criminal kept imprisoned is set free from pretrial detention, and following that, they are received again to serve the given term after the sentence goes into effect. In 1998 for instance, 45 percent of those received were received 2-4 times.

Table 13

The distribution of convicts by the number of their criminal sentences (1998)

Number of criminal sentences	Number of persons	Distribution (percent)
1	263	50.6
2	122	23.5
3	79	15.2
4	33	6.3
5	10	1.9
6-7	10	1.9
8 or more	3	0.6
Total	*520*	*100.0*

Comparing the findings of the two surveys it is clear that it is in the case of the first four receptions that significant changes have taken place, the differences between the relative numbers of further receptions are incidental. In the case of 1983 receptions the first receptions were rare (6.6%), a significant part of those received consisted of criminals received 2-4 times (64.8%). In 1998 those received once make up 43.3 percent of those surveyed, while those received 2-4 times represent only some 30.6 percent of the sample. These numbers indicate that there are few prison sentences, and second or further prison sentences are seldom passed, and at the same time, with the dramatic rise in criminality the sphere of criminals is significantly broadening, more and more new perpetrators appear in the statistics.

Measuring the density of recidivism

In many statistics the danger of criminal careers is measured by the order of recidivism, that means the number of previous convictions.

Though the order of recidivism is an important index of recidivism, nevertheless, it cannot express the danger which society is exposed to either by the offenders or the offences. This is much better reflected by the punishment meted out. On the one hand, persons with fifteen, twenty, twenty-five previous convictions generally do not commit very heavy crimes, they are given short-term punishments which served in a short time makes it possible for them to be up against the law again and again. On the other hand, others, the offenders of the heaviest crimes, convicted to ten-fifteen-year imprisonment at a time, consequently spending the better part of their lives in prison, do not attain such a great number of sentences.

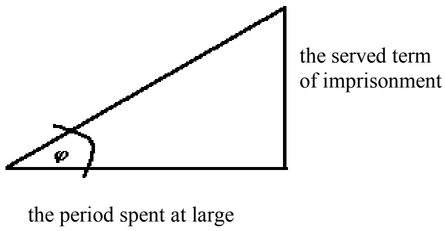
When studying the criminal career, it is necessary to study – along with the order of recidivism – the length of time a person spends at large with previous convictions and with imprisonment. When measuring these periods must be compared by means of the following ratio:

$$\text{tg } \varphi = \frac{\text{THE SERVED TERM OF IMPRISONMENT}}{\text{THE PERIOD SPENT AT LARGE}}$$

If we give a graphic representation of the punishment imposed on the convicted, plotted against the period spent at large, the latter information will be represented by co-ordinate *X* and the sum of the terms of imprisonment by co-ordinate *Y*.

If the numerator and the denominator of the mentioned quotient are plotted within one system of co-ordinates, the numerator and the denominator of the quotient will be the two perpendicular sides of a right-angled triangle, that is the quotient will be the tangent to the angle at the origin. According to the angle of the frequency of recidivism the offenders can be ranked by the rate of their dangerousness (Figure 2.): the bigger this angle, the more dangerous the corresponding criminal is.

Figure 2. The definition of density of recidivism



By the help of the calculated angles I grouped the offenders into six classes, one class representing a 15º degree angular range. In the two angle-groups of under 30º degrees are placed the less dangerous criminals, who spend at least 1.7 times more time at large than in prison, in the range of 30º-60º we can find criminals, though being up against law but several times between their punishment of shorter and longer terms spending a longer period of time at large and perhaps having employment. Persons belonging to the range up to 45º spend in prison at most as much time as they spend at large. Offenders belonging to the range beyond 60º represent the most dangerous criminals who spend at least 1.7 times more time in prison than at large.[6]

Analysis of the density of recidivism

According to the data of the mentioned representative sample referring to 964 persons, the distribution of the 900 persons with more than one previous conviction shows the following picture.

If we analyse the density of recidivism compared to any subset of the criminals kept imprisoned and not to the whole of their number, we get a similar distribution to the previous mentioned ones.

In the 1983 survey, data not detailed here show that the categories between 15.0º, 29.9º, 60.0º and 74.9º are the most frequent ones. This refers to the fact that the density of recidivism means a unique aspect of classification not depending on other ones. It reflects the danger of the convicts to the society regardless of the number of convictions and the homogeneity or inhomogeneity of the crimes. In the survey of 1983 the most frequent

[6] It should be stressed that the introduction of angles may be an interpretation but it cannot replace the original figures expressed in forms of ratios.

categories of the criminals received two or three times is below 30º and above 75º. It shows that among the criminals received 2 or 3 times the less dangerous criminals are those who spend a long time at large between their receptions, but there are some of them who spend most their lives in penal institutions as a result of two-three rather serious crimes they commited.

Table 14

Distribution of the criminals kept imprisoned according to the density of recidivism

Density of recidivism	Proportion of criminals kept imprisoned (percent)	
	1983	1998
Below 15º	15.3	49.2
15.0º-29.9º	19.7	14.8
30.0º-44.9º	16.6	10.4
45.0º-59.9º	16.3	8.1
60.0º-79.9º	17.1	7.1
Above 75º	15.0	10.4
Total	*100.0*	*100.0*

In the case of criminals received twice or 3 times the categories of 15-45º and 60-75º occur regularly. It is in accordance with the experience that the smaller the number of receptions is, the shorter the length of penalty is. The convicts sentenced many times get to court for less serious crimes and they are sentenced to shorter punishments.

It is in the 1998 sample that the ratio of those under 30º is the highest, but the ratio of those under 15º is particularly high, which indicates that the duration of prison terms has significantly decreased in the last years.

5. Conclusions

As a result of the two surveys I have outlined here and in my other researches, especially the ones I made in the field of the Penal Registration, I am convinced that for the scientific cognition of delinquency and the study of criminal careers the statistical progress in registration serves as a scientific basis.

Official criminal statistics – as well as police and court ones – describe the delinquency only of a period of one year and they do not show the process of criminality. These statistics are connected with criminal investigation and activities of court administration. They are more of operative statistics and they are not able to study delinquency as a social phenomenon. Since the Penal Registry has been processed on computers, the computerisation of penitentiary operative records has been completed, at least in pending cases, not in archive materials, their elaboration for statistical purposes is only a question of an appropiate computer program.

The establishment of an on-line connection between the two kinds of registrations would serve as a labour-saving device concerning data-collection and it would keep increasing the efficiency of investigation.

EXPS FOR WINDOWS, A SOFTWARE APPLICATION *

TIBOR KISS[1] – BÉLA SIPOS[2]

SUMMARY

Exponential smoothing is still very popular world-wide. Well-known and frequently used statistical program packages contain this methodology. This paper demonstrates an exponential smoothing program that provides a more sophisticated software solution for this statistical method, namely it allows the automatic selection of the smoothing type, and it calculates a 'what if' and a sensitivity analysis.

Keywords: Exponential smoothing; Program packages.

Some kind of forecasting has always been a need of companies who wanted to know the near future. From the wide range of statistical methods decision makers have to find the one that fits best their actual situation. In situations where decision makers wanted to predict the continuation of a problem or relationship or wanted to forecast changes, time series methods were applied. Since the early 60s, with the growth in size and complexity of companies, the need for more and more sophisticated time series methods has increased. Computer usage spread from the early 70s, and time-shared computers were available at organisations. This spread of computers still continues. *Makridakis* et *al.* (1983, p.14) stated that in the 80s the greatest gains would derive from application and not new methods. New methods that are currently in the main stream are really important. These methods include: chaos theory (anharmonic analysis), *Gleick* (1987), wavelet analysis, *Percival* and *Harold* (1997) and others. However, a number of researchers are still working on exponential smoothing (*Aerts* et *al*., 1997; *Cleveland* and *Loader*, 1996; *Efron* and *Tibshirani*, 1996; *Eilers* and *Marx*, 1996; *Fan* et *al*., 1996; *Hardle* and *Marron*, 1995; *Jones*, 1996; *Jones* and *Foster*, 1996; *Marron*, 1996; *Wahba* et *al*., 1995). It is known world-wide and is effective; especially for short term forecasting purposes. Compared with other methods, like the Box-Jenkins method, exponential smoothing often has superiority (*Makridakis* et *al*., 1983). However, the

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number of computers, currently available and the time shortage of decision makers emphasize the importance of software applications that use the ‘old’ methodology.

Exponential smoothing is a relatively simple method. It does not need a profound mathematical-statistical background, but it can provide a useful information base for decision making. It has the best performance in the case of short-term forecasting, e.g. monthly or weekly data (*Makridakis* et *al*., 1983). Most current statistical packages (SPSS, Statistica) also comprise the exponential smoothing method. Software developers are compelled to design better and better quality products. Software that can satisfy consumers’ needs is very important. The time interval between two versions of leading software packages has decreased to less than 1 year.

1. Theory

This section provides the theoretical background of the proposed computer program. First the most important features of the time series will be described followed by a very brief summary of the methodology of exponential smoothing.

Time series

If decision makers want to know more about the future, they have to collect data from the past. This time series is used for forecasting patterns derived from data. It is necessary to know the past behaviour of the process (if it is possible) in order to recognise its future. A basic principle of forecasting is to project the connection with the help of the knowledge of past and present data.

The simplest tools of time series analysis are computation of ratios and delineation of time series. Delineation is a useful tool, because it makes possible to recognise the type of function and constant trend. With mathematical-statistical methods one can do a more profound analysis, because the knowledge of deeper processes and principles can help with extrapolation.

Time series are always the results of observations, and researchers have to recognise principles on the basis of these data. Nowadays the fast change in economy results in time series a lot of breakpoints; sometimes a continuous length of time series is 5-6 years or less. However, it is not always possible to prepare correct extrapolation because of sudden changes. A more complex economic analysis is needed to determine the probability of unchanged variables or a variable for which the variation can be calculated.

It is necessary to have an appropriate length of time series - it is said to be as long as the extrapolated length (*Makridakis* et *al*., 1983). For a truly sound extrapolation about a minimum of six-year series is necessary (*Makridakis* et *al*., 1983), where e.g. the first three years can be computational periods (testing and estimating the seasonal component, because seasonal fluctuation has to be repeated at least three times), and the other three are the test periods. In the case of quarterly data it means $6 \cdot 4 = 24$ observed values. In the case of monthly data $6 \cdot 12 = 72$ months are appropriate. In the latter case the test period can start at $72/2 + 1$ that is at 37^{th} case. Analysing time series before extrapolation is necessary in order to discover the seasonality, trend, cycles and accidental changes. A longer time series provides chance of a better extrapolation.

Ones of the most popular methods are trend analysis and extrapolation. Trend analysis can discover permanent tendencies and trend-extrapolation is the projection of this tendency. A firm has complex functional processes; a basic tendency of these processes is the function of a lot of factors. A trend assumes a permanent effect in time, which is not always the case in practice. These differences can be significant. Sometimes it is a problem that last values of time series have greater influence on the future than previous ones, however a traditional trend-extrapolation ignores these facts. This problem can be solved by special procedures, e.g. exponential smoothing methods. Apart from trend analysis, discovery of periodical fluctuation and limitation of developmental conditions are important parts of extrapolation. It has to be stressed that using automatic trend-extrapolation is not correct; and it can rarely give proper extrapolation. Sometimes the application of other statistical or intuitive methods is more suitable. The longer the period of extrapolation is, the bigger the ratio of intuitive methods is according to some experts' opinions. Sometimes the latter one is the only acceptable method.

The traditional decomposition of time series are the following (*Makridakis* et *al*., 1983): trend, seasonality, cycles, and random changes. There may be a connection between them in additive or multiplicative ways. In the case of an additive connection, the model is:

$$X_t = T_t + S + C + E_t$$

where

X_t = time series observations (t =1, 2,...n),
T = trend,
S = seasonality,
C_t = business cycles (for instance length of period can be e.g. 3, 9, 27, 54 year),
E_t = residual, error term.

In the case of a multiplicative connection the model is as follows:

$$X_t = T_t \cdot S \cdot C \cdot E_t$$

Exponential smoothing method, moving average

Exponential smoothing is the improved version of the moving average. Traditional moving average use identical weights for all cases,[3] while exponential smoothing gives greater emphasis on most current data, but it still does not need deep mathematical - statistical knowledge. Additionally, it does not need long processing time from the computer either.

The basic model of the exponential smoothing is (*Makridakis* et *al*., 1983):

$$S_t = \alpha P + (1-\alpha)Q$$

where Q and P change by the type of trend and seasonality.

[3] There are moving average methods using different weights as well.

Pegels (1969) classified smoothing methods according to their seasonality and trend component.

This classification is shown in Table 1.

Table 1

Connections between seasonality and trend

Trend	Seasonality none	Seasonality additive	Seasonality multiplicative
None	$P_t = X_t$ $Q_t = S_{t-1}$	$P_t = X_t - C_{t-L}$ $Q_t = S_{t-1}$	$P_t = X_t / D_{t-L}$ $Q_t = S_{t-1}$
Additive	$P_t = X_t$ $Q_t = S_{t-1} + A_{t-1}$	$P_t = X_t - C_{t-L}$ $Q_t = S_{t-1} + A_{t-1}$	$P_t = X_t / D_{t-L}$ $Q_t = S_{t-1} + A_{t-1}$
Multiplicative	$P_t = X_t$ $Q_t = S_{t-1} \cdot B_{t-1}$	$P_t = X_t - C_{t-L}$ $Q_t = S_{t-1} \cdot B_{t-1}$	$P_t = X_t / D_{t-L}$ $Q_t = S_{t-1} \cdot B_{t-1}$

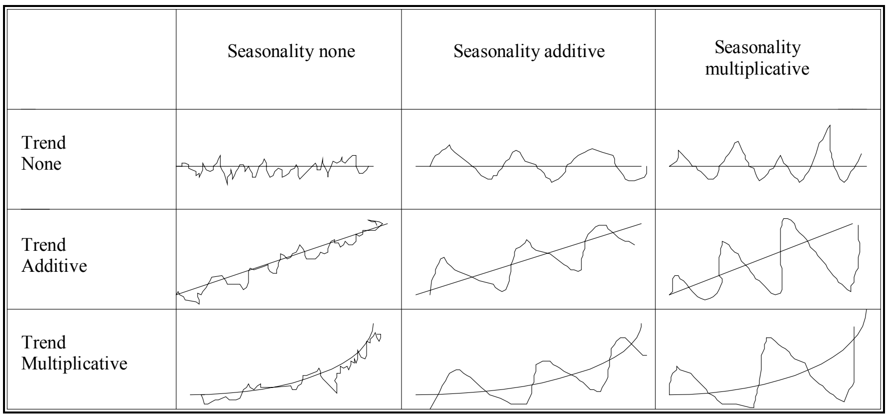
Source: *Makridakis* et *al*. (1983, p. 110).

where:

X_t = observed data,
S_t = smoothed data, $\alpha P + (1-\alpha)Q$,
$A_t = \beta (S_t - S_{t-1}) + (1-\beta)A_{t-1}$ (additive trend),
$B_t = \gamma (S_t/S_{t-1}) + (1-\gamma)B_{t-1}$ (multiplicative trend),
$C_t = \partial (X_t - S_t) + (1-\partial)C_{t-L}$ (additive seasonality),
$D_t = \theta (X_t/S_t) + (1-\theta)D_{t-L}$ (multiplicative seasonality),
L = length of seasonality.
Parameters $\alpha, \beta, \gamma, \partial, \theta$ are between 0 and 1.

Table 2 depicts equations of extrapolation (F_t+m) for different types of smoothing methods for m seasons.

Figure 1. Connections among the factors of time series



Source: *Makridakis* et *al*. (1983, p. 69)

Table 2

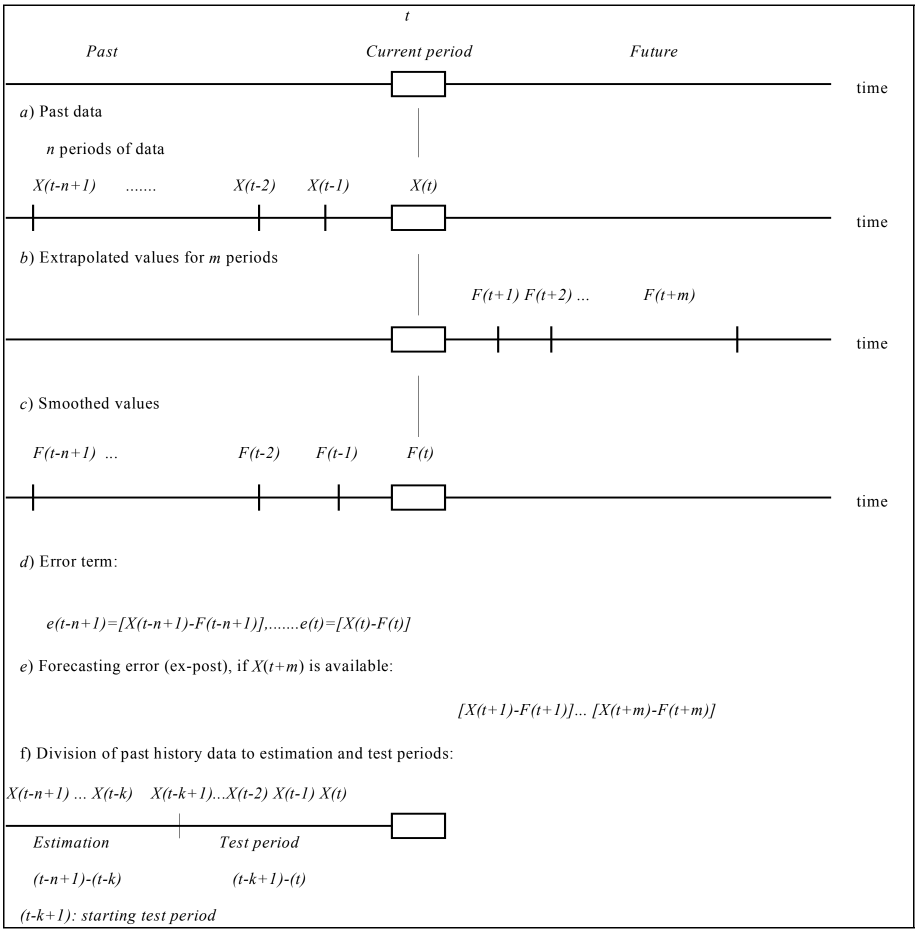
Equations of exponential smoothing methods

Trend	Seasonality		
	none	additive	multiplicative
None	S_t	$S_t + C_{t-L+m}$	$S_t \cdot D_{t-L+m}$
Additive	$S_t + mA_t$	$S_t + mA_t + C_{t-L+m}$	$(S_t + mA_t) \cdot D_{t-L+m}$
Multiplicative	$S_t \cdot B_t^m$	$S_t \cdot B_t^m + C_{t-L+m}$	$S_t \cdot D_{t-L+m} \cdot B_t^m$

Source: *Makridakis* et *al*. (1983, p. 111).

Let's assume that *n* periods of observation are available at the time of *t*, *and* the length of extrapolated period is *m.* Observed values are denoted by *X*, fitted values by *F.* In this case the correct meaning of elements can be seen in Figure 2.

Figure 2. Extrapolation procedure



Source: Part of the figure is based on: *Makridakis* et *al*. (1983, p. 66).

Algorithms of applied methods

Pegels' classification contains 9 methods, three additional methods are selected from Makridakis (1983). The first 9 rows of the following list comprise the combinations of the three seasonality types and the three trend components.

1 = Single exponential smoothing
2 = Seasonality - additive, trend none
3 = Seasonality - multiplicative, trend none
4 = Seasonality - none, trend additive (Holt's method)
5 = Seasonality - additive, trend additive
6 = Seasonality - multiplicative, trend additive (Winters' method);
7 = Seasonality - none, trend multiplicative
8 = Seasonality - additive, trend multiplicative
9 = Seasonality - multiplicative, trend multiplicative
10 = Adaptive Response Method (ARRSES)
11 = Brown one-parameter linear method
12 = Brown one-parameter quadratic method

T1 – Normal exponential smoothing:

$$F_{t+1} = \alpha X_t + (1 - \alpha) F_t$$

or (according to Table 1):

$$S_t = \alpha X_t + (1 - \alpha) S_{t-1}$$

Initialisation: given that F_1 is not known, the most frequent initialisation is: $F_1 = X_1$.
Extrapolation horizon is only 1 period: $F_{t+1} = S_{t+1}$

T2 – Seasonality additive, trend none:

$$S_t = \alpha (X_t - C_{t-L}) + (1 - \alpha) S_{t-1}$$
$$C_t = \partial (X_t - S_t) + (1 - \partial) C_{t-L}$$

where L = the length of a season, e.g. 4 in the case of quarterly data.

Initialisation: See Method 6 for the initialisation of C.
Extrapolation for m periods: $F_{t+m} = S_t + C_{t-L+m}$

T3 – Seasonality multiplicative, trend none:

$$S_t = \alpha (X_t / D_{t-L}) + (1 - \alpha) S_{t-1}$$
$$D_t = \theta (X_t / S_t) + (1 - \theta) D_{t-L}$$

Initialisation: See Method 6 for the initialisation of D (seasonal component).
Extrapolation for m periods: $F_{t+m} = S_t \cdot D_{t-L+m}$

T4 – Seasonality none, trend additive (Holt's method):

$$S_t = \alpha X_t + (1 - \alpha)(S_{t-1} + A_{t-1})$$
$$A_t = \beta (S_t - S_{t-1}) + (1-\beta) A_{t-1}$$

This procedure is identical with Holt's method, which applies the parameter of b_t, instead of A_t, and γ instead of β.

Holt's linear two parameter method: additive linear trend for t observed date with two parameters [α and γ]:

$$S_t = \alpha X_t + (1 - \alpha)(S_{t-1} + b_{t-L})$$
$$b_t = \gamma (S_t - S_{t-1}) + (1 - \gamma) b_{t-1}$$

Initialisation: S_t (initial value) and b_1 (trend) should be determined. S_1 can be equal to X_1. b_1 (trend component) can be determined by different ways. Two of them are:

$$b_1 = x_2 - x_1$$
$$b_1 = \frac{(x_2 - x_1) + (x_3 - x_2) + (x_4 - x_3)}{3}$$

Extrapolation for m periods: $F_{t+m} = S_t + mb_t$

T5 – Seasonality additive, trend additive:

$$S_t = \alpha (X_t - C_{t-L}) + (1 - \alpha)(S_{t-1} + A_{t-1})$$
$$A_t = \beta (S_t - S_{t-1}) + (1 - \beta) A_{t-1}$$
$$C_t = \partial (X_t - S_t) + (1 - \partial) C_{t-L}$$

Initialisation: See Method 6 for the initialisation of C, and Method 4 for the initialisation of the trend component (A_t).

Extrapolation for m periods: $F_{t+m} = S_t + mA_t + C_{t-L+m}$

T6 – Seasonality multiplicative, trend additive, Winters' three parameter trend and seasonality method:

This method comprises three smoothing methods. The overall smoothing equation is:

$$S_t = \alpha (X_t / (D_{t-L})) + (1 - \alpha)(S_{t-1} + A_{t-1})$$

Trend component:

$$A_t = \beta (S_t - S_{t-1}) + (1 - \beta)(A_{t-1})$$

Seasonal component:

$$D_t = \theta (X_t / S_t) + (1 - \theta)(D_{t-L})$$

Forecast: $F_{t+m} = (S_t + b_t m)\, I_{t-L+m}$

Initialisation: Let us assume that L=4 (quarterly data). In this case I_1 to I_4 should be estimated by means of the first four X values ($I_1 = X_1 / ((X_1+X_2+X_3+X_4)/4)$), and b can be estimated as follows (*Makridakis* et *al*., 1983, p.108):

$$b = \frac{1}{L}\left[\frac{X_{L+1} - X_1}{L} + \frac{X_{L+2} - X_2}{L} + \ldots + \frac{X_{L+L} - X_L}{L}\right]$$

where it is convenient to use two complete seasons.

Extrapolation for m periods: $F_{t+m} = (S_t + A_t m)\, D_{t-L+m}$

This method is the same as Winters' method which applies parameter b_t for trend, and parameter I_t for seasonality:

$$S_t = \alpha\,(X_t / (I_{t-L})) + (1 - \alpha)(S_{t-1} + b_{t-1})$$
$$b_t = \gamma\,(S_t - S_{t-1}) + (1 - \gamma)(b_{t-1})$$
$$I_t = \beta\,(X_t / S_t) + (1 - \beta)(I_{t-L})$$
$$F_{t+m} = (S_t + b_t m)\, I_{t-L+m}$$

T7 – Seasonality none, trend multiplicative:

$$S_t = \alpha X_t + (1 - \alpha)(S_{t-1} \cdot B_{t-1})$$
$$B_t = \gamma\,(S_t / S_{t-1}) + (1 - \gamma)(B_{t-1})$$

Initialisation: See Method 4 for the initialisation of the trend component (B_t).

Extrapolation for m periods: $F_{t+m} = S_t B_t^m\, I_{t-L+m}$

T8 – Seasonality additive, trend multiplicative:

$$S_t = \alpha\,(X_t - C_{t-L}) + (1 - \alpha)(S_{t-1} \cdot B_{t-1})$$
$$B_t = \gamma\,(S_t / S_{t-1}) + (1 - \gamma)(B_{t-1})$$
$$C_t = \partial\,(X_t - S_t) + (1 - \partial)\, C_{t-L}$$

Initialisation: See Method 6 for the initialisation of C, and Method 4 for the initialisation of the trend component (B_t).

Extrapolation for m periods: $F_{t+m} = S_t B_t^m + C_{t-L+m}$

T9 – Seasonality multiplicative, trend multiplicative:

$$S_t = \alpha\,(X_t / D_{t-L}) + (1 - \alpha)(S_{t-1} \cdot B_{t-1})$$
$$B_t = \gamma\,(S_t / S_{t-1}) + (1 - \gamma)(B_{t-1})$$
$$D_t = \theta\,(X_t / S_t) + (1 - \theta)\, D_{t-L}$$

Initialisation: See Method 6 for the initialisation of D, and Method 4 for the initialisation of the trend component (B).

Extrapolation for m periods: $F_{t+m} = S_t D_{t-L} + m B_t^m$

Using the program of ExpS in the case of types 5, 6, 8 and 9 (where both the trend and seasonal components are calculated), the first parameter (/1) is the parameter of seasonality (additive: ∂, multiplicative: θ); the second (/2) is the parameter of the trend (additive: β, multiplicative: γ).

T10 – Adaptive Response Method (ARRSES):

The method will always change the parameter α_t automatically if the pattern changes in the time series, therefore the time-invariant α value will be replaced by the time-dependent α_t.

$$F_{t+1} = \alpha_t X_t + (1 - \alpha_t) F_t ,$$

where

$\alpha_{t+1} = |E_t / M_t|$,
$E_t = \beta e_t + (1 - \beta)(E_{t-1})$,
$M_t = \beta |e_t| + (1 - \beta)(M_{t-1})$,
$e_t = X_t - F_t$,
α and β are between 0 and 1,
e_t is the error term,
E_t is the error term of smoothing and
M_t is the absolute error term of smoothing.

About the value of α_{t+1} the following note should be added: if forecasted values are good, then e_t will frequently change, therefore the numerator (E_t), together with α_{t+1} will be a small value. As a consequence, smoothed values get bigger weights, according to the original smoothing equation. However, if the sign of e_t does not change for a longer time, then the value of α_{t+1} will be higher, with a bigger weight of observed data.

Initialisation:

$F_2 = X_1$,
$\alpha_2 = \alpha_3 = \alpha_4 = \beta = 0.2$,
$E_1 = M_1 = 0$ and
β is a constant term that can control α_t.

The of order calculation is the following:

1. e_2;	2. E_2;	3. M_2	4. F_3;	
5. e_3;	6. E_3;	7. M_3	8. F_4;	
9. e_4;	10. E_4;	11. M_4	12. F_5;	
13.e_5;	14. E_5;	15. M_5	16. α_5;	17. F_6;
18.e_6;	19. E_6;	20. M_6	21. α_6;	22. F_7; etc.

Extrapolation: only 1 period ahead.

T11 – Brown one parameter linear method:

This method is a double exponential smoothing. The first smoothed values (S_t^1) will be smoothed again (S_t^2) because there is an assumed linear trend in the time series. Basically, it estimates a linear trend.

This method gives decreasing weights for past data:

$$S_t^1 = \alpha X_t + (1-\alpha) S_{t-1}^1,$$

$$S_t^2 = \alpha S_{t-1}^1 + (1-\alpha) S_{t-1}^2,$$

where

$$a_t = 2S_t^1 - S_t^2,$$

$$b_t = \frac{\alpha}{1-\alpha}\left(S_t^1 - S_t^2\right).$$

Initialisation: $S_1^{\,1}=X_1$.

Extrapolation: $F_{t+m} = a_t + b_t m$

T12 – Brown one parameter quadratic method:

This method assumes a second order trend in the time series, therefore a third smoothing step is performed. Basically, it estimates a parabola of a second degree.

$$S_t^1 = \alpha X_t + (1-\alpha) S_{t-1}^1,$$

$$S_t^2 = \alpha S_t^1 + (1-\alpha) S_{t-1}^2,$$

$$S_t^3 = \alpha S_t^2 + (1-\alpha) S_{t-1}^3,$$

where

$$a_t = 3S_t^1 - 3S_t^2 + S_t^3,$$

$$b_t = \frac{\alpha}{2(1-\alpha)^2}\left[(6-5\alpha)S_t^1 - (10-8\alpha)S_t^2 + (4-3\alpha)S_t^3\right]$$

$$c_t = \frac{\alpha^2}{(1-\alpha)^2}\left(S_t^1 - 2S_t^2 + S_t^3\right)$$

Initialisation: $S_1^1 = S_1^2 = S_1^3 = X_1$

Extrapolation for *m* periods: $F_{t+m} = a_t + b_t m + \frac{1}{2} c_{t-L+m}$

Univariate statistics[4]

This exponential smoothing program uses different statistics of the error terms in order to measure the ‘goodness of fit’. Four of them participate in the model building process of the program: *MAE*, *SDE*, Durbin–Watson statistic and Theil’s *U* statistic (see their role in the overview of the program in the next section). For other statistics only the calculation method will be described here.

a) *ME* – Mean Error

$$ME = \sum_{i=1}^{n} e_i / n,$$
$$e_i = X_i - F_i,$$

where

F_i is the smoothed value,
X_i is the observed values.

The problem of this statistic is that positive and negative error terms equalise each other therefore further statistic, *MAE*, *SSE* and *MSE* were created to eliminate this problem.

b) *MAE* – Mean Absolute Error

MAE is the average of absolute values of the error terms. The less the value is, the closer the smoothed values are to the observed ones.

$$MAE = \sum_{i=1}^{n} |e_i| / n$$

c) *SSE* – Sum of Squared Errors

$$SSE = \sum_{i=1}^{n} e_i^2$$

d) *MSE* – Mean Squared Error

$$MSE = \sum_{i=1}^{n} e_i^2 / n$$

e) *SDE* – Standard Deviation of Errors

$$SDE = \sqrt{\sum_{i=1}^{n} e_i^2 / (n-1)}$$

[4] Statistics, used in ExpS for Windows are described here on the basis of *Makridakis* et *al*., (1983).

f) PE_i – Percentage Error

$$PE_i = \frac{X_i - F_i}{X_i}(100)$$

g) *MPE* – Mean Percentage Error

$$MPE = \sum_{i=1}^{n} PE_i / n$$

h) *MAPE* – Mean Absolute Percentage Error

$$MAPE = \sum_{i=1}^{n} \left| PE_i \right| / n$$

i) Theil's *U* statistic

$$U = \sqrt{\frac{\sum_{i=1}^{n-1} \left(\frac{F_{i+1} - X_{i+1}}{X_i} \right)^2}{\sum_{i=1}^{n-1} \left(\frac{X_{i+1} - X_i}{X_i} \right)^2}}$$

This is the most important statistic in the program. This value is calculated at each iteration, and the selection of the smoothing type and parameter set is based on the minimum value of Theil's *U* statistic. The closer the smoothed value is to the observed value, the smaller the nominator of is. This value is close to zero, if a good smoothing model has been applied. If the value is bigger than 1, then it is better to replace F_{t+1} with X_t, because this 'naiv' method provides a better extrapolation as a whole in the case of the simple exponential smoothing. If trend or seasonal component is calculated, then forecasted values will be adjusted accordingly with these parameters, therefore it can provide a better forecasting than the value of the previous period.

Another (similar) measure of evaluation is *MBA*.

j) *MBA* – McLaughlin Batting Averages

$$MBA = [4 - U] \cdot 100$$

k) *DW* – Durbin–Watson statistic

If F_i smoothed values comprise all important factors (trend, seasonality, cycles) then e_i-s are expected to be free of autocorrelation. *DW* statistic is one way to test the first order autocorrelation. This value is between 0 and 4 with an expected value of 2. The closer the value to 2 is, the more random the change and size of the error terms are, therefore, the better the chance is that subsequent error terms are not correlated with each other.

$$d = \frac{\sum_{i=2}^{n}(e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2}$$

2. ExpS for Windows – a computer program

ExpS for Windows allows the automatic selection of the smoothing type, and additionally, it calculates a 'what if' and a sensitivity analysis.

The program starts with the main screen, shown in Figure 3. Users can set different parameters manually, or can ask for their automatic calculation. Initial parameters, smoothing parameters, length of seasonality, trend and seasonal parameters can either be set manually, or be calculated by the program.

In the case of a large computer speed or a lot of available time, users can set all parameters for automatic calculation. However, it is reasonable to ask for some parameters as automatic ones, while others have to be set manually. It is a good way to set manually the *initial value* for F_1 (to X_1), and the *length of seasonality* (to the theoretical value, such as 4 in the case of quarterly data). This procedure is used in the application part of this paper.

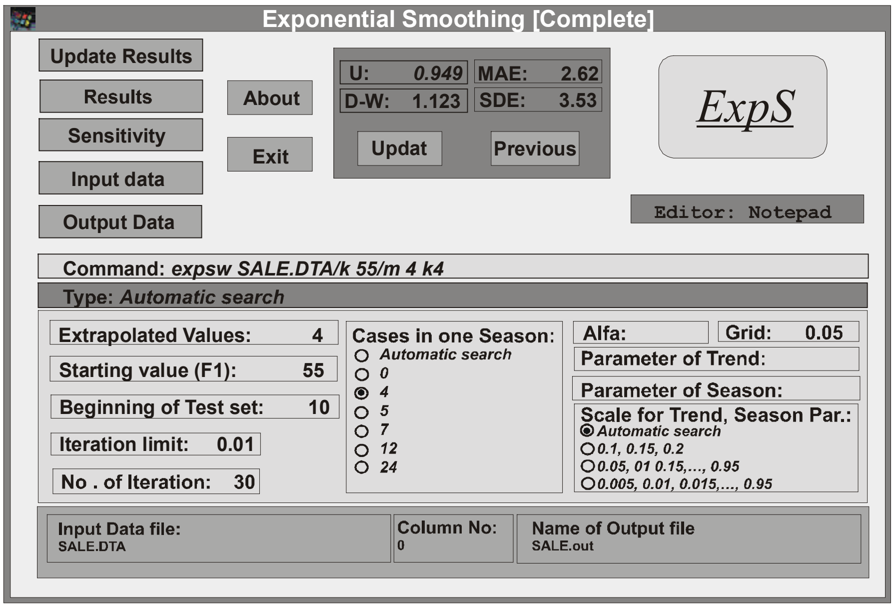
Trend and seasonal parameters between 0 and 0.2 are frequently used in practice (*Makridakis* et *al*., 1983), therefore, the first option is the 'Scale of Trend, Seasonal par.' section comprises only these values. In later stages user can ask for more subtle calculation. However, the most important step is at the first stage to set the 'type' to 'automatic search' as it happens to be in this example in the main screen. The program scans all the possibilities and provides one case from each type in order to compare different types. The best type is selected automatically, and details of the best model are described just after the summary table. The basic tool of the selection is the Theil's *U* statistic, discussed before.

After this automatic selection a summary table is provided (see Table 4 in the application section). The applied method will always assume that the recognised trend or seasonality is stable in the time series. If for example the ninth method was the best, then stable multiplicative trend and seasonality would be assumed. If this pattern changes during the test period, then the extrapolation will be uncertain. In such a case, the stability of time series has to be checked. There is a built in sensitivity analysis to check this factor. The program has a parameter of 'beginning of test set'. It means that the residuals are calculated only after this period to the end of the time series. If the seasonality and trend are stable in the time series, then different 'beginning of the test set' will provide similar results, similar to *U* statistics. This program's sensitivity analysis sets three different test periods and calculates the appropriate *U* statistics. Obviously, all the other parameters and the types of smoothing are unchanged. These *U* values can be applied to test the *stability* of the model, since the model can be considered as a stable one if *U* values are close to each other. There is no exact measurement for the size of this type of variation, it is only an experimental value. In case of stable data, the selected method can probably be applied effectively for extrapolating purposes. If the time series is not stable, the extrapolation can be uncertain. In this case the method of CENSUS II (*Herman–Kiss*, 1987) can be applied which is appropriate for managing the changing seasonality and trend, in the case of monthly data. In ExpS these starting periods are the half, two thirds and four fifths of the time series, respectively. In the case of quarterly data and a six-year time series (6·4 = 24 observations) these data are 13, 19 and 21 respectively. In the empirical part of this paper, we have 81 monthly data, where these starting periods are 41, 54, 64 (see in Section 4).

After the selection of the best parameter set, a 'What if' analysis is performed within the program (see Figure 4 in the application section). We explain the 'What if' analysis in the following example. Let us assume that we have quarterly data, and we are interested in the results of this model in order to compare them to actual data. Obviously, it is impossible to compare them to actual future values; therefore we can only use our own last years' four observations as actual data. A reasonable way is to compare the estimated results with actual data, if we assume that we have known this model for a year, and performed an extrapolation. This is the so called 'what if' analysis: 'What would have happened, if we had known this model earlier?' This model provides extrapolated values, denoted by '=', with these optimal parameters and values. The observed values can be found in the last column. Comparing observed values to fitted ones, the decision maker can assess the reliability of the given model. It is not impossible that a year earlier we had a different parameter set for the shorter time series, however, one solution had to be selected.

The main screen of the program is depicted in Figure 3. Data on the main screen are not relevant now; displaying the structure of the program is the only purpose of this screen.

Figure 3. Main Screen of ExpS



Clicking the *Update Results* (RUN) button will result in the actual running of the ExpS program with the preset parameters. The *Results* button will show the results of the model.

Sensitivity analysis can help a faster model building (see the explanation before). With the help of the following parameters, the user can build up an arbitrary model.

Starting value (initial value) (F_1) is of decisive importance in the case of each exponential smoothing method. They can frequently change the results to a great extent in either a positive or a negative direction. Estimation of a good quality initial value is essential. Iteration of the initial value is the following: the program generates five different initial values, and the best value is selected (where the *U* statistic is the smallest one). The five possible initial values are the following:

– minimum,
– maximum,
– mean,
– mean-minimum/2,
– minimum+(maximum-minimum)/2

computed from the first part of the time series in study.

The '*Season*' field will set the number of periods in one season. If there is no seasonality, it can be set to *zero*. In the case of *Automatic search* the program finds the best of the preset period-lengths that may be 4, 5, 7, 12 or 24.

There is a command line in the middle of the screen, which will be used at the updating process.

Apart from the methodological uniqueness, some other special features, user friendly solutions exist within the program.

1. Users can build up their own model in one screen by updating (perhaps) the four most important statistics, the *U* statistics, the *DW* statistics, the *MAE* and the *SDE* (for the error terms; see Section 1). The '*Update*' and '*Previous*' buttons will always switch the current and the previous results to follow the changes. If the user has run a different model previously, then the '*Previous*' button will show the statistics of that model.

2. In the case of an uncertain structure, an automatic selection of the length of the seasonality is allowed (see the middle of the main screen).

3. The user can see the observed, forecasted values and the error term in one common chart (see Figure 4 in the application section).

3. Comparison with other program packages

SPSS for Windows[5] 7.5 and Statistica for Windows[6] 4.3 are the bases of this comparison.

All the programs allow for selecting both the trend and seasonal components separately, which means an arbitrary combination of theirs. ExpS uses *Makridakis*' suggestion for the trend component: the choice among none / additive / multiplicative

[5] SPSS Inc. 1996.
[6] StatSoft Inc. 1993.

types of trend (see the theoretical part) is offered. SPSS and Statistica uses four different types of trends: none / linear / exponential / dumped. All the programs use none / additive / multiplicative type seasonal components.

All the programs are able to perform the automatic calculation of the initial values of; the smoothing (α), the trend (γ); and the seasonal parameters (δ). The methodology of the calculation of the initial value is not known in SPSS and Statistica. Table 3 depicts the main features of the mentioned program packages.

Table 3

Comparison of different exponential smoothing programs

Features	ExpS	SPSS	Statistica
Automatic selection of smoothing parameter	X	X	X
Automatic trend parameter selection	X	X	X
Automatic seasonal parameter selection	X	X	X
Automatic initial value calculation	X	X	X
Automatic selection of seasonality	X		
Automatic selection of the method	X		
Comparison of different methods	X		
Sensitivity analysis	X		
What if analysis	X		
ACF* calculation			X

* Autocorrelation function.

SPSS and Statistica are complex program packages, therefore they allow using the smoothed values as a separate variable. ExpS allows saving data in case one would like to use the original and fitted values of the best model. There is a special data file with '.ft1' extension. These data can be used for other statistical (e.g. SPSS, BMDP), graphical (Harvard Graphics), Spreadsheet (Excel, Lotus), or Database (Paradox, Dbase) programs, because it is an ASCII text file.

4. Application – The number of visitors in Hungary

Data are collected about the number of visitors in Hungary (from European countries), from January 1992 to September 1998[7] that means 81 monthly data.[8] Observation for 1988 can be followed on Figure 4 ('X-i' column). ExpS for Windows prepared a summary table about the results of the twelve methods that is shown in Table 4, where the explanation of columns:

T – type, smoothing method,
Alpha – value of α,
$p1$, $p2$ – the first (trend) and second (seasonal) parameters, if any,
L – length of one season, if any.

[7] Source: Statisztikai Havi Közlemények. Központi Statisztikai Hivatal, Budapest.
[8] Data are available from the authors: kisst@ktk.jpte.hu

The other columns displayed are explained in Section 1.

Table 4

Summary table of different methods about the number of visitors in Hungary

T	Alpha	*p*1	*p*2	*L*	*ME*	*MAE*	*MAPE*	*SDE*	*MSE*	*DW*	*U*	*MBA*
1	1.050	0.000	0.000	0	-5.7	615.3	19.0	850.7	706003	1.951	0.993	301
2	**0.350**	**0.100**	**0.000**	**12**	**-54.7**	**192.9**	**6.1**	**253.2**	**62533**	**1.414**	**0.384**	**362**
3	1.050	0.100	0.000	12	848.3	930.0	25.8	1278.1	1593604	0.553	1.518	248
4	1.050	0.100	0.000	0	-5.8	636.5	20.0	890.8	774097	1.959	1.036	296
5	0.750	0.100	0.100	12	-24.7	204.2	6.7	262.5	67210	2.043	0.406	359
6	0.450	0.200	0.100	12	1026.9	1046.5	28.9	1370.2	1831564	0.393	1.660	234
7	1.050	0.100	0.000	0	-112.2	639.5	20.2	926.6	837695	1.907	1.029	297
8	0.750	0.100	0.100	12	-32.2	207.3	6.8	263.6	67801	2.071	0.404	360
9	0.450	0.200	0.100	12	1013.5	1035.0	28.5	1359.7	1803582	0.399	1.646	235
10	0.150	0.100	0.000	0	91.9	697.3	22.7	963.8	906209	0.828	1.378	262
11	0.650	0.000	0.000	0	-30.4	673.8	21.8	986.2	948922	1.918	1.133	287
12	0.350	0.000	0.000	0	-17.9	780.1	25.4	1067.6	1111892	1.416	1.361	264

Table 4 shows that method 2 – 'additive seasonality – no trend' – has the smallest *U* value: 0.384. The parameter set of this model is further refined. Method 2 was set at the 'type' section of the program, and we have searched for a better parameter set. The final *U* value was 0.379. The smoothing parameter α and the seasonal parameter equally have a final value of 0.4. Initial value was 2398. The sensitivity analysis of this result can be seen in as follows:

Alpha : 0.4000
Beginning of Test: 41 U: 0.3791
Beginning of Test: 54 U: 0.3063
Beginning of Test: 64 U: 0.2993

Ratio (*R*) of the smallest and biggest *U* values denotes 21 percent difference.

$$R = \frac{|U_{\min} - U_{\max}|}{U_{\max}} = \frac{|0.2993 - 0.3791|}{0.3791} = 0.21\,.$$

(In the case of absolute stability – with the same *U* values – the difference is 0 percent).

The difference seems to be big enough to reject the model. However, the second and the third *U* statistics are very close to each other, and additionally, these data are closer to the current date. Consequently, this analysis can be accepted. A decision maker should have a look at the 'What if' analysis as well, to study the behaviour of the 'quasi' forecast. Figure 4 depicts the 'What if' analysis of the model.

These forecasts are sometimes rather accurate. Comparing the values of observed (*X*-i,'+') and 'what if' (Whatif '=') values it can be seen they are very close to each other, apart from the latest three periods (the last quarter of the year). As a consequence, decision makers can accept this model and can use the forecasts in the future. However, forecasts for the last quarter need special attention.

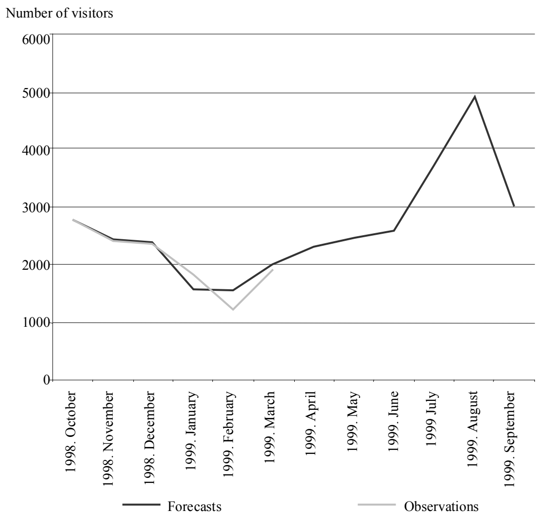
Figure 4. What if analysis

```
Type ( 2)  : Seasonality - additive, Trend none

 Time X-i (+)  F-i (-) WhatIf (=) -> Fitted values              Error    WhatIf
  72  2661.4  2551.8 ł          -=                         ł   109.64( 2662.06)
  73  1866.2  1772.2 ł    -=                               ł    94.02( 1838.62)
  74  1816.1  1807.9 ł     =                               ł     8.22( 1836.71)
  75  2193.2  2306.0 ł        +=                           ł  -112.76( 2331.50)
  76  2562.3  2512.4 ł           =                         ł    49.85( 2583.10)
  77  2612.6  2733.5 ł            +=                       ł  -120.87( 2784.18)
  78  2852.5  2763.3 ł             -=                      ł    89.17( 2862.38)
  79  3610.2  4019.6 ł                    +   =            ł  -409.35( 4082.94)
  80  4854.7  4997.2 ł                             +- =    ł  -142.54( 5224.37)
  81  3000.0  3025.0 ł               *  =                  ł   -25.03( 3309.17)
--------------------------------------------------------------------------------
  82          2746.3 ł             -                       ł
  83          2435.1 ł          -                          ł
  84          2394.2 ł          -                          ł
  85          1567.0 ł   -                                 ł
  86          1544.5 ł  -                                  ł
  87          2010.3 ł      -                              ł
  88          2300.9 ł         *                           ł
  89          2461.0 ł          -                          ł
  90          2589.6 ł           -                         ł
  91          3690.5 ł                     -               ł
  92          4896.0 ł                               -     ł
```

The last figure of this paper shows the line-diagrams of the observations and the line-diagrams of the observations and the forecasts.

Figure 5. Comparison of forecasts and observations



As a *summary*, it is reasonable to say that ExpS for Windows is a useful tool in extrapolating the number of visitors in Hungary. The automatic type selection helped to choose the best method; the sensitivity analysis provided a deeper insight into the stability of the model; and finally the 'what if' analysis helped us to evaluate the behaviour of the time series in order to decide whether to accept the results or not.

REFERENCES

AERTS, M. – AUGUSTYNS, I. – JANSSEN, P. (1997): Smoothing sparse multinomial data using local polynomial fitting. *Journal of Nonparametric Statistics*, **8**, pp. 127–147.

CLEVELAND, W. S. – LOADER, C. (1996): Smoothing by local regression: principles and methods (with discussion). In Statistical theory and computational aspects of smoothing. (Eds.: Hardle, W. – Schimek, M.G.) *Physica-Verlag*, Heidelberg, pp. 10–49; 80–102; 113–120.

EFRON, B. – TIBSHIRANI, R. (1996): Using specially designed exponential families for density estimation. *Annals of Statistics*, **24**, pp. 2431–2461.

EILERS, P. H. C. – MARX, B. D. (1996): Flexible smoothing with B-splines and penalties (with discussion). *Statistical Science*, **11**, pp. 89–121.

FAN, J. – HALL, P. – MARTIN, M. – PATIL, P. (1996): On local smoothing of nonparametric curve estimators. *Journal of the American Statistical Association*, **91**, pp. 258–266.

GLEICK, J. (1987): Chaos – making a new science, *Penguin Books Ltd*, Harmondsworth, Middlesex.

HARDLE, W. – MARRON, J. S. (1995): Fast and simple scatterplot smoothing. *Computational Statistics and Data Analysis*, **20**, pp. 1–17.

JONES, M. C. – FOSTER, P. J. (1996): A simple nonnegative boundary correction method for kernel density estimation. *Statistica Sinica*, **6**, pp. 1005–1013.

MAKRIDAKIS, S. – WHEELWRIGHT, S. C. – MCGEE, V. E. (1983): Forecasting methods for management. *John Wiley & Sons*, New York – Chichester – Brisbane – Toronto – Singapore.

PERCIVAL, D. – MOFJELD, H. (1997): Analysis of subtidal coastal sea level fluctiations use in wavelets. *Journal of American Statistical Association*, **92**.

WAHBA, G. – WANG, Y. – GU, C. – KLEIN, R. – KLEIN, B. (1995): Smoothing spline ANOVA for exponential families, with application to the Wisconsin epidemiological study of diabetic retinopathy. *Annals of Statistics*, **23**, pp. 1865–1895.