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Growth and Technological Change in the Russian Economy: a Contribution to the Investigation of Russia's Economic Crisis

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Abstract

The present paper uses the "growth accounting" methodology to estimate technological change, in an attempt to formulate an explanation of Russia's economic decline and signs of recovery in the period 1992-1999 in relation to technological change. The results do show that, despite the general economic collapse during the 1990s rooted in the very structure of the Soviet economy, the level of technology has practically remained unchanged which, in turn, prevented the Russian Economy from further deteriorating. Our empirical findings also show that the Russian economy tended to be a labour-intensive economy and this, possibly, explains the limited unemployment in the crisis period. We investigate these findings in relation to the type of class coalitions within Russian social formation. In this paper, we also examine the structural characteristics of the particular post-soviet form of socio-economic organization, in order to shed some light on the Russian economy's evolution during the first years of transition.

KEYWORDS: Russia, Cobb-Douglas, growth accounting, technology, crisis, recovery

JEL classification: P26, O10

Introduction

The present paper has two objectives: on the one hand, the estimation of change in the technological level of the Russian Economy, which constitutes a very important determinant of long-term economic growth, and, on the other hand, an attempt to formulate an explanation of its economic crisis during the 1990s.

The economic importance of technology and innovation is great since, according to Mokyr: "The difference between rich nations and poor nations is not […] that the rich have more money than the poor, but that rich nations produce more goods and services. One reason they can do so is because their technology is better; that is, their ability to control and manipulate nature and people for productive ends is superior" (Mokyr, 1990: preface). If Western Europe has been superior, in terms of economic growth, compared to most of the Central-Eastern and Former Soviet Union (F.S.U.) countries, this is undoubtedly, at least partly, due to its technological superiority.

However, although technology can be viewed from an "econometric" point of view as an (e.g. exogenous) independent variable determining the output, it is also

country specific, that is it depends on the overall complex socio-economic framework of the historically specific social formation under investigation. Our study refers to the Russian economy, as a whole, for the time period 1992-1999, which, practically, marks the end of the crisis period (Stikuts, 2003) and is based on the *Growth Accounting* methodology.

The paper is structured as follows: in the second part the performance of the Russian economy during the last decade is briefly analyzed, in the third part the methodological framework is presented, in the fourth part both the data and the variables are set out in detail and the empirical results are presented. In the fifth part, the (empirical) results are analyzed, while in the sixth part a further discussion of the paper's findings is set forth. Finally, the last part summarizes our concluding remarks.

The Russian Economy in the 1990s: An Overview

The decentralization of enterprise decision-making mechanisms and accountability, price liberalization and, finally, the largest enterprise privatization in history (Boycko, Shleifer and Vishny, 1995) constituted the key elements of the economic reform in the process of Russia's transition from a centrally planned economy to a Western type economy.

After the break-up of the Union, state revenues were drastically reduced. Also, the commercial transactions among the F.S.U. countries became "foreign trade", and the COMECON collapsed. Furthermore, income taxation from non-state activities constituted a significant cost factor and drove to tax evasion and to delays in tax payments from certain large enterprises. Therefore, the (money) economy was partly replaced during the 1990s by non-monetary transactions[1], which favored the spread of tax evasion (O.C.D.E., 1997, Kaitila, 2003). Meanwhile, the state was unable to control many other fundamental economic and social variables, while the quality of state education, health and transport services deteriorated significantly.

The first apparent result of the "transition" process was the dramatic decline in output up to 1998, combined with very high inflation rates. According to official Russian statistics (Goskomstat), Russia's G.D.P decreased in the time period 1989-1994 by more than 50% of its 1989 value (which means the middle of the crisis period), and by approximately 30% during the last decade, given the recent recovery of economic activity.

[1] *For the significance of "the widespread use of money substitutes" in Russian economy, see Aukutsiovek (1998); Maroudas and Rizopoulos (2002).*

In any case, we should, at this point, note the following fact: the official Russian statistics overestimated the values of the macroeconomic data prior to 1991 (O.E.C.D. 1995). Thus, based on the most recent studies of Gavrilenkov and Koen (1995), Kuboniwa (1996), Kuboniwa and Gavrilenkov (1997) and O.C.D.E. (1997), aggregate output decline in Russia in the period 1989-1994 is, approximately, 35%. In these studies, an effort was made to account for various factors which might have affected the estimations (Haaparanta and Kerkela, 2000), e.g. the extent of tax evasion. Finally, under the new conditions, small enterprises "hide" part of their income and, consequently, the aggregate output of the economy is underestimated. In this framework, the extensive diffusion of non-monetary transactions should also be taken into account. The opposite is in force during the period of the recovery, i.e. after 1998. The reported increase in output is partly deceptive, because of the recession of the non-monetary transactions (Broadman, 2001). This situation sets limitations to the estimations of the present paper, as far as both, the extent of the crisis of the Russian economy and the observed recovery are concerned.

Therefore, given our reservations concerning the accuracy of the data, there was a much greater decline in industrial output (as to the total output – G.D.P.), while investments practically collapsed (Kaitila, 2003, I.M.F., 2002a, b, O.E.C.D., 1995: 3 ff). Finally, the decrease in production was accompanied by a significant reduction in Research and Development (R&D) expenditure (Goskomstat, 1997). Thus, the aggregate output decline did not affect all the branches of the Russian economy which resulted equally in significant sectoral restructuring, which in turn benefited the service sector at the expense of the industry's share in G.D.P. (Milios, 2001). In the industrial sector, electric energy and metallurgy achieved the highest increases in G.D.P. share, whereas light industry and machine building, traditionally "technology intensive" sectors, were the most negatively influenced sectors (O.E.C.D., 1995: 4). Furthermore, high inflation rates prevented the national currency from functioning as a means of value storage and resulted in the abandonment of the ruble for international transactions, in favor of the U.S.A. dollar (I.M.F., 1994: 71).

Table 1: Main Economic Indicators of the Russian Federation (1990-2000)

Year	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00
Real GDP (%change)	-2.1	-12.9	-18.5	-12	-15	-4	-7.7	-1.3	3.6	6.0	5.7
Prices (%change)	5	93	1354	915	320	200	48	15	28	86	21
Investment (% change)	n.a.	n.a.	n.a.	-26.4	-12.8	-7.7	-8.2	-9.3	-6.6	-1.4	18.8
Exports (bn$)	48.8	53.2	42.4	43.7	67.8	82.9	90.6	89.0	74.9	75.7	105.6
Imports (bn $)	50.2	44.5	35	34.1	50.5	62,6	68.1	79.1	63.8	43.6	49.1
Tr.Balance (bn $)	-1.4	8.7	7.4	9.6	17.4	20.3	22.5	22.5	11.1	32.1	56.5
Unempl/ment (%)	n.a.	0.1	0.8	5.7	7.5	8.9	9.9	11.3	13.3	14	n.a.

Sources: I.M.F (1994, 2001, 2002a), OECD 1995, United Nations 1996.

Despite the dramatic decline in G.D.P. and in industrial production up to 1998, the rate of the registered unemployment in Russia continued to remain low, i.e. below 10%, until the mid 1990s. More specifically (see *Table 1*), the rate of unemployment rose from 5.7% in 1993, to 8.9% in 1995. However, the fact that official figures underestimate real unemployment rates, that early retirement of the elderly as well as a decline in women's participation rates in total employment helped to limit unemployment rates, are not enough to explain why the collapse in production did not result in rapidly increasing unemployment. As is illustrated in *Table 1*, the situation was quite different in the following years and the rate of unemployment "climbed" to a 14% in 1999. This behaviour goes hand in hand with the positive rates of change in output (since 1998) and in investment (since 1999). The low unemployment rate did not avert the substantial decline of the living standards of the Russian population (see O.E.C.D., 1995: 125, 128-129; Rosefielde, 2001).

Methodological Framework

The empirical investigation will be based on the *Growth Accounting* approach. Growth accounting was pioneered by Abramovitz (1956) and Solow (1957) and aimed at explaining the determinants of growth worldwide, after World War II. In growth accounting (see e.g. Romer, 1996: 26-33), growth in a single country is decomposed over time, using a production function, into a part explained by growth in factor inputs and another part (i.e. the Solow residual), which is attributed to technological change, and is called Total Factor Productivity (T.F.P.). The basic framework can be extended in other ways (see e.g. Denison, 1967; Mankiw, Romer and Weil 1992), the most common of which is to consider different types of capital and labour (Romer, 1996: 26). Growth accounting has been applied to numerous cases in the last two decades (see e.g. Denison, 1985; Baily and Gordon, 1988; Griliches, 1988; Jorgenson, 1988; Page, 1994; Young, 1994; etc) with very satisfactory results.[2]

The most commonly used production function in empirical investigations using aggregate data is the Cobb-Douglas production function (Thirlwall, 2001: 181).[3]

[2] *For instance, Young (1994) used the growth accounting methodology to argue that rapid growth of Taiwan, Singapore, South Korea and Hong Kong was mainly due to increasing labour-force and investment, and not to technological progress. Also, growth accounting has been extensively used for the study of the slowdown in productivity in the United States since the 70's.*

[3] *Despite its extensive use and its considerable success in modeling economic growth, the Cobb-Douglas production function presents some theoretical shortcomings, one of which is the fact that it considers as homogenous the production and labour expanded originating from different sectors and*

We thus assume a Cobb-Douglas production function with two inputs, capital and labour and Hicks-neutral technological progress.[4] So production at time t is given by:

$$Y(t) = A(t)\, L(t)^{a}\, K(t)^{\beta} \quad (1)$$

$$Y(t)>0,\ L(t)>0,\ K(t)>0,\ A(t)>0,\ \alpha>0,\ \beta>0$$

The notation is standard: Y is output, L labour, K capital, A the level of technology, while α and β are the elasticities of output with respect to labour and capital, respectively.

A central problem in examining technological change and one that makes it difficult to define or characterize is that it takes many different forms (Rosenberg, 1982: 3). The most useful common denominator underlying its multitude of forms is that it constitutes any change in the application of knowledge that can make it possible to produce (i) a greater volume of output from a given amount of resources (ii) a qualitatively superior output, or (iii) a completely new output (Rosenberg, 1982: 3; Mokyr, 1990: 6). Technology constitutes a very crucial determinant of an economy's total productivity and competitiveness (O.E.C.D., 1996), however its direct quantification is difficult and it is often estimated indirectly using a production function.

From equation (1), using simple mathematics, we get that (see e.g. Thirlwall, 1999: 181):

$$\frac{\partial Y(t)}{\partial t}\frac{1}{Y(t)} = \frac{\partial A(t)}{\partial t}\frac{1}{A(t)} + \alpha \frac{\partial L(t)}{\partial t}\frac{1}{L(t)} + \beta \frac{\partial K(t)}{\partial t}\frac{1}{K(t)} \quad (2)$$

and

$$\frac{\partial A(t)}{\partial t}\frac{1}{A(t)} = \frac{\partial Y(t)}{\partial t}\frac{1}{Y(t)} - \alpha \frac{\partial L(t)}{\partial t}\frac{1}{L(t)} - \beta \frac{\partial K(t)}{\partial t}\frac{1}{K(t)} \quad (3)$$

Equation (2) implies that the rate of change in output depends on growth in labour and capital, and on technological change, while equation (3) allows us to estimate

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skills. For a brief review of the model's theoretical limitations see Thirlwall (2001: 185-7), which are, however, of limited practical character, as the author himself implies (ibid: 187).

[4] *The assumption of (Hicks-) neutral technological progress is, according to the empirical literature, a very reliable one (Thirlwall, 2001: 187).*

technological change, indirectly.

Using simple mathematics, the rates of growth of labour productivity (Y/L) and capital productivity (Y/K) respectively, are given by:

$$l = \frac{\partial Y(t)}{\partial t}\frac{1}{Y(t)} - \frac{\partial L(t)}{\partial t}\frac{1}{L(t)} \quad (4)$$

$$k = \frac{\partial Y(t)}{\partial t}\frac{1}{Y(t)} - \frac{\partial K(t)}{\partial t}\frac{1}{K(t)} \quad (5)$$

Thus, given that, typically, the sum of the values of α and β are set equal to unity (see e.g. Dornbusch and Fischer, 1993; Thirlwall, 2001; Stikuts, 2003; Billmeier, 2004), the Cobb-Douglas production function takes the form:

$$\frac{Y(t)}{L(t)} = A(t)\left(\frac{K(t)}{L(t)}\right)^{1-a} \quad (6)$$

Empirical Results

The Data and the Variables

The significance of the factors, entering the production function of the Russian economy, is tested using the available data collected from the publications of the International Monetary Fund (I.M.F.) entitled *International Financial Statistics* (2001, and 2002a, 2004). The data available is on an annual basis and covers the period 1992-1999 (eight observations).

The econometric method used for the estimation of Russia's technological level employs annual G.D.P. data starting with the year 1992. The selection of data has been determined by several factors. First, we start with 1992 because it is the first year, after the major economic reform process in the early 1990s, that data are available. On the other hand, we stop in 1999, because, it is the year that a significant reform process caused Russia's national economy to experience structural shocks, (such as an increasing trade balance, decreasing inflation, changes in terms of trade, slowly growing competitive markets, etc), the intensity and scope of which differentiates the model estimation for the given period when compared with the 2000 situation (I.M.F., 2002a; Milios, 2001) and is consistent with the thesis of Stikuts (2003: p. 7) who, explicitly, stated that the Russian crisis ended in 1999. In addition, no sufficient and reliable data are available for the

study of the extremely short remaining (recovery) time span and so we are prevented from attaining a statistically satisfactory level of estimation.

Dependent Variable

1. The Gross Domestic Product (G.D.P.) of Russia at constant 1991 prices measured in billions of Rubles.

Independent Variables

2. Labour in Russia is measured as the number of employees in millions.
3. Fixed Capital Formation in Russia is estimated using the *perpetual inventory* method (see Appendix) and is expressed in billions of Rubles at constant 1991 prices.

Result Presentation

The most widely used functional form of the production function is the linearised Cobb-Douglas specification (Thirlwall, 2001; Stikuts, 2003), which reduces the number of coefficients to be estimated and eliminates the multicolinearity problem of the explanatory variables (Stikuts, 2003). The relationship is, thus, linearised and we use a time-series data set for the period 1992-1999, when data is available. The results of the regression through Ordinary Least Squares (O.L.S.), which is used for the estimation of the linearised Cobb-Douglas production function (Andrikopoulos, 2000: 358), are presented in *Table 2*.

$$\ln\left(\frac{Y(t)}{L(t)}\right) = \ln A(t) + (1-\alpha)\cdot \ln\left(\frac{K(t)}{L(t)}\right) \quad (7)$$

Table 2 presents the regression results for the dependent variables.

***Table 2*:** Regression Results for the Cobb-Douglas Production Function for Russia, 1992-1999

Independent Variables	*Estimate*	*t-statistic*
Intercept	2.35	
β	0.41	2.08*
implied a	0.59	
R	0.42	
F-Ratio	4.33	
S.E.E.	0.21	
M.A.E.	0.16	
D.W.- statistic	0.70	

Note: * Significance at the 10% level

The signs of the estimated coefficients are consistent with the stated hypotheses and economic theory; the results are statistically significant for the independent variable, while the equation explains a considerable part of the variability of G.D.P. The results should be assessed as satisfactory given the various imperfections in this sort of country data (Mankiw, Romer and Weil, 1992: 408), as well as the crisis period and the various violent shocks that the Russian economy faced in the period under investigation. After all, the empirical investigation is to be viewed from a long-term perspective (Stikuts, 2003). [5]

Also, there are no signs of a serious violation of the basic assumptions concerning the residuals, as was easily confirmed with the aid of the relevant procedures (see Samouel et al., 1996: ch.12): specifically, the normality of the errors was assessed through the examination of the frequency distribution of the residuals as well as by reference to the Q-Q or P-P normality plot, which is a special type of plot for checking normality. As far as the assumption of homoscedasticity is concerned, compliance with this assumption was evaluated by examination of the scatter plot of the standardized residuals against the predicted values. Finally, as for the assumption that the residuals are independent of each other, investigation of the scatter plot of the standardized residuals against the time variable provided some idea of possible dependence between successive values, i.e. an autocorrelation effect.[6]

[5] *The estimation of the unrestricted non-linearised Cobb-Douglas model did not yield acceptable statistical or theoretical results.*

[6] *An alternative diagnostic is provided by the Durbin–Watson statistic which indicates the degree of autocorrelation in our dataset. However, given the value of this statistic in our dataset, the hypothesis that the residuals are autocorrelated cannot be accepted.*

Labour elasticity derived is 0.59, and the value of capital stock elasticity is 0.41. These values are, in general terms, consistent with estimations produced by researches on other countries. For instance, as is known, the majority of research papers indicate that the value of labour elasticity for the developed countries is around 2/3, while that of capital is 1/3 (labour elasticity estimates in the US are within the range of 0.59 and 0.87, and from 0.57 to 0.59 in Germany) (see Bolt and Els, 2000; Dimitz, 2001). Recent studies show that in Estonia labour elasticity is around 0.67 (Stikuts, 2003). On these grounds, the estimation of labour and capital elasticity of Russia's production function may be regarded as credible.

Result Analysis

We notice that the elasticity of production, as far as labour is concerned, is higher than the elasticity of capital, because the estimated $\alpha = 0.59$ is greater than $\beta = 0.41$. Thus, production is much more "sensitive" with respect to labour than with respect to capital. These findings suggest that the Russian economy tends to be a labour-intensive economy and, at a first level, it seems that this way we are offered, *ceteris paribus*, a possible explanatory parameter of the limited unemployment under the conditions of economic crisis. As we are about to see below, this possible explanatory parameter is related to the type of class coalitions within the Russian social formation.

On the other hand, these findings give us a first indication that for the factors which allow (or even seek) the "economy in the use of constant capital"[7] – as a pre-condition for the recovery of profitability (see Marx, 1991: 170 ff.) – the labour and the economy-intense discipline methods at the cost of the workers acquire a primary role.[8] Based on the above, we could claim, following Maroudas (2001: 55), that after the break-up, the following remark remains in force: "Emphasis was placed [in the Soviet economic system] on productivity increase at a faster rate than the accumulation of fixed capital and on work discipline at the cost of security and health conditions".[9]

In *Table 3* that follows, we can see the estimated average annual rates of change in production and inputs, labour productivity, capital productivity and total productivity (i.e. technological change), as a result of the application of equations

[7] *Fixed capital constitutes a part of Marxian constant capital.*
[8] *For an analysis of the Marxian approach in Part One (Chapter 5) of Volume Three of Capital see Milios (1997: 188 ff.) and Milios et al (2002: 196 ff.)*
[9] *For a discussion of the (types of) capital accumulation in Marx's analysis and its relevance for the dynamics of the soviet economy see Chattopadhyay (1990).*

(4), (5) and (3) respectively, after the empirical estimation of the production function.[10]

In the period 1992-1999, the growth rate in production was negative, and declined by -7.9% per year. The capital stock contributed to this fall with a rate equal to -16.9% per year (which was caused by the collapse of investment), while labour declined by -2.3% per year and managed to withhold the significant decline of production, given its higher share in production. Finally, the annual average rate of change in T.F.P. during the period 1992-2001 was slightly positive and equal to 0.4%. We can see, therefore, that labour and technology constituted the "sheet-anchor" of the Russian economy during the period under investigation, since they kept the negative average annual rate of change in G.D.P. to "only" -7.9%, when a dramatic decline of the capital stock took place in the economy.

The average annual rate of change in the productivity of capital (Y/K), during the specific time-span, is high (9%) and is due to the capital's over-employment, which is the result of the rapid capital decline that takes place at a faster rate than that of production, resulting, in turn, in the production, over time, of more output by a smaller part of the capital used. The average annual rate of change in labour productivity (Y/L) is negative (-5.6%) and is, due to the limited decline of labour (-2.3%) in the period under investigation, while production has more than dwindled (-7.9%). This, means that fewer products are being produced by a slightly less amount of labour as time goes by, and is consistent with the findings of Kaitila (2003: 15).

The above findings could be better highlighted if we take into consideration the fact that during the period under investigation (1992-1999) both a dramatic crisis in and a tendency towards recovery (after 1997) of the Russian economy emerge. *Table 4* that follows isolates the crisis period (1992-1997) from the recovery period (1998-1999).

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[10] *The change in T.F.P. is expressed through* $\frac{\partial A(t)}{\partial t} \bullet \frac{1}{A(t)}$ *which is, as seen, attributed mainly to technological change.*

Table 3: Average annual rates of change in production, labour, capital, productivity of labour, productivity of capital and total productivity (T.F.P.) (1992-1999).

[dY/dt]/Y	[dL/dt]/L	[dK/dt]/K	[dY/dt]/Y– [dL/dt]/L	[dY/dt]/Y– [dK/dt]/K	[dA/dt]/A
- 7.9 %	-2.3 %	- 16.9 %	- 5.6 %	9.0 %	0.4%

Source: I.M.F. (2001, 2002a), authors' elaboration

Table 4: Average annual rates of change in production, labour, capital, productivity of labour, productivity of capital and total factor productivity (T.F.P.) (1992-1999).

Year	[dY/dt]/Y	[dL/dt]/L	[dK/dt]/K	[dY/dt]/Y– [dL/dt]/L	[dY/dt]/Y– [dK/dt]/K	[dA/dt]/A
1992-97	-14.6%	-3.3 %	-16.2 %	-11.2 %	2.4 %	-6.0%
1992-99	- 7.9 %	-2.3 %	- 16.9 %	- 5.6 %	9.0 %	+0.4%

Source: I.M.F. (2001, 2002a), authors' elaboration

If we take a closer look at the results concerning the sub-period 1992-1997, in relation to the period under investigation 1992-1999, we believe that the two following fundamental and interrelated conclusions can be easily drawn. First, except for the growth rate of the capital stock – which remains almost unchanged during the period under investigation – all the other variables experience an almost dramatic deterioration, in terms of growth rates, during the crisis sub-period, since the negative change in production progresses with almost double the average growth rate (-14.6%) compared with the -7.9% of the whole period. The negative average annual rate of change in employment for the sub-period, compared with the slightly changed one for the whole period, indicates that the positive change of employment progresses parallel to the significant rise in the unemployment level observed during the recovery period (see *Table 1*). Second, the sub-period of the emerging recovery (1998-1999), which is related positively to the changes in employment, in labour productivity and especially in capital productivity and, partly, to the change in the technological level, comes to a blunt end without however (yet) obliterating, the results of the crisis period of the Russian economy (i.e. negative growth rate in production, in capital stock, in labour productivity and, almost non-existent technological progress between 1992-1999).

A symptom resulting from the latest findings is the decrease in the ratio of the (fixed) capital's value to the labour force's value for the period 1992-1999 (as can be easily computed with the aid of the data available) or, in other words the decrease in the fixed capital's value per labour force's value unit. This indicates the relative decrease of the fixed capital's value with respect to the aggregate capital and corresponds conversely to the "economy in the use of constant capital". This finding demonstrates the reduced efficiency – as to the saving of fixed capital – of the intense-discipline methods of labour, etc. for the period under investigation.

We will insist on the subject of the technological level, which remains practically unchanged, in the period under investigation, and is responsible for about 5% of the change in G.D.P., as is evident from the data in *Table 3*.[11] Thus, we notice that the decline in production is limited by the non-negative growth rate of the technological level of the Russian economy.[12] However, the problematic situation

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[11] *Doyle et al (2001) estimated that in the last decade total factor productivity contributed 9% in Slovakia, 44% in Poland, 51% in the Czech Republic, 82% in Slovakia and 122% of G.D.P. in Hungary,.*

[12] *It is interesting to note that in a seminal article, Wladimir Andreff (1978) followed, in general terms, a similar methodological framework, concerning the relation between the level of technology and the economic slowdown of the Eastern European countries in the 1950s and in the beginning of the 1960s. Also, for a brief survey of some classic articles measuring the percentage of growth which rises from an increase in total factor productivity in the former U.S.S.R, see Andreff (1978: 50).*

- concerning the level of technology - in the crisis sub-period, namely between 1992-1997, was caused by the reduction in the Research and Development (R&D) expenditure. The R&D statistics for the sub-period of crisis in Russia are overwhelming. In 1991 the R&D expenditure amounted to approximately 1.85% of G.D.P. and in 1997 they were reduced to 0.5%. Namely, during the period 1991-1997, a rapid decline in the expenditures for R&D is observed, equal to 72.97%, which implies a decline of 19.59% annually. Additionally, from surveys in various production branches it became evident that the Russian factories' machinery and equipment were technologically "old" (Goskomstat, 1997; O.C.D.E., 1997). Furthermore, the poor state of the production infrastructure had a negative effect on exports (O.C.D.E., 1997) as well (for example, the inoperative oil drillings increased from 4,000 to 32,000 in 1993, due to the shortage in appropriate capital and technological infrastructure, see Analytis, 1999: 299; Kaitila, 2003: 8, 19).

Thus, the findings of our investigation confirm the so-called "Russian paradox" (Milios, 2001), expressing the fact that *reform which has advanced in the name of economic development and modernization led the country to economic and technological retrogression*, or, in the words of Kagarlitsky (1995: 88): "What is unusual about the capitalist reforms in Russia is that for the first time in history, the 'old' structures are on the technological level […] far higher than the 'new'" (see also Maroudas and Rizopoulos, 2002: 126).

Further Discussion

The main approaches to the case of the economic crisis in the countries of Eastern Europe and the former Soviet Union make use of arguments, which are based on the view that the crisis had mainly "external" causes as far as the transition process is concerned, while the factor of technology is systematically neglected (see Milios, 2001).[13] Nevertheless, the statistical data available (see *Table 1*) seem to refute these analyses. On the contrary, it seems that the restructuring of external trade and the adoption of the international market prices improved the situation for the Russian trade, and in combination with the rapid decline in internal demand, it accelerated Russian exports (traditionally consisting of raw materials and oil-products[14]) to the countries of O.E.C.D. In the past, Russia exported these kinds of products mainly to the COMECON countries, but the prices had been significantly lower than those of the western capitalistic markets. The dissolution of the COMECON and the adoption of the prices of the global capitalistic market

[13] *According to these approaches, output decline is due to the deterioration of the position of the former "socialist" countries in the global market, i.e. to "external" factors.*

[14] *For a comparative analysis of the Russian trade fleet's performance before and after the break-up of the Soviet Union, see Economakis et al., 2003.*

improved the Russian trade balance and the balance of payments on current account in real terms, even during the period of the appreciation of the ruble since the 1993 (O.E.C.D., 1995).

In a first attempt to interpret the Russian social formation's economic crisis, it can be mentioned that the collapse of the Soviet regime followed by the cessation of state regulation and price liberalization for the sake of competition, allowed businesses to adopt to high prices (a fact that led to very high inflation rates, especially during the first years of the transition process, see *Table 1*), in an effort to increase their profit margins and to cope with demand decline, caused by the drastic cut in "planned" state orders (O.C.D.E., 1997).

However, this price explosion caused a further dramatic fall in demand. A vicious circle of rising prices and decreasing demand thus sunk the Russian economy into continuous output decreases and economic crisis. Meanwhile, in the monopolistic economic structure that emerged (Maroudas, 2000), the few new technologies created led to high prices, causing further price increases. In this way, many enterprises were prevented from further buying and using new technologies, because of a lack of strong incentives due to their high costs. The questions rising, at this point, are the following: *why was the "free" economy not capable of counterbalancing (or even overcoming) the above mentioned decreases of the state demand up to 1997 and in what sense do the causes of the crisis interrelate with the technological fall back and, finally, how can the observed signs of recovery in the time period 1998-1999 be understood, even at a preliminary level?*.

In the present paper, we defend the thesis that the particularities of the Russian capitalist economy, which are expressed – at least until 1998 – through the coalition of the new ruling class with the workers, the preservation of the main volume of labour, the limited development of competition, the non-pursuit of profitability (as the main objective of production/reproduction) and the absence of entrepreneurial incentives for business plans, and consequently for technological innovation, formed a special historical framework for the expression of the crisis, the overcoming of which constitutes a pre-condition, as well as the result, of the liberation of the counterbalancing tendencies of the crisis (Marx, 1991: 362-364, see also, Liodakis, 2001: 57).

More precisely, the particularities of the Russian capitalist economy could be expressed as "a particular form of socio-economic organization" that seems to persist after the demise of the Soviet Union (see Maroudas, 2001: 52, 60). This particular form of socio-economic organization consists of *four structural elements, in their unity:* First, "the creation of a paternalistic-type coalition

between managerial staff and workers" (Maroudas, 2001: 52). This coalition between managerial staff and workers was expressed, as seen, from the workers' point of view, through their support to the transfer of the enterprises to the existing managers and their senior cadres,[15] and from the new owners' point of view by the promise of the maintenance of the current employment levels. Our finding then, that the elasticity of production is higher than the elasticity of capital, seems to be consistent with this premise. The ability to promise current employment levels is based, in turn, on a second structural element: the limited development of competition. Both these structural elements are reduced to the particular type of privatization of the post-soviet enterprises.[16] At the same time, the absence of competition development, but also the increasing negotiating power of enterprises *vis a vis* the regional and local power centres (see Maroudas, 2001: 61-64) is connected directly with an additional, third structural element of the particular form of socio-economic organization in Russia. The reproduction of the given status of economic authority and power, and not the creation of profit is probably the central question of production. It is a fact that, in turn, determines as a fourth main characteristic a low level of entrepreneurial incentive and – consequently of risk – for long-term investment plans (see Maroudas and Rizopoulos, 2002: 127) and, therefore, for technological innovation as well.[17]

At this point, it is interesting to note that, to the extent that the paternalistic-type coalition between managerial staff and workers sets restrictions and/or limits to the control of the former over the production process it sets, at the same time, disincentives for the introduction of new technologies, as long as technological change is also a process used by the employers in order to introduce new ways of control over labour (Bowles and Edwards, 1993: ch. 11). In this way, "[t]he monopolistic capitalism that emerged from the state's withdrawal is deprived not only of the 'planned' state markets but also of all traditional incentives, without being able to create new ones" (Milios, 2001: 82).

To the crisis factors for the period until 1998, we should add "the weakening of the state to the extent that it could clearly no longer perform its most elementary

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[15] *In the same line of argument, "wage arrears representing in practice interest-free loans granted from employees to their enterprise". (Maroudas and Rizopoulos, 2002: 130).*

[16] *The privatization process was nothing more than a transfer of enterprise ownership from the central planning authorities to managers and senior cadres, who were supported by the delegates of the employees (O.E.C.D., 1995; Blasi, Kroumanova and Kruse, 1997; Milios, 2001; Maroudas and Rizopoulos, 2002).*

[17] *"The major way for capitalists to compete within sectors is by introducing technological innovations. This move is spurred not only by the need to save on rising costs, but also by the need to improve efficiency, that is, the units of output per capital invested, and thus competitiveness and profitability" (Carchedi, 2001: 79).*

functions" (Maroudas and Rizopoulos, 2002: 126), primarily of a consistent and reliable economic policy[18] (also see O.E.C.D., 1995: 1). The institutional deregulation is an additional factor immanently connected with the technological fall back.[19]

However, after 1998 the Russian economy showed signs of recovery from the dramatic crisis that it had been experiencing. In brief, the inflation rate decreased considerably, while the declining trend of the real G.D.P. was reversed to an increase, and investments, in constant prices, increased in the specific time span (see *Table 1*). At the same time, the period of recovery (1998-1999) that comes to blunt end without, however, being able to obliterate the results of the crisis period of the Russian economy, is related to the changes in employment (and unemployment), in labour productivity and especially in capital productivity, and of course to the change in the level of technology. It is not possible, at present, to formulate safe predictions as to when the crisis will be overcome. It is also early for conclusions concerning the causes of the observed signs of recovery of the Russian economy. Yet, we will attempt to formulate very briefly some first thoughts defending the thesis that the observed signs of recovery and their prospects should probably be looked for in the following factors and directions.

First, it should be looked for in the means of overcoming the crisis, which the crisis itself liberates during its evolution – and which are related to the class balance of power as it is formed through the crisis in the historical field of the Russian social formation; that is the intensity of capitalist competition, the massive capital destruction, the rise in unemployment (despite the rise in employment) and the decrease of real wages. Specifically, since the recovery is based on the grounds of a continuous destruction of fixed capital – which goes along with the increase in investments after 1999 – a possible trend of "modernization" of the productive basis and of development of capitalist competition is implied (see O.E.C.D., 1995; E.B.R.D., 1999; Broadman, 2001; Kaitila, 2003: 12; B.C.C.R., 2003). On the basis of the arguments we outlined above, a first indication is surely the strengthening itself of the artificial surplus population. However, we are not in a position to know the depth of the restructuring of the paternalistic type class coalition of managers and workers, at the expense of the latter (and ultimately the extent of the overthrow of the class framework, which determined what we called particularities of the Russian capitalist economy and special historical field of expression of the crisis), which constitutes a pre-condition for the development of competition, except for

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[18] *For the importance of state intervention in ensuring macroeconomic stability in transitional economies see Siriopoulos and Asteriou (2001).*

[19] *Following Loasby (2002:41): "[I]nstitutions provide both the necessary baseline and the boundaries across which one may move to an adjacent state of knowledge".*

the fact that the crisis itself weakens the negotiating power of the working class.

Second, these prospects should be looked for in the state economic policy – as an expression of the class balance of power – which seems to be establishing an institutional environment of macroeconomic stability that permits the emergence of the main financial institutions (see O.E.C.D., 1997-8: 3, 149).

Concluding Remarks

To sum up, the present paper used the *growth accounting* methodology to estimate technological change, in an attempt to formulate an explanation of Russia's economic decline and (signs of) recovery in the 1992-1999 time span in relation to technological change. The results showed that, as a consequence of the economic collapse during the 1990s the growth rate of the technological level remained practically unchanged, which, in turn limited the further deterioration of the Russian economy. Furthermore, the optimistic trends of the Russian economy towards recovery were discussed briefly.

In this framework, technical change and innovation are considered in Marx's perspective to emerge from the regularities determining the capitalist system as a whole, i.e. from the trends regulating the expanded reproduction of social capital, on the base of capitalist competition and class struggle.[20] Continuous innovation ensures on the one hand the increase in the rate of exploitation of labour by capital – and thus may increase the rate of profit – (what Marx describes, in Vol. 1 of *Capital* as "production of relative surplus-value"), while on the other it is the means *par excellence* for improving the individual enterprise's position vis-a-vis its competitors (Marx, 1990: 959, 1037).

Technological progress and sustainable economic growth in Russia still seem to "entail a long lasting process of […] social rearrangements" (Milios, 2001: 82-3). After all, crises are temporary destabilizations of the capitalist process of expanding reproduction and they also function as mechanisms that "re-establish the disturbed balance for the time being", (Marx, 1991: 357).

[20] *Innovation and technical change are the main means of increasing labour productivity and "no less than other socio-economic activities, were best analysed as social processes" since "the focus of Marx's discussion of technology is […] upon a collective, social process" (Rosenberg 1982: 35). Marx wrote: "A critical history of technology would show how little any of the inventions of eighteenth century are the work of a single individual" (Marx 1990: 493).*

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Appendix

The Fixed Capital Formation in the Russian Economy was estimated using the *Perpetual Inventory method* and the Production Prices Index (I.M.F., 2002a, 2004). The equations used are the following:

$K(i) = [S(i) + S(i-1)]/2$

$S(i) = \sum_{t=1}^{i} I(t)$

$I(t) = E(t) - d(t)$

$E(t) = E'(t)/p(t)$

$d(t) = E(t)[\gamma \bullet (\gamma+1)^{t-1}]/[(1+\gamma)^{1+T} - 1]$

where:
K(i): fixed capital in the middle of year i (constant prices)
S(i): fixed capital at the end of year i (constant prices)
I(t): net fixed capital investments (constant prices)
E(t): gross fixed capital investments (constant prices)
E'(t): gross fixed capital investments (current prices)
p(t): production prices (index)
d(t): consumption of fixed capital depending on the depreciation policy

$\gamma = 0.20$ parameter depending on the time-structure of investments (Tsolas, 1995).
$T = 15$ the average lifetime of machinery and equipment (Goskomstat, 1997).