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THE DETERMINANTS OF LONG-RUN GROWTH: WHAT LESSONS CAN BE LEARNED FROM EMPIRICAL TESTS?

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1. INTRODUCTION

The economics of long-run growth probably has been one of the most lively areas of economic research. Although interest in the analysis of long-run growth has never been lost, its revival may be observed since the mid-1980s. The following advancements in both theoretical and empirical research have contributed to a better understanding of the complex growth process, but a comprehensive answer to the question of what determines growth is, however, still to be reached.

Section 2 briefly reviews the existing growth theories and serves as an introduction to the overview of empirical tests that have been made to reexamine the determinants of long-run growth and to explore whether there is anything automatic about the growth of an economy. After an empirical exercise that closes the discussion in Section 3, Section 4 focuses on the case of Croatia, questions the applicability of cross-country regression analysis to the case of a specific economy and drives future-oriented policy implications as well as some insights on the Croatia's growth prospects. It is followed by concluding remarks in Section 5.

2. THEORETICAL BACKGROUND

Classical economists used to approach the issue of economic growth by exploring the relationship among income distribution, capital accumulation, and growth.[1] Following that line, the growth theorists Sir Roy Harrod and Evsey Domar built models that reflected their belief

[1] *See Ramsey (7928).*

that market forces were not sufficient to assure equilibrium growth with full employment, and they determined conditions under which there would exist an equilibrium path of growth.

Developed by Solow (1956) and others,[2] the neoclassical growth model, which is usually regarded as the origin of modern growth theory, placed its emphasis on the ease of substitution between capital and labor in the underlying production process. Substitutability ensured steady-state growth and avoided the problem of instability present in the Harrod-Domar model as a result of the assumed fixed capital-labor ratio. Main implications of the Solow's 1956 model are comprised in its fundamental equation of capital accumulation, where k represents per

$$\Delta k = sy - (n+\delta)k$$

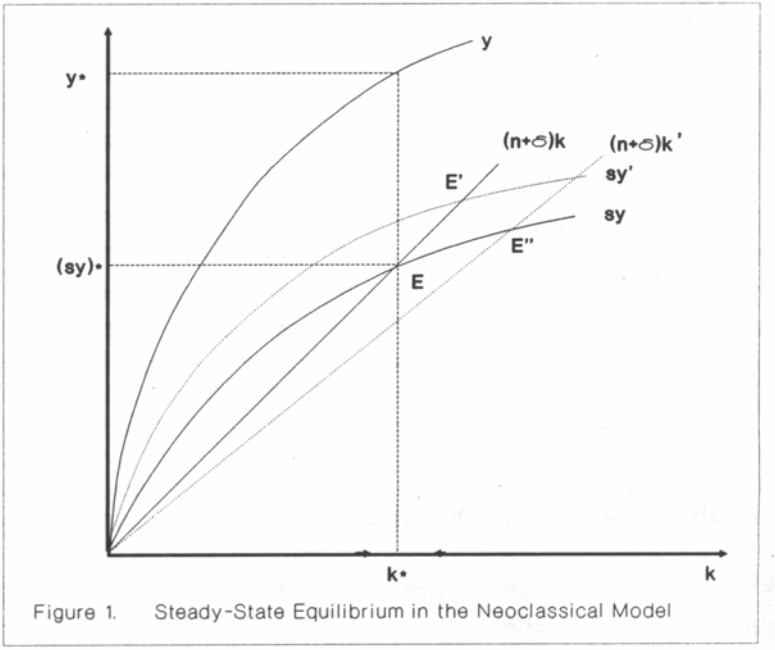

Figure 1. Steady-State Equilibrium in the Neoclassical Model

[2] *Significant contributions were made by Swan (1956), Koopmans (1965), and Cass (1965).*

capita capital, s saving rate, y per capita output, n exogenously determined rate of population growth, and a depreciation rate of physical capital.[3] Equation indicates that the growth of capital, in per capita terms, is equal to the rate of per capita saving (sy) less the amount needed to equip the new entrants in the labor force (nk) and to replace the depreciating capital (δk). Consequently, the long-run equilibrium is reached when capital-labor ratio reaches position (point E in Figure 1) in which per capita saving becomes just equal to the amount of saving needed to equip the new entrants to the labor force and to replace the depreciating capital. Whenever the economy is away from its steady-state, with either too much or too little capital per capita there are forces that push it back to the long-term steady-state equilibrium. Namely, as per capita capital increases (decreases), marginal productivity of capital declines (increases) due to diminishing returns to factor inputs and capital-labor ratio approaches constant.

In the absence of technological progress, the levels of output, capital stock and labor force are increasing at the exogenously determined rate n in the steady-state, while there is no change in the per capita terms. If, however, the technological progress is present, neoclassical model predicts that output and capital stock will grow in per capita terms at the exogenously determined rate of technological progress.

Increasing savings and investment does not lead to a permanent increase in the growth rate of either the capital stock or output. As per capita stock grows, the return to capital falls and because of the constant investment share, the amount of new investment per capita increases at a diminishing rate. The dashed curve (sy)' in Figure 1 shows effect of the higher saving rate, while the dashed line (n+δ)k' shows the impact of the lower rate of population growth rate in the steady-state. In either of these two cases the levels of per capita output and capital stock are improved in the long-run equilibrium

[3] *See, for example, Sachs and Larrain (1993) for the complete description of the basic neoclassical model*

position, but the change of parameters has no effect on the long-run growth rate.

For our further analysis it is important to notice that in the absence of technological progress (or if technology is effectively available everywhere) traditional neoclassical model predicts convergence in growth rates of per capita output across countries no matter what the initial endowments of an economy are. Within this framework, then, the differences in per capita growth rates can be explained only by the transitional dynamics, namely, either by the fact that countries that started from different initial conditions grow at different rates in the process of approaching the same long-run equilibrium, or by different underlying parameters that specify various economies (like social institutions and preferences about investment), so that economies are actually moving along different paths towards different equilibrium positions.

Being one of the main contributions to the theory of economic growth Solow's model is still, to the great extent, regarded as relevant. However, the time that has passed since its development, intensive work in the field of economic growth, improvements in the model building, and new data sets that can more precisely capture the growth experiences across a variety of countries have resulted in a number of new theories that are today often referred to as the "new growth theories."

This recent work distinguishes itself from the neoclassical framework by emphasizing that economic growth is an endogenous outcome of economic system and not the forces that are operating outside the system. The researchers of the late 1980s and early 1990s have felt uncomfortable with the fact that in the prevailing growth model long-term growth is actually determined by exogenous technological progress. In addition, the neoclassical theory has not offered adequate policy advice for the continuing problems of the real world such as the

slower growth of high-income countries and persistent non-increasing growth of the low-income ones.[4] Much of the new growth literature emphasizes, therefore, that distortions and policy interventions that affect the level of output in the traditional model, can also affect the steady-state growth rate.

In spite of the extensive work on endogenous growth that is still underway, there are several groups of models that may be identified. Following the work of Arrow and others[5] in the 1960s, in the first approach that is usually attributed to Romer (1986), Lucas (1988, 1993) and Scott (1991), new investments in capital lead to technological progress in the form of "learning-by-doing" with constant returns to scale on the level of a single firm but increasing returns to scale at the aggregate level, thus retaining the assumption of perfect competition and avoiding the explicit recognition of monopoly power. Beneficial external effects of capital, that includes both physical and human, outweigh the harmful consequences of increasing capital per worker and assure that marginal productivity of capital does not decline. Consequently, rich countries may grow forever, while poor may stay poor. Due to human capital, the increasing returns to scale as well as the possibility of an infinite growth of economies are set into the model. When individuals or firms accumulate new capital, they unintentionally contribute to the productivity of capital held by others.

The second area of endogenous growth analysis has devoted more attention to research and development (R&D). In these models there is some kind of spillover, externality or public good. Private returns might be diminishing but due to externalities, social returns are not

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[4] Romer (1986) and Lucas (1988) cited the observed failure of cross-country convergence as a motivation to build models of growth with technological change being neither exogenous nor instantly available in all countries of the world. In addition, new growth theories were motivated by struggle to construct a viable alternative to perfect competition aggregate-level theory since the neoclassical model has not captured the fact that many individuals and firms have market power and earn monopoly rents due to achieved technological advances (Romer, 1994).

[5] See Arrow (1969, 1973), and Nelson and Phelps (1966).

decreasing, and the competitive equilibrium is sub-optimal. Following Uzawa (1965) and others, this class of model was developed by Romer (1990), Grossman and Helpman (1990) and Aghion and Howitt (1992). The models with monopoly power essentially assume the existence of a separate technology sector in the economy that supplies the other sectors with new technologies. Producers buy the new technology and charge a price above the marginal cost of their production to generate enough income to cover the costs that include the initial investment in new technologies. Innovation raises the productivity of all subsequent innovation projects and the productivity of new investments in innovative activity does not have decreasing productivity allowing the growth to go on.[6]

Growth can be understood through another line of new growth theories to result purely from the accumulation of capital, if capital is interpreted as a broad measure of all relevant types including human and nonhuman (Becker, Murphy, and Tamura, 1990; Jones and Manuelli, 1990; King and Rebelo, 1990; Rebelo, 1991). In these models growth is endogenous despite absence of increasing returns.

Capital is the driving force behind the economic growth, and firms continually add to their stocks of capital in the perfectly competitive markets with constant returns to scale. In this linear model of endogenous growth, perfect competition requires that capital is paid its marginal product, which must be above the discount rate for investment to remain profitable. The authors posit a lower bound on the private return to capital as a property of the aggregate production function to assure that investment continues to be profitable.

All models of endogenous growth must break the constraint of diminishing returns to accumulation imposed in the basic Solow model. Main implication is that economies that save and invest more will

[6] *See Helpman (1992) and Grossman and Helpman (1994) for an overview of models with innovation-based growth.*

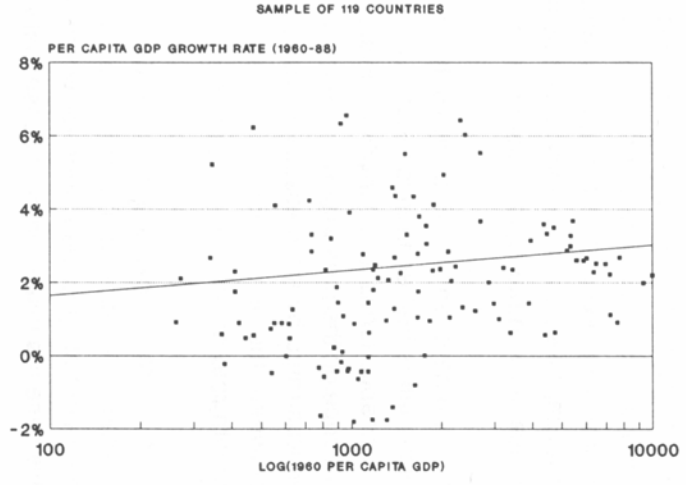
generally grow faster in the long-run and, therefore, the policies that affect saving rate will have more significant impact on the economic welfare. Consequently, economies do not necessarily reach the steady-state growth rate just equal to the rate of population growth and technological progress. Growth at higher level than this can be self-sustaining, since diminishing returns to capital do not set in. Increasing saving rate may result in a permanent increase in growth and countries do not necessarily converge.

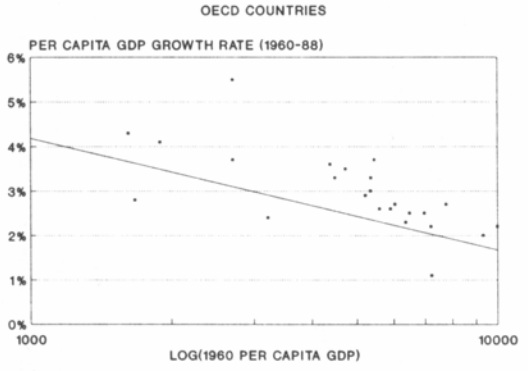
3. EMPIRICAL EVIDENCE

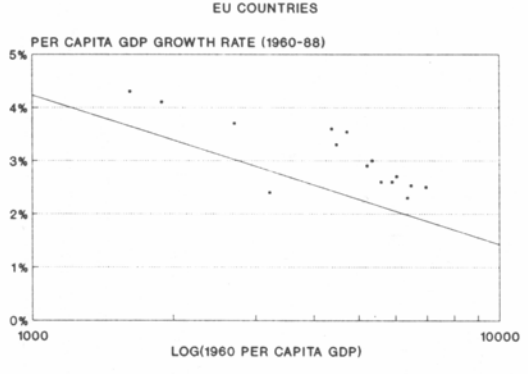
The slowdown of growth that was observed worldwide in the first half of 1970s persisted throughout 1980s with only marginal improvements in the standards of living in the industrial countries and almost no improvements among a huge number of poorest countries. This experience, although punctuated by some miraculous growth performances that occurred, renewed interest among economists in empirical analysis aimed at determining the factors affecting growth. Important additional incentives have come both from the new growth theories and from improved cross-country data sets that have allowed extensive empirical and, in particular, econometric work.

Most often these recent empirical analysis have focused on the hypothesis which claims that economies that start out behind tend to grow faster in per capita terms and converge toward those that began ahead. The evidence on the presence or absence of the convergence pattern is often illustrated by the statistical significance of the inverse association between the initial position of an economy and its subsequent growth rate as shown in Figure 2.

The first chart of Figure 2. covers a broad and heterogenous set of 119 countries including most of the industrial and developing countries except for the ex-centrally-planned ones for which the data was not available. In this case the initial levels are essentially uncorrelated (or







Data source: Summers and Heston (1991).

Figure 2. Growth Rate vs. Initial per Capita GDP

even slightly positively correlated) with the subsequent average growth rates, indicating the absence of convergence. The second two charts deal with DECD and EU economies as more homogeneous sets of countries that have similar underlying structures. It is clear that in these two cases those economies that had started behind, have experienced more rapid growth over the 1960-88 period.[7]

As follows from the previous section, the standard theoretical framework for studying convergence hypothesis is the neoclassical growth model that implies the presence of convergence on the basis of diminishing returns to capital. However, since different economies are essentially defined by different underlying parameters, countries may be heading towards different long-run steady-states which, according to the supporters of traditional growth theory, explains the observed nonconvergence pattern in the real world. Factors like existing institutional framework, protection of property rights or education in addition to those that are not directly influenced by governments such as attitudes toward saving, fertility rates or availability of natural resources, determine whether economies would or would not converge at all. In the case of heterogenous groups of countries with different underlying parameters, standard neoclassical model recognizes the conditional form of convergence according to which an economy grows faster if its initial level of per capita income is further away from its long-run target. If, however, the underlying parameters, such as preferences, technology and government policies, are the same across countries or regions of countries, the traditional model predicts the absolute form of convergence implying that poorer countries would grow faster in per capita terms than the richer ones (Barro, 1994).

A substantial part of the contemporary empirical literature that studies why different economies experience sharp divergences in the longterm

[7] *Statistically significant inverse association hetween initial level of income and subsequent growth has also been confirmed across U. S. states, different regions of European countries and provinces of Japan (Barro, 1994; Barro and Sala-i-Martin, 1990, 1991).*

growth rates, regresses the average GDP growth rates on the initial income levels and various explanatory variables. These empirical tests usually attempt to isolate observable variables that serve as proxies for the long-run income target and test the inverse relationship between a country's starting position and its subsequent growth rate. The variables that are most often held constant are measures of human capital and economic openness, the shares of investment and government consumption in GDP, as well as different indicators of socio-political stability.

These empirical tests are often also viewed as a means of testing the validity of the two competing theoretical views of growth, the traditional one and new one. Baumol (1986), Dowrick and Nguyen (1989), Barro (1991), Mankiw, Romer and Weil (1992), and Barro and Sala-i-Martin (1991, 1992) have argued that the observed tendency for initial income to be robustly negatively related with subsequent growth in cross-country regression analysis, after controlling for potential differences, could be interpreted as evidence in favor of the neoclassical model with diminishing returns to capital accumulation. In order to justify the pure version of the neoclassical model, capital only needs to include both physical and human capital, so that the diminishing returns set in very slowly. Although there exists a growing number of empirical studies, some of which support Solow's theory and others which support the new growth theories, Helpman (1992) concludes that at this stage the data do not distinguish sharply enough between these alternatives. This situations has partly to do with the fact that the neoclassical theory and the new growth theories are more complements than substitutes and partly with the fact that existing tests are not powerful enough. As opposed to the empirical work of 1960s and 1970s which involved primarily the analysis of factor sources of growth, this type of framework is focused on policy sources of growth and should be viewed more as a reconciliation of the traditional and new growth theories since the components of both models can be recognized in empirical studies.

Table 1 gives an overview of recent studies and their results.[8] A quick glance at the table confirms that authors study different sets of countries over different time periods using thereby rather different explanatory variables. The great diversity of these studies makes it difficult both to discover consistent relationships and to compare the results. However, the most important lessons from the existing empirical literature refer to the general support for the models where a catch-up variable is combined with additional explanatory variables reflecting efforts to close the existing gap between the current and long-term equilibrium position of an economy. The two most often used explanatory variables are investment in physical capital and investment in human capital. It is, however, hard to distinguish between them, since the importance of education usually diminishes when included with physical capital investment. Similar situation occurs with the economic openness: it is usually not significant but probably works through other variables.

On the basis of cross-country regressions it can be said that rapid growth is associated with high saving and investment, well educated work forces and the ability to capture the technology of leading countries. Export orientation, low government spending, absence of price distortions and stable socio-political system are also linked with good growth performances. The results suggest that potential for catch-up exists, but it can only be realized by countries that have a sufficiently strong social capability, that manage to mobilize the necessary resources, and that have a stable macroeconomic environment. In the process of economic growth most of these factors are not substitutes but complements.[9]

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[8] The collection of studies is by no means complete. It has been selected on the largely arbitrary basis, with the main objective to review the most recent empirical studies. An extended review of studies undertaken in the second half of 1980s may be found in Levine and Renelt (1991) and in Fagerberg (1994).

[9] A more detailed analysis of the results of cross-country regressions may be found Mervar (1996).

Table 1.

AN OVERVIEW OF MULTIVARIATE CROSS-COUNTRY REGRESSIONS FROM STUDIES ON ECONOMIC GROWTH

AUTHOR	PERIOD	SAMPLE SIZE AND TYPE	DEPENDENT VARIABLE - growth in -	INDEPENDENT VARIABLES											R^2 / RBAR^2
				CATCH-UP VARIABLE	INVESTMENT	LABOR FORCE GROWTH	HUMAN CAPITAL	GOVERNMENT CONSUMPTION	TRADE INTENSITY	INFLATION	FINANCIAL DEVELOPMENT	INCOME DISTRIBUTION	SOCIO-POLITICAL INSTABILITY	OTHER VARIABLES	
Alam (1992)	1950-86	16* / industrial	GDP per man-hour	-	+	+			+/0					Y	RBAR^2 0.79
Barro (1991)	1960-85	98 / mixed	GDP per capita	-	+		+	-					-	Y	R^2 0.59
Barro (1994)	1960-85	73* / mixed	GDP per capita	-	+		+	+					-/0	Y	
Barro and Lee (1993a)	1975-85	95 / mixed	GDP per capita	-	+		female: -/0; male: +	-					-	Y	R^2 0.58
Benhabib and Spiegel (1994)	1965-85	78 / mixed	GDP	+/0	+	+/0	+							Y	
De Gregorio and Guidotti (1995)	1960-85	95 / mixed	GDP per capita	-	+/0		+	-			credit to priv. sector: +		-	Y	R^2 0.57
De Long and Summers (1993)	1960-85	88 / mixed	GDP per worker	-	equipment: +; other: +	+/0								N	R^2 0.47
De Long and Summers (1993)	1960-85	27 / LDCs	GDP per worker	-/0	equipment: +; other: +	-/0								N	R^2 0.66
Dowrick and Nguyen (1989)	1950-85	23 / industrial	GDP (trend)	-	+	+								N	R^2 0.56

AUTHOR	PERIOD	SAMPLE SIZE AND TYPE	DEPENDENT VARIABLE - growth in -	INDEPENDENT VARIABLES												R^2 / $RBAR^2$
				CATCH-UP VARIABLE	INVESTMENT		LABOR FORCE GROWTH	HUMAN CAPITAL	GOVERNMENT CONSUMPTION	TRADE INTENSITY	INFLATION	FINANCIAL DEVELOPMENT	INCOME DISTRIBUTION	SOCIO-POLITICAL INSTABILITY	OTHER VARIABLES	
Easterly and Rebelo (1993)	1970-88	53 mixed	GDP per capita	-				+	marginal income tax -					-	Y	R^2 0.36
Fischer (1993)	1970-85	73 mixed	GDP per capita	-	+			+	budget surplus +	foreign debt -/0	-				Y	$RBAR^2$ 0.60
Goel and Ram (1994)	1960-85	55 industrial	GDP per capita	-	R&D +	physical capital +		+							N	R^2 0.62
Goel and Ram (1994)	1960-85	37 LDCs	GDP per capita	-	R&D +/0	physical capital +		+							N	R^2 0.63
Helliwell (1992)	1960-85	90 mixed	GDP per adult	-	+			+						democracy index -/0	Y	$RBAR^2$ 0.54
King and Levine (1993)	1960-89	92 mixed	GDP per capita	-				+				financial sector size +		-	Y	R^2 0.52
Lee and Lee (1995)	1970-85	17 mixed	GDP per worker	-	+/0		-/0	achievement scores +							N	R^2 0.54
Mankiw, Romer and Weil (1992)	1960-85	98 mixed	GDP per worker	-	+		-/0	+							N	$RBAR^2$ 0.46
Mankiw, Romer and Weil (1992)	1960-85	22 industrial	GDP per worker	-	+/0		-	+/0							N	$RBAR^2$ 0.65
Nelson and Singh (1994)	1980-89	47* LDCs	GDP	-	private +	public +	-/0	+/0	budget deficit -/0		-/0				Y	R^2 0.50
Perssonn and Tabellini (1992)	1960-85	35 mixed	GDP per capita	-				+					+		Y	R^2 0.56

AUTHOR	PERIOD	SAMPLE SIZE AND TYPE	DEPENDENT VARIABLE - growth in -	INDEPENDENT VARIABLES											R^2 / $RBAR^2$
				CATCH-UP VARIABLE	INVESTMENT	LABOR FORCE GROWTH	HUMAN CAPITAL	GOVERNMENT CONSUMPTION	TRADE INTENSITY	INFLATION	FINANCIAL DEVELOPMENT	INCOME DISTRIBUTION	SOCIO-POLITICAL INSTABILITY	OTHER VARIABLES	
Pourgerami and Assane (1992)	1950-77	47 mixed	GDP	-	+/0	+			+	-/0			social capability +	Y	$RBAR^2$ 0.68
Pourgerami and Assane (1992)	1950-77	27 LDCs	GDP	-	+/0	+			+/0	+/0			social capability +	Y	$RBAR^2$ 0.67
Roubini and Sala-i-Martin (1992)	1960-85	53 mixed	GDP per capita	-			+	-			negative interest rate -		-/0	Y	$RBAR^2$ 0.69

Notes: *+ (-) indicates that the regression coefficient is significantly positive (negative) at the 5 percent level; +/0 (-/0) indicates that the regression coefficient is positive (negative), but insignificant at the 5 percent level; blank indicates that the respected variable is not included in the regression.*

*PERIOD: Time period of cross-section analysis. SAMPLE SIZE AND TYPE: Number of countries included in the sample that according to type may consist of less developed (LDC) or/and industrial countries; * = pooled cross-section and time series data set.*

If not otherwise specifically indicated, the independent variables have the following interpretation:

CATCH-UP VARIABLE: GDP per capita in the initial period or equivalent.

INVESTMENT: Share of investment in GDP.

LABOR FORCE GROWTH: Labor force or population growth.

HUMAN CAPITAL: Primary or secondary school enrollment rates or school attainment as a proxy for stock of human capital.

GOVERNMENT CONSUMPTION: Share of government consumption in GDP.

TRADE INTENSITY: Export growth or growth of the share of exports in GDP or equivalent proxy reflecting the openness of the economy.

INFLATION: Inflation rate.

INCOME DISTRIBUTION: Income equality measured by the distance between median and mean income.

SOCIO-POLITICAL INSTABILITY: Assassinations per million, number revolutions and coups, war casualties per capita or similar.

OTHER VARIABLES : Yes (other variables included)/No (no other variables included, except for the constant term).

After reviewing a portion of the empirical literature on economic growth that include cross-country regression analysis, one is tempted to agree with Fagerberg (1994), who argues that we face nowadays sharply diminishing returns to this type of analysis. However, it should be stressed that in each specific study researchers have considered only a small number of explanatory variables in the attempt to establish a statistically significant relationships between growth and policy indicators of their particular interest. Some researchers have, for instance, tried to tide trade and growth but, at the same time, have completely ignored the role of fiscal or monetary policy, or just the opposite.[10] In that respect is the exercise that follows different since, besides checking for the convergence, it attempts to simultaneously employ a comprehensive set of different policy variables.

Exercise is based on Barro-Sala-i-Martin's (1990, 1991, 1992) framework for measuring convergence effect, which was developed within the neoclassical growth model for closed economies with diminishing returns to capital. According to this methodology per capita growth of real GDP is related to the initial level of GDP as well as initial level of human capital stock and a number of ancillary variables, such as proxies for macroeconomic policies and sociopolitical stability.

Explanatory variables that are employed in each of the six equations presented in Table 2 are initial level of GDP and human capital stock as well as investment share of physical capital to GDP. However, in some of the equations these variables are replaced by more narrowly defined measures and combined with a number of other indicators of macroeconomic policies and socio-political stability.

[10] *Fischer's (1993) study, in which author combines different indicators of macroeconomic policy, is one of a few exceptions.*

Table 2.

CROSS-COUNTRY GROWTH REGRESSIONS

(Dependent Variable: Growth Rate of Real per Capita GDP)

INDEPENDENT VARIABLES	EQUATION					
	1	2	3	4	5	6
Constant	0.729E-01 (3.429)	0.902E-01 (3.578)	0.938E-01 (3.787)	0.938E-01 (3.641)	0.125 (4.650)	0.137 (4.889)
Log(initial GDP per capita)	-0.926E-02 (-3.180)	-0.105E-01 (-3.179)	-0.111E-01 (-3.706)	-0.110E-01 (-3.598)	-0.141E-01 (-4.562)	-0.143E-01 (-4.638)
Log(initial human capital)	0.637E-02 (2.954)	0.938E-02 (2.695)	0.791E-02 (2.119)		0.564E-02 (2.103)	0.676E-02 (2.465)
Log(initial human capital - male)				0.479E-02 (0.773)		
Log(initial human capital - female)				0.292E-02 (0.667)		
Population growth (average)	-0.344 (-1.960)					
Share of investment in GDP (average)	0.101E-02 (3.712)	0.724E-03 (2.339)				
Share of equipment investment in GDP (average)			0.324E-02 (8.856)	0.325E-02 (8.953)	0.297E-02 (8.250)	0.224E-02 (5.227)
Share of nonequipment investment in GDP (average)			0.236E-03 (0.600)	0.221E-03 (0.564)	0.301E-03 (0.754)	0.202E-03 (0.521)
Share of government consumption in GDP (average)		-0.865E-03 (-2.631)	-0.750E-03 (-3.229)	-0.754E-03 (-3.270)	-0.840E-03 (-3.647)	-0.104E-02 (-4.188)
Share of trade in GDP (average)		0.834E-04 (1.335)				
Inflation rate (average)		-0.377E-04 (-3.421)	-0.277E-04 (-3.053)	-0.282E-04 (-3.007)		
Black market exchange rate premium (average)					-0.176E-01 (-2.987)	-0.194E-01 (-3.511)
Revolutions and coups						-0.925E-03 (-0.146)
Dummy for Latin America						-0.981E-02 (-2.988)
SUMMARY STATISTICS						
Observations	93	85	71	71	63	63
R^2	0.348	0.415	0.630	0.632	0.667	0.709
$RBAR^2$	0.318	0.370	0.596	0.592	0.631	0.665

Note: Data for the sample that includes both industrial and less developed countries in the period 1960-88 has been drawn from several sources specified in Appendix. The regressions use OLS to estimate equations of the following form:

$$(\frac{1}{T})\log(\frac{y_t^i}{y_{t-T}^i}) = a - \frac{(1-e^{-\beta T})}{T}[\log(y_{t-T}^i)] + other\ \ variables$$

where y_t^i is the real per capita income in country i at time t; y_{t-T}^i is the real per capita income in state i at the beginning of the observation interval; T is the length of the observation interval; β is convergence coefficient, while the other variables are additional explanatory variables, e.g. proxies for various macroeconomic policies and socio-political conditions. See Barro and Sala-i-Martin (1990, 1991, 1992) for the full description of the framework used in the empirical analysis.

T-statistic is given in parentheses. It is computed using the procedure suggested by White (1980) in order to derive heteroskedastic-consistent estimates.

The regression coefficient with the initial level of GDP is negative and highly significant in each of the six equations. This negative effect of the initial per capita income on output growth relates to the convergence hypothesis implying that countries with output per capita lower than their long-run target values are expected to grow faster conditioned on variables that are held constant. It should be stressed that this finding of convergence does not mean that typically poor countries tend to catch up to the rich ones. The essence of the conditional convergence is that the poor countries also have low long-run target values of per capita incomes. Therefore, absolute convergence concept would apply only if the determinants of their target positions, which are essentially dependent on the national government policies, would improve.

Since recent growth theories have emphasized the importance of human capital for the diffusion of technology a positive sign is expected with its initial level. It is also important to notice that the proxy for human capital stock (average number of years of total schooling in 1960) comes from the Barro and Lee (1993b) data set on international educational attainment. The literacy rate and school enrollment ratios that were frequently used elsewhere as proxies for human capital accumulation measure either only one component of human capital or the current flow of education that creates the future human capital stock. The lag between flow and stock is long, and consequently even if it is taken into account in a regression, it is doubtful how to evaluate the initial stock of human capital. Likewise, it is doubtful how to correctly resolve the issues of mortality and migration. These estimates, therefore, have not accurately measured the stock of human capital available for current production. In that respect the Barro-Lee data set is a significant improvement although the data still miss adjustment for the quality of education.[11]

[11] *Benhahib and Spiegel (1994) as well as Barro (1994) have shown that the proxy for the stock of human capital performs much better in cross-country regressions than previously used proxies such as the literacy rate and the primary and secondary school enrollment rates.*

The first equation, besides the initial level of GDP and human capital stock, includes as explanatory variables the share of investment in GDP and the average rate of population growth. The investment share of physical capital to GDP captures the positive effect of capital formation on income according to standard growth theory. Namely, in the traditional Solow model, both the investment share and population growth are exogenously determined and have no impact on the longrun per capita growth rates, but do affect the level of long-run per capita income which is improved by an increase in the investment ratio and diminished by the higher rate of population growth. Both coefficients are of the expected sign.

Second equation is expanded by indicators of government, trade, and monetary policy. The expected negative effect of government spending, explained by the fact that higher taxes necessary to finance increased government expenditures would distort economic incentives (and efficiency, is highly significant. So is the coefficient with inflation rate. The regression coefficient with the proxy for trade policy is of the expected sign, but insignificant either because of the imperfections in proxy used or because it is correlated with some other variables.

In Equations 3 through 6, the share of total physical investment to GDP is replaced by the share of equipment and nonequipment investment. Equipment investment proves to be highly significant and strongly improves the overall characteristics of the estimated equation, while the coefficient for the nonequipment share is plainly insignificant.

In Equation 4 the initial stock of total human capital is replaced by the more narrowly defined stocks of both male and female human capital. Although a positive sign persists for each variable, the significance is substantially reduced.

Equation 5 introduces the black market exchange rate premium as a general proxy for distortionary policies and overall macroeconomic instability. Obviously, the distortions impair economic growth.

Finally, in Equation 6, measures of socio-political instability and conditions in Latin American countries are added to equation.[12] They join the initial level of GDP, the total human capital stock, the shares of equipment and nonequipment investment, the share of government consumption, and the black market exchange rate premium. Although the "new" regression coefficients are of the expected signs, the variable that relates to the number of revolutions and coups per year is insignificant. The problem arises from the fact that reliable data that would measure socio-political conditions across a wide number of countries are not available.[13]

The independent variables in Equation 6 explain a fairly high proportion of the variation in growth rates across countries. All variables have the expected signs, and all but two are significantly different from zero at the usual 5 percent level. When allowance is made for other factors, strong convergence persists. As the estimated coefficient shows, the gap towards the target value of per capita income is closed at approximately 1.8 percent per year.

Since parameter estimates reflect intercountry averages, and do not apply to a single country, cross-country regressions of this type may only be viewed as establishing certain patterns of correlations. Levine

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[12] Roubini and Sala-i-Martin (1992), stimulated by the observation that growth experience of Latin American countries has been different from rest of the countries, since dummy for this region is significantly negative in cross-sectional empirical studies (Barro, 1991), found that including various proxies for financial repression substantially reduces the significance of the Latin American dummy.

[13] In that respect the index of social capabilities that has heen compiled by Pourgerami and Assane (1992) and is defined as a combined score of a cross country classification of democracy, civil liberties, and human rights is an important improvement. However, it is available only for a small number of countries, and hence it was not used here.

and Renelt (1991, 1992) and Levine and Zervos (1993) have found, for instance, that many of the findings of cross-country regressions are fragile to only small changes in the conditioning information set, meaning that even minor changes of explanatory variables change the sign and/or substantially reduce the significance level of certain regression coefficients leading to the considerably different conclusions regarding the dependence between the long-run growth and a specific macroeconomic policy.[14]

When interpreting the results of cross-country regressions some other limitations should be kept in mind. Economists today have the opportunity to use improved cross-country data sets, but the entries across a wide variety of countries are still measured inaccurately and inconsistently. The problem of interpreting causal linkages is also highly present in this type of analysis. In addition, econometrics has not yet found a clear answer to the question of whether vastly different countries should or should not be put into the same regression (Levine and Renelt, 1991). Therefore, Levine and Zervos (1993) strongly argue that the regression coefficients in this case should not be interpreted as elasticities that imply a magnitude by which the growth rate will change in response to a one-percentage change in the specific policy indicator. In addition, the relationship between, for example, exports and growth should be viewed more as a relationship between trade and growth, since using any other relevant proxy for trade intensity would imply the same conclusions in respect to the trade-growth relationship.

Although the results of cross-country regressions should in many aspects be taken with caution, they remain very useful and insightful. After all, by implementing a rather simple methodology, one is able to demonstrate whether certain policy-growth relationships do or do not hold well across a large number of countries.

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[14] Levine and Renelt (1992) have found the relationship between the share of investment in GDP and growth to be robust, while Levine and Zervos (1993) extended this list by the indicators of financial sector development and black-market exchange rate premium.

4. THE GROWTH POTENTIAL: CASE OF CROATIA

The practical relevance of the growth framework introduced in the previous section may now be demonstrated by its application to the specific case of Croatian economy. The reason why such a procedure is being used to discuss the long-run growth potential of the Croatian economy is twofold. Although the available data would allow, at least to a certain extent, for some other methodological approaches, it seems unreasonable to draw future-oriented conclusions from the past in which Croatia was, on one hand, a part of another country, and on the other, characterized by a significantly different socio-political system than the one that is currently being established. Therefore, it seems more credible to speculate on the possible growth scenarios and, in particular, on policies that are relatively more favorable for economic growth given the experience of a wide range of different countries comprised in the results of cross-country regression analysis.

The implications of one-equation growth framework leave almost no room for optimism in respect to the time needed for full convergence between industrialized and less developed economies. Barro's type of regressions, reviewed in the previous section, almost unanimously imply, for different regions of a country, different countries or groups of countries, gap closing at approximately 2 percent per year.[15] These results were reinforced in our empirical exercise where the preferred Equation 6 implies convergence coefficient of 1.8 percent. If all other conditions remained unchanged, this rate suggests that the convergence would occur, but in a very slow manner with 50 percent of the gap being closed in 39 years, 75 percent in 78, and 90 percent in as long as 129 years.

However, this type of reasoning does not leave any room for special factors. It excludes the possibility that there are countries that enjoy some specific favorable conditions which, through beneficial effects on

[15] *An overview is given in Barro (1992a).*

the long-run growth might help improve performance beyond that suggested by the convergence coefficient in the cross-country regressions. Some authors argue that such advantageous conditions are primarily applicable to the group of former socialist countries in transition. The geographic proximity of these countries to the most advanced industrial countries must have favorable effects for trade, and for the transfer of skills and technology. In addition, relatively high human capital stock, low population growth and shift to the market economy should in these economies allow for additional improvements in productivity (Dornbusch and Wolf, 1992).

Croatia shares with economies in transition these favorable conditions that improve her position. Furthermore, the policy makers themselves have the tools to define the long-run productivity target and to enhance growth performance beyond what is suggested by the convergence coefficient alone. Nevertheless, the process of closing the gap will take time, and it is unlikely that the Croatian economy can reach full convergence to the productivity level of industrial countries in a relatively short period of time. Quick convergence is inconsistent with the experience of the most successful countries in the postWorld-War-II period.[16]

In order to answer the question of how rapidly the Croatian economy can grow in the future one is confronted with two basic answers. The first one suggests that each economy is in an identical catch-up situation and hence will follow the rule of closing the gap with the more advanced economies at the rate of approximately 2 percent per year.

The second answer is that the Eastern European transition economies in general and Croatia in particular are characterized by a number of

[16] *Postwar Germany, Japan, and more recently Hong-Kong, Singapore, South Korea, and Taiwan have experienced rapid growth episodes. With very high investment rates even these high-growth performers eliminated in the 1960-88 period only 20 to 50 percentage points of the gap between their productivity levels and the productivity level of the U. S. (Summers-Heston, 1991).*

special advantages and country-specific growth reserves that may be unlocked through proper government policy. Those advantages include the already existing high levels of education, low population growth, and geographic proximity to those advanced industrial countries that may facilitate the transfer of skills and technology. In addition, there are the beneficial effects for increased productivity that come from newly established market incentives. Growth reserves include the long-term openness of the Croatian economy to Western influences resulting in the well-established trade relations with the industrialized countries and the war-ravaged capital stock which allows for higher returns to the capital input than might be otherwise expected. Yet within this approach doubt remains about what specific policy actions would be most favorable for enhancing growth performance if political stability removes the risk factor.

This problem may be approached by keeping in mind the current economic conditions in Croatia, conditions that serve as background for the evaluation of the growth opportunities. The Croatian economy achieved macroeconomic stabilization in 1994,[17] and some of the main economic indicators for that year may be used as an appropriate starting point in an attempt to quantify future growth prospects. The following procedure makes use of the econometric results on the determinants of growth rates presented in Section 3. It should, however, be noted that this procedure does not allow for all the special advantages and country-specific growth reserves to be comprehensively included in simulation experiments. The basic strategy is to apply the regression parameters of the preferred Equation 6 in order to conjecture on the future growth prospects under alternative assumptions about required policy initiatives.

Table 3 contains average values for each of the growth determinants considered in the sixth equation of Section 3 for the full set of 119 countries as well as for the specific subsamples of countries. In addition

[17] *See for details Anušić et al. (1995).*

to the full sample, average representative countries are defined for the fast growing economies, whose average growth rate exceeded 2.5 percent in the period 1960-88; slow growing economies, whose average growth rate fell below 2.5 percent; DECD economies; EU economies; and the fastest growing economies of four East Asian "tigers"- Hong-Kong, South Korea, Singapore, and Taiwan.

Baseline values refer to the corresponding policy indicators for the Croatian economy. The following assumptions are made for all three simulation experiments:

- Expressed through the real per capita GDP, the initial current ratio of productivity between the Croatian economy and the economies of industrialized countries is set at 30 percent (0.3 of the average for DECD countries).[18]
- Peace shall be sustained in the long-run.
- A market-oriented economy with the full set of market incentives will be put in place.
- Stable macroeconomic policies implying the absence of both price instability and the black market exchange premium will be maintained.
- There is no change in human capital stock, since it is already high and requires long time to be significantly changed (average number of years of total schooling of the Croatian population in the 1990s is set to 8.85 years).

[18] *The calculations take into account the recent estimates of GDP according to the SNA concept.*

Table 3.

EFFECTS OF SELECTED INDICATORS ON PRODUCTIVITY GROWTH

POLICY INDICATORS	FULL SAMPLE	FAST GROWING ECONOMIES	SLOW GROWING ECONOMIES	OECD ECONOMIES	EU ECONOMIES	EAST ASIAN TIGERS	FORECASTS FOR THE CROATIAN ECONOMY		
							BASELINE	MODERATE	PREFERRED
	n≤119	n≤48	n≤56	n≤24	n≤15	n≤4			
Human capital stock (current)	4.85	5.83	4.64	8.32	7.70	6.73	8.85	8.85	8.85
Share of equipment investment in GDP	3.93	6.54	2.61	7.54	7.28	8.26	6.00	18.00	21.00
Share of nonequipment investment in GDP	13.94	17.25	12.59	18.46	18.05	15.55	9.00	12.00	14.00
Share of government consumption in GDP	17.96	16.96	17.72	14.15	15.46	11.79	25.00	15.00	10.00
Black market exchange rate premium	23.18	8.26	27.35	1.93	0.58	6.95	0.00	0.00	0.00
Revolutions and coups	0.21	0.14	0.22	0.05	0.06	0.11	0.00	0.00	0.00
GDP PER CAPITA GROWTH RATE									
Actual/Forecast	1.94	3.66	1.22	2.98	3.07	6.34	2.16	4.72	5.75

Notes: Policy indicators are defined as in Table 2. See Appendix for details.

The baseline values additionally include government share of 25 percent and investment ratio of 15 percent (6 percent for equipment investment and the remaining 9 for the nonequipment investment).[19]

As opposed to the baseline experiment that yields the long-run average growth rate of approximately 2 percent, indicators of government consumption and investment activity are significantly improved in the "moderate" simulation and imply an average growth rate of per capita output of about 5 percent. Even more improvement with government consumption in GDP decreasing to 10 percent and a simultaneous increase of investment activity to 35 percent generates a GDP per capita growth rate of about 6 percent in the third or "preferred" experiment. This scenario corresponds to the growth path of the fastest growing countries in the last several decades. One should keep in mind that the long-run average growth rate implied within this framework means higher initial rates that decrease as time passes and as the productivity level comes closer to that for the advanced economies.

Nevertheless, even with such enhanced explanatory variables, it will take about 20 years for Croatia to reach the current values of per capita output in DECD countries. Since these countries are expected e to grow at approximately 2 to 3 percent per year, it will take much more time for Croatia to come close to full convergence with them. Whether it is possible to sustain the very high investment rates implied by the preferred third experiment year after year depends however on incentives for private and public investment and most of all on the availability of domestic and foreign resources.

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[19] Authors's calculations for the current level of human capital stock are based on "Popis stanovništva 1991" (1994). Baseline values for the other policy indicators are derived from SYC, Mjesečno statističko izvješće, Gospodarska kretanja u Hrvatskoj, and Miljenović (1995). See Mervar (1996) for details.

The conclusion seems to be quite clear. As expected, there is no simple way to boost Croatia's economic growth. However, in the years ahead the prospects for growth seem strong. Formulation of wellbalanced policy packages that can actually achieve such growth performance is, of course, much more complex.

5. CONCLUDING REMARKS

There is general agreement that policy makers should pay more attention to long-run growth and that there are some general principles that work to improve the process of continued economic growth. Broad empirical evidence suggests that beneficial effects for long-run growth would emerge from stable macroeconomic policies within a market-oriented structure, from high saving and investment, from a well educated work force, from improved economic openness, from a low burden of government, and from low population growth within a stable socio-political environment. Still each individual country is left to manage the art of applying these general principles to specific policies.

There is a broad agreement among economists that macroeconomic stabilization is a necessary precondition for economic growth (Dornbusch, 1991; Roe, 1992; Allen, 1992; Frenkel, 1992). However, because of political pressures to deliver results on growth performance in the short-term, policy makers in many countries have been repeatedly forced to move to the growth stage before the stabilization phase was finished thereby endangering the whole process (Frenkel, 1992).

The empirical tests based on the growth experiences across a variety of countries suggest that policy makers in Croatia should continue pursuing stable macroeconomic policies in the future in order to build confident environment with minimum risk for sudden policy changes or reversals. That prospect primarily refers to the price stability which appears to be the aggregate indicator of whether such a goal has been

accomplished. Although the principal factors of growth are investment rates, human capital stocks, openness of the economy, and many other factors, failure to achieve price stability increases uncertainty, destroys optimal decision-making, thwarts optimal resource allocation, and jeopardizes economic growth. Therefore, the role of monetary policy in creating the proper economic environment for growth is to ensure price stability in the long-run. Such a policy minimizes the risk of sudden policy changes and contributes to the credibility of the overall economic policy (Duisenberg, 1992; De Long and Summers, 1992; and Shigehara, 1992).

Attention should also be given to establishing and continually improving general conditions of a fully market-strategy. The proper blend of state and market in the economy is a decisive factor in the sense that government actions should be confined only to the establishment of the rules of the game as well as to the areas where market fail (Summers and Thomas, 1993). Government needs to provide a basic institutional infrastructure for the normal functioning of a market economy; that infrastructure includes a legal system that is capable of protecting property rights, a diversified financial system, and a stable monetary and exchange rate regime. Domestic policies should also focus on building an environment that offers an adequate reward to foreign investors when they bring capital and ideas from the rest of the world and put them to use with domestic resources.

Investment in physical and human capital remains, however, the driving force of economic growth. Certain part of the already existing capital stock in the economies in transition has little value in the market economy since the investment decisions in the former system have been made upon criteria other than profitability. As shown by Borensztein and Montiel (1992), due to the significant returns, investment rates of only modest proportions are needed to produce rather impressive growth in the former socialist economies. However, inefficiencies of the old system are also present in areas other than

fixed capital, and there are many other potential gains from market incentives.

It is reasonable to expect that in the Croatia's current phase characterized by the uncompleted processes of privatization and restoration of private property rights within the environment still burdened by uncertainty, public investment will be significant. Processes of restructuring and rebuilding physical capital stock can generate sufficiently high levels of investment demand in Croatia, but the problem still exists regarding the feasibility of financing such investment needs. Mobilization of public saving seems most important in the short-run because other financial sources, such as domestic private saving and foreign saving, are unlikely to make decisive contributions soon, with the former still being low and the latter remaining unavailable due to the potential risks. Sufficient mobilization of public resources requires, therefore, an exceptional revenue effort. However, building institutional conditions and diversified portfolio options to encourage private saving needs to take place immediately. Change in attitude towards saving is needed if domestic savings is not to become a persistent obstacle for long-run investment. In addition, incentives through deregulation, liberalized trade policies, productive financial framework and confident environment would allow domestic saving to be invested at home and the foreign saving to become available (Auerbach, 1992).

Some authors argue that there is no basis for intervention in the form of generalized or targeted incentives to actively encourage additional investment in capital beyond what would result in competitive markets. Other scholars--and the cross-country regressions of Section 3-suggest tax credits targeted to investment in general as well as to certain types of investment that are especially favorable for enhancing growth such as machinery and equipment investment (De Long and Summers, 1992; and Feldstein, 1992). Incentives to saving and investment are also

likely to have positive effects on technological progress since progress is capital-using and partly embodied in fixed capital goods.

When using the average number of years of schooling of total population as a proxy, the Barro-Lee data set (1993b) on educational attainment indicates that ex-socialist countries have the highest human capital stock due to the compulsory primary education. Croatia is no exception in that respect due to the eight-year compulsory primary education. If compared with the corresponding figures in the Barro-Lee data set, the estimates for Croatia are among the highest and above the average for the DECD countries. It should, however, be stressed, that this proxy does not include any information on the quality of education.

Besides promoting formal education, effective support for human capital formation should be directed to on-the-job-training. Due to externalities and spillover effects, there is general agreement that both education and on-job-training should be highly subsidized (Plosser, 1992). However, more money invested in education does not necessarily improve human capital stock. The potential for that improvement is often related to the structural reforms in the school system that might include the introduction of competition in providing education services. Alternative measures within the effective support for education include sending students abroad for advanced education and giving incentives for individuals with skills and knowledge to migrate to the country. In general, attractive wages and good working conditions for skilled work continue to be the best incentives for acquiring higher education and for preventing the outflow of a highly educated work force.[20]

Empirical evidence verifies that differences in growth performances are not a result of a random process. Growth rates are systematically correlated with variables that describe the economic and socio-political

[20] *See Calvo and Frenkel (1992), Barro (1992b), Miller (1992), and Romer (1993).*

environment. Thus, catching-up must be a very complex process, and only countries with appropriate economic and institutional characteristics can succeed in accomplishing it (Fagerberg, 1994).

However, by managing appropriate long-run policies an opportunity to substantially reduce the gap with respect to developed countries does exist.

There is no doubt that this convergence process takes time and that it requires strong and consistent economic policy making. However, there is also a sound hope that if the requisite conditions are fulfilled, the optimistic scenarios for the future growth prospects of Croatian economy would become a description of reality.

APPENDIX

Source and Definition of Cross-Country Statistical Series

DEPENDENT VARIABLE:
Growth rate of real GDP per capita, average, 1960-88: Summers and Heston (1991, PWTS).

INDEPENDENT VARIABLES:
Initial GDP per capita, 1960: Summers and Heston (1991, PWT5).

Initial human capital - average number of years of schooling of total population, 1960: Barro and Lee (1993b).

Initial human capital, male - average number of years of schooling of male population, 1960: Barro and Lee (1993b).

Initial human capital, female - average number of years of schooling of female population, 1960: Barro and Lee (1993b).

Population growth, average annual rate, 1960-88: Summers and Heston (1991, PWT5).

Ratio of investment to real GDP, average, 1960-88: Summers and Heston (1991, PWTS).

Ratio of equipment investment to real GDP, average, 1960-88: De Long and Summers (1993).

Ratio of nonequipment investment to real GDP, average, 1960-88: De Long and Summers (1993).

Ratio of government consumption to real GDP, average, 1960-88: Summers and Heston (1991, PWTS).

Ratio of trade in GDP, (exports+imports)/GDP, average, 1960-88: Summers and Heston (1991, PWTS).

Inflation rate, average, 1960-89: King and Levine (1993).

Black market exchange rate premium, average, 1960-88: King and Levine (1993).
Number of revolutions and coups per year, 1960-85: Barro and Wolf (1989) Dummy for Latin America: 1 for Latin American countries, 0 otherwise.

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