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Determinants of Growth in an Error-Correction Model for El Salvador[1]

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Abstract

An error-correction model identifies determinants of growth consistent with results from panel regressions based on a standard Cobb-Douglas production function for El Salvador for 1970-1995, with structural factors affecting the technology variable and macroeconomics and expectations explaining the deviations from the long-run trend. Consistency of the parameters is satisfactory, especially considering that half of the sample period was affected by a civil war, 40 percent of the working population migrated to foreign countries during that period, and the rapid process of economic reform after the advent of peace resulted in overlapping structural patterns.

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I. SUMMARY

An error-correction model identifies determinants of growth consistent with results from panel regressions based on a standard Cobb-Douglas production function for El Salvador for 1970-95, with structural factors affecting the technology variable and macroeconomics and expectations explaining the deviations from the long-run trend.The model permits the incorporation of information about long-run equilibrium forces and also allows the data to play a strong role in the specification of the dynamic structure. It identifies long-run determinants of total factor productivity in the context of an equilibrium relationship given by a technological production function. Short-run deviations result from forces set in motion when the long-run relationship is not exactly satisfied, and their magnitude is explained by stationary variables. Such a model imposes certain requirements on the way that variables are grouped as well as on the parameters, which serve indirectly as a test of the robustness of the results, and provides information about the growth trajectory and the nature of the business cycle.

The main findings are: (i) an increasing annual long-run growth rate and a decreasing deviation from the long-run trend in the transit from the chaos period to the reform period; (ii) a downward deviation from the long-run trend during the intensification of the civil war followed by an upward deviation as the economy moved toward stability; (iii) a decline in total factor productivity as defined for the Cobb-Douglas production function at an average annual rate of 0.6 percent during the chaos period, which was not reversed in the first half of the 1990s; (iv) a significant positive impact of education improvements and a significant negative impact of competitiveness losses on total factor productivity; and (v) a significant positive impact on short-term growth of positive expectations and a negative impact of adverse macroeconomic factors, reflected in the average rate of inflation.

II. ANALYTICAL FRAMEWORK

Following Hendry et-al (1984), the error-correction model is constructed starting from unrestricted autoregresive distributed lags. The reduction to one equation is made possible by an additional assumption of weak exogeneity of the explanatory stationary variables, which permits to work with enough degrees of freedom in spite of sample size limitations. The unrestricted equation is reformulated to incorporate an error-correction term once the relevant explanatory variables are identified

The basic framework for the model is a standard Cobb-Douglas production function with constant returns to scale (standardized by labor units), converted to a logarithmic expression for tractability:

$$Y = A\ K^{\alpha}\ L^{(1-\alpha)} \qquad (1)$$

$$y = \frac{Y}{L} \qquad k = \frac{K}{L}$$

$$Log\ y = Log\ A + \alpha\ Log\ k \qquad (2)$$

$$Where\ \ 0<\alpha<1$$

Where Y is output, K the capital stock, L the labor stock, A technology (total factor productivity), and α the long-run contribution of capital to output. Treating the technology variable as non-constant, allows the simultaneous determination of pure technological parameters in the production function together with the structural factors affecting the way factors of production are combined. The magnitude of the deviations from this long-run trend would depend on short-term factors, such as macroeconomics and expectations. For a case like El Salvador, these deviations were expected to decline as the economy reaches more stability.

Consistent with this approach, A is allowed to change overtime as a function of nonstationary variables z (determinants of total factor productivity), while GDP converges to its long-run path (given by equation 2) at a speed of adjustment reflected in the coefficient δ ($0 < \delta < 1$) (equation 4, below).

$$Log\ A = f\ (z) \qquad (3)$$

$$dLog\ y = \zeta\ dLog\ k - \delta\ (Log\ y[-1] - \alpha\ Log\ k[-1] - f\ (z[-1])) + \chi\ f'\ (z)dz + g(w) \qquad (4)$$

Short-run growth may be also affected by fluctuations of z and k (with their short-run contribution given by ζ and χ) and other exogenous stationary variables w. Rival hypothesis about the values of α and ζ can be tested, to evaluate the weight of market frictions on decisions at the firm level (i.e., if in the short-run the contribution of capital may appear higher than in the long run as a result of more rigidities for shutting down a plant compared to firing workers).

Initially, no dummies are included as it appears that all long-run variables share the same structural breaks during the war until 1991 and the accelerated reforms in 1992-1995. However, to the extent that not all relevant variables affecting total factor productivity could be identified, the inclusion of a trend variable will be eventually tested to account for absent variables after finding the best specification with available variables. Also, a level dummy for the period of major deviations from the long-run trend would be eventually tested after finding the best specification, if it appears evident that remaining deviations are the result of the impact of the war.

III. GROWTH PATTERNS IN EL SALVADOR 1970-1995

El Salvador was affected by an open civil war that lasted from 1978 to 1990, half of the sample period that constitutes the scope of the econometric analysis. The period preceding the war was one of dramatic structural disarray, with segments of the civil society organized in quasi-military movements since the beginning of the 1970s. After the advent of peace, a process of economic reform took place at the same time that the government made an effort to pursue prudent financial policies based on fiscal discipline while broadening democratic participation as agreed under the peace agreements. For analytical purposes, the analysis differentiates the chaos period (1970-1991) from the reform period (1992-1995). An area of particular interest is to determine if the acceleration of growth observed in the first half of the 1990s is related to the rapid structural reforms undertaken after the advent of peace.

To analyze the long-run trends in the evolution of output in El Salvador, it is useful to take as a reference the stylized facts typifying growth as listed by Kaldor[2], among them: ***i) per-capita output grows over time, and its growth rate does not tend to diminish; ii) physical capital per worker grows over time; iii) the ratio of physical capital to output is nearly constant; and, iv) the shares of labor and physical capital in national income are nearly constant.***

In the case of El Salvador, the identification of growth patterns implies to overcome difficulties in: ***i) identifying capital destruction and distraction to non-productive uses during the war period; ii) interpreting labor statistics in the face of migration to foreign countries of a magnitude equivalent to 40 percent of the working population between 1975 and 1990; iii) inferring long-run trends based on information available only since 1970;***

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[2] See Kaldor (1963). The stylized facts are relevant for steady-state growth.

and, iv) analyzing overlapping structural patterns brought about by a rapid process of economic reform after the advent of peace.

Labor is measured by the number of private contributors to the Social Security Health System, assuming a constant share of about 20 percent in total labor force [3]. The capital stock was inferred from data on gross capital formation in the national accounts (excluding changes in stocks) [4]. Some statistical issues result from the heterogeneity of the indexes that were used: First, labor measures actual employment and the capital stock measures availability [5]. Second, coverage is different as the capital stock incorporates public and private investment while labor estimates comprise only private sector employment. Regarding the first issue, it was considered that the costs in terms of the risk of information loss exceeded the potential benefits of correcting the data, specially with information for half of the sample period affected by a war. Regarding the second issue, the bias was considered appropriate in the sense that the incorporation of public investment into the capital stock does have a more undisputable impact of growth than public employment.

The main features of the evolution of GDP and the use of inputs in this period are:

i) ***The upward trend in per-capita GDP observed in the seventies stopped during the war and resumed during the reform period. Nonetheless, GDP per worker has consistently declined, even after 1990*** [6]. The divergence of trends between these

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[3] Alternative labor statistics in El Salvador are based on unreliable surveys that have not been regularly conducted, especially during the war, and which focus basically on the urban population.

[4] As Young (1994) noted for East Asian economies "changes in stocks series..are either (i) outright gross fabrications using to conceal large discrepancies between the production and expenditure accounts; and/or (ii) based upon the flimsiest of data".The calculation of the capital stock was based on the traditional perpetual inventory method for a standard 5 percent depreciation rate, with an additional discount factor accounting for the intensity of the war proportional to the net migration rate for 1975-1991, period of abnormal migration rates, assuming 4 percent of average net growth of the stock of capital for 1970-1991.

[5] The intensity of the war must be reflected on both capital destruction and capital distraction from productive uses. The latter may have resulted in a) final allocations to war-related purposes (i.e. tanks and war planes); b) non-productive investment (i.e. higher walls in residential construction), or; c) temporary spare capital (i.e. machinery that cannot operate because of lack of energy). Capital distraction would not be fully captured by the use of availability of capital as the operational variable.

[6] The discrepancy is more severe relative to per-capita income, that includes the remittances

(continued...)

variables in the 1970s and the 1990s is mainly explained by increases in the participation rate (as measured by the share of labor force in total population at working age): It shifted from 24 percent in 1970 to 30 percent in 1980 mainly reflecting the incorporation of a larger number of women into the labor force; subsequently remained in the range of 20-25 percent in the rest of the 1980s (war period); and climbed again to about 35 percent by 1995, as a substantial segment of population was incorporated to the labor force between 1990 and 1995 -employment expanded at 11 percent per year in the period- (see Figure 1). Although the magnitude of the shifts may be the result of measurement problems coming from the simplicity of the procedure to infer labor force, the decline of average labor productivity in the reform period should not be that surprising considering the massive incorporation of unskilled labor force. The conclusion with respect to labor is then similar toYoung's study for the East-Asian economies [7]: Labor productivity growth under performs per-capita GDP growth, because of massive transfers of labor into productive activities [8].

ii) ***The reduction in average GDP per worker appears related to the reduction in capital per worker, i.e., capital has not increased overtime as much as employed labor.*** Even in recent years, while the economy went through a process of recapitalization, capital per worker remains low.

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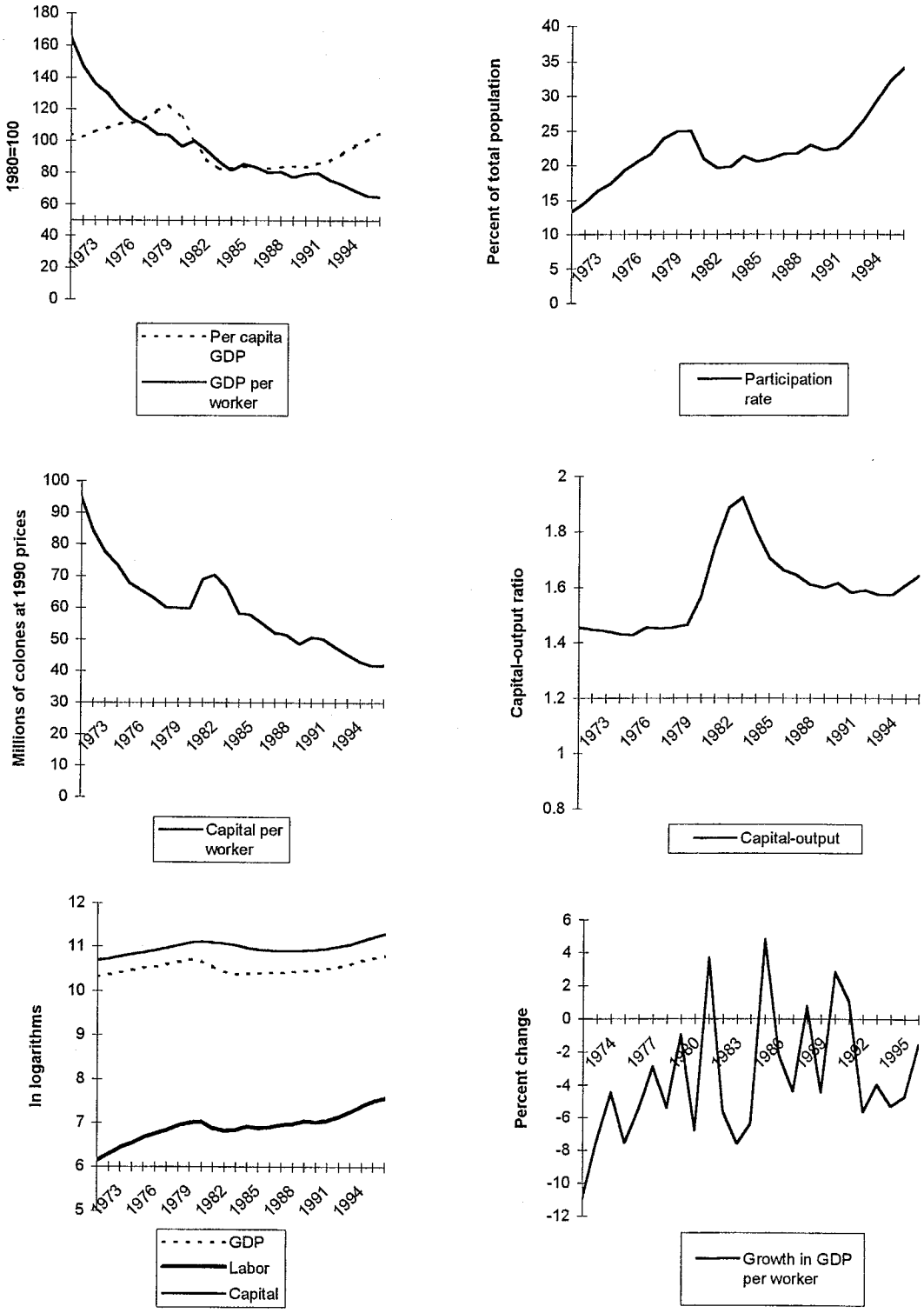
[6](...continued)
sent by those who migrated abroad. Real per-capita income increased by more than 30 percent between 1990 and 1995, while real per-capita GDP increased by around 21 percent.

[7] See Young (1994). In constructing an index of quality of labor, Elías (1990) finds that average real wages decline in periods of massive incorporation of women to the labor forcev consistent with the hypotheses of lower average productivity. In the case of El Salvador, after all, a significant share of population incorporated to productive activities had spent their youth fighting!

[8] For 1992-1995, information available on unit labor costs for a sample of nontraditional exporters (in all likelihood, the sector showing higher productivity gains) shows weighted productivity gains of only 3 percent, with one third of the sample experiencing reductions in average productivity.

Figure 1. El Salvador: Evolution of Output, Capital, and Labor



iii) ***The capital-output ratio fluctuates around 1.4 in the 1970s and 1.6 in the 1990s*** [9] (Figure 1). Dramatic fluctuations in the 1980s result from GDP falling at rates that reached 10 percent per year, related to a lower use of available capital. The derived evolution of the capital stock mimics that of gross capital formation and reflects the impact of the war.

iv) ***It appears evident that capital, labor and GDP show the same structural break due to the war.*** This makes it possible to perform an econometric analysis to determine if it is at all possible to find nearly constant contributions of labor and physical capital to the determination of output [10], in spite of the sizable impact of the war on per-capita GDP and the ratio of capital per-worker that precluded long-term growth from following the patterns stated by Kaldor. Lack of market prices for most of the period makes the analysis of input shares on national income accounts less relevant.

In terms of Kaldor, it seems that El Salvador requires substantial capitalization to reach levels of capital per-worker and capital-output that would sustain reasonable long-term growth rates. Any projection based on recent trends must consider that there is still room for the capital-output ratio to grow toward standard levels.

IV. DETERMINANTS OF GROWTH

The list of all explanatory variables that were used as well as their properties are provided in Table 1 (see Figure 2 for their evolution in the sample period).The results for the variables that resulted significant are shown in table 2 [11] . The main findings based on the unrestricted equations (first three columns) are the following:

i) ***It takes for the economy some 11 years to reach the level of output consistent with long-run growth after a given shock.*** The speed of adjustment to the long-run growth path is given by the coefficient of the term measuring the deviations of actual GDP with respect to its potential, equal to about 26 percent of the deviations per year.

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[9] De Gregorio (1992) finds a ratio of between 1.12 and 1.35 for a sample of Latin American countries in the period 1950-1985, based on the assumption of a constant capital-output ratio throughout the period.

[10] Multicollinearity between capital and labor is avoided by standardizing GDP and the capital stock per units of labor (see equation 2).

[11] The t values appear between parentheses.

Figure 2. El Salvador: Variables Explanatory of Growth

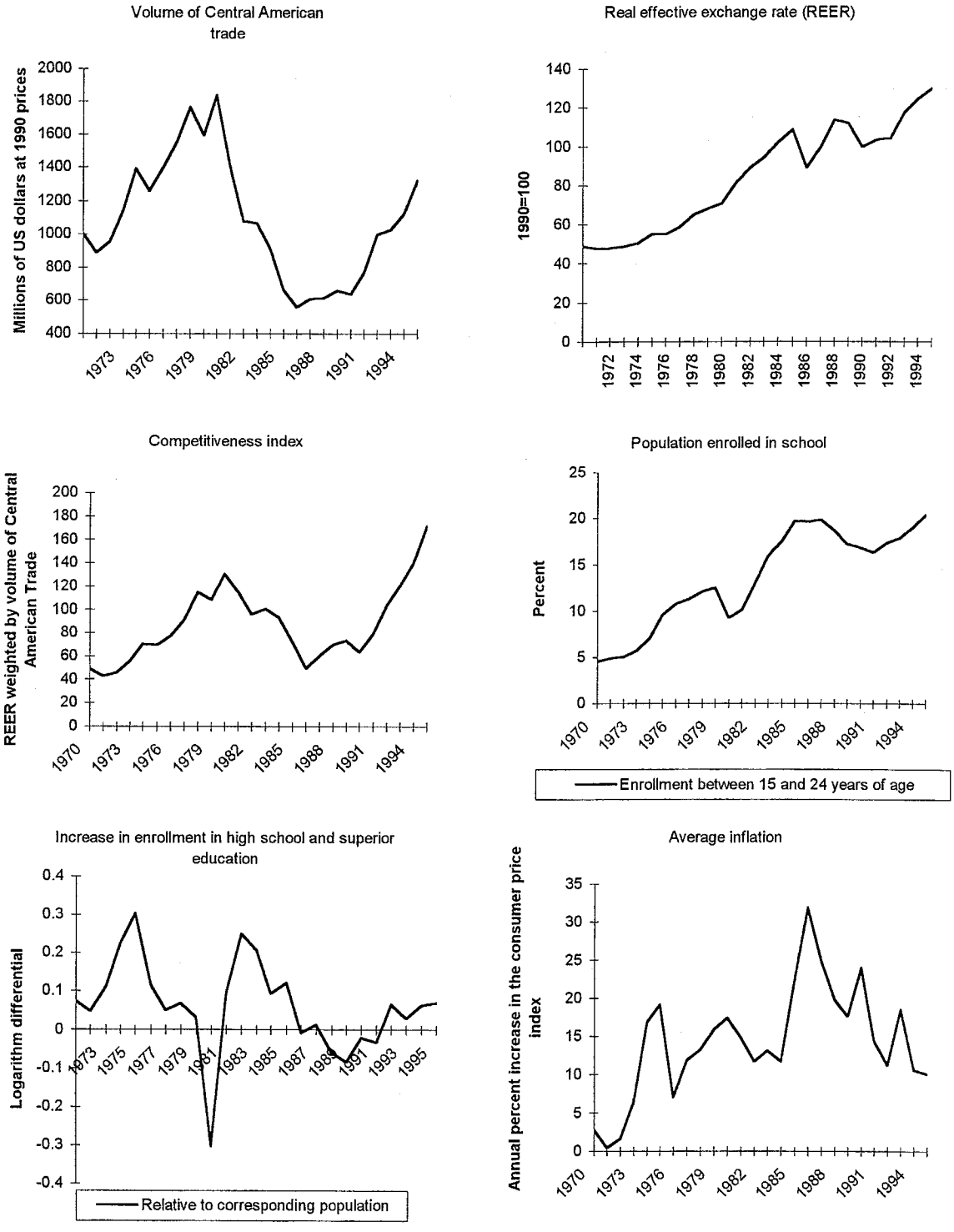

Table 1. Augmented Dickey-Fuller Test of Unit Roots of Variables in the Model

Critical values: 5%=-3.004 1%=3.767; constant included

t-adf

Lags	LGDPpw	DLGDPpw	LKpw	DLKpw	super 1/	DLsuper	LCatlrea 2/	LREER	Lcompe	Avginf
0	-1.5003	-4.9781	-0.6961	-3.484	-1.6966	-2.9134	-0.9016	-1.2477	-0.9072	-3.0491
1	-1.5496	-3.3835	-0.9133	-2.9925	-1.7234	-2.904	-1.3717	-1.2127	-1.3667	-3.2214
2	-1.6085	-2.6327	-0.8412	-3.0213	-1.6233	-2.4254	-1.5523	-1.1873	-1.2887	-2.6628

Beta

Lags	LGDPpw	DLGDPpw	LKpw	DLKpw	super	DLsuper	LCatlrea	LREER	Lcompe	Avginf
0	0.9358	-0.1087	0.9513	0.2409	0.8816	0.4078	0.9139	0.9305	0.876	0.4053
1	0.9324	-0.1239	0.9359	0.1692	0.8876	0.2917	0.8744	0.9308	0.8144	0.3076
2	0.9252	-0.0267	0.9389	0.0301	0.8909	0.2713	0.8492	0.9338	0.8096	0.3798

For:

LGDPpw, DLGDPpw: Log and percent change of GDP per worker, respectively.
LKpw, DLKpw: Log and percent change of capital stock per worker, respectively.
LREER: Log of real effective exchange rate.
LCatlrea: Log of Central American trade at constant US dollars.
Lcompe: Competitiveness index [Log (REER*Catlrea)]
Super, DLsuper: Share and percent change of the population between 15 and 24 years of age enrolled in high school and superior education.
Avginf: Average annual inflation.

1/ All Log variables were found to be nonstationary, as well as Super, and all differentials (including average inflation) were found to be stationary with the exception of DLsuper, but its beta coefficients indicate that it is in all likelihood stationary as well.

2/ As the IMF does not make the calculation for years prior to 1980, the series was completed based on the main four partners for 1970-1979: USA, Germany, Japan and Guatemala, whose trade volume with El Salvador is equivalent to 60 percent of Salvadorean trade.

Table 2. El Salvador - Econometric Results:Variables Explaining Percent Change (GDP/labor)

	Unrestricted equations			Error-correction model
	1	2	3	
CONSTANT	1.3025	1.3025	1.337759	1.3379
	(2.328)	(2.328)	(2.3785)	(9.5818)
Log(GDP/labor)[-1]	-0.260374	-0.260374	-0.252066	
	(-2.348)	(-2.348)	(-2.583)	
Log (K/labor) [-1]	0.198851	0.198851	0.123699	
	(2.943)	(2.943)	(2.374)	
Super [-1]	0.008455	0.008455	0.010736	
	(2.645)	(2.645)	(2.909)	
Percent change (SUPER)	0.138351	0.138351	0.13296	0.13295
	(2.428)	(2.428)	(2.563)	(4.3597)
Log (CAtrade) [-1]	-0.07799	0.0875756		
	(-3.985)	(1.697)		
Log (REER) [-1]	-0.165565			
	(-2.898)			
Log (COMPE)[-1]		-0.165565	-0.0859	
		(-2.898)	(-5.683)	
TREND			-0.006726	
			(-3.1512)	
DUMMY			-0.04238	
			(-2.7724)	
Percent change (K/labor)	0.862491	0.862491	0.75796	0.75796
	(6.482)	(6.482)	(6.375)	(11.3724)
Avg. inflation [-1]	-0.002754	-0.002754	-0.002084	-0.00284
	(-3.269)	(-3.269)	(-3.399)	(-4.4821)
Error-correction term [-1]				-0.25209
				(-9.8393)
Short-term output elasticity of capit	0.862491	0.862491	0.75796	0.75796
Long-term output elasticity of capit	0.763713	0.763713	0.4907405	0.4907405
R square	0.86	0.86	0.924	0.9242
F statistic	12.288	12.288	20.317	60.9499
Durbin-Watson	1.95	1.95	2.752	2.752

ii) ***The null hypothesis that both short-term and long-term capital elasticity of output have the same value is rejected only after a trend variable (as a proxy for absent variables affecting total factor productivity) and a dummy variable (as a proxy for an unmeasured remaining impact of the war) are included.*** The coefficients of capital in the production function are close to its expected value of 0.7 reflecting the correlation of human capital (not explicitly included in the equation) with physical capital[12]. Once the trend and the dummy variable are included, the coefficient of capital for the long-term equation decline to 0.49, consistent with the findings of De Gregorio, while the short-term coefficient of capital remains at 0.76. As explained before, this result is more consistent with evidence of market frictions constraining decisions at the firm level.

iii) ***Completion of basic education as measured by the enrollment in high school and superior education appears to have a positive impact on total factor productivity.*** A one percent increase in enrollment relative to the corresponding age group appears to be related with one quarter of a percent of growth of GDP per unit of labor.

iv) ***Competitiveness losses as measured by the real effective exchange rate has an unequivocal adverse impact on growth***. This may result from the prolonged recurrence to a fixed exchange rate resulting on a bias toward appreciating the exchange rate, which may make current account adjustments more costly in terms of output [13]. In addition, structural factors may have disfavored the relative price of tradeable goods against non-tradeable goods, with an impact on growth. Moreover, the equilibrium exchange rate may have moved toward a more appreciated value by exogenous factors affecting growth (for example Dutch disease problems caused by remittances in the nineties).

v) ***Integration as measured by the volume of Central American trade shows an ambiguous impact on growth.*** A negative impact of integration results from the first unrestricted equation, which could be interpreted as a result of either stronger trade-deviation than trade creation effects during much of the sample period or a combined

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[12] See Mankiew, Romer and Weil (1990) and Barro and Sala-i-Martin (1995). Measurement of human capital and labor in general is made difficult by data problems. In an unpublished paper by Harberger (1993), standard labor units are used based on the reports to the Social Security corrected by per capita GDP, which would result in inaccurate estimates when the evolution of productivity and per capita GDP diverge significantly (as it is likely, as explained in section 3). Nehru and Dhareshwar (1994) use labor estimates based on population growth, that show constant growth of labor even in the period of intensified migration.

[13] Milesi-Ferreti and Razin (1997) find that higher cumulative appreciation of the real effective exchange rate prior to a current account reversal, may cause a higher cost in terms of output growth after the reversal.

impact on competitiveness in conjunction with the real effective exchange rate, in such a way that the impact on economic activity coming from changes in the competitive position of the country is magnified in periods of higher volume of regional trade (a magnified negative impact in periods of exchange rate appreciation and a magnified positive impact in periods of exchange rate depreciation). This latter hypothesis is tested by creating an index that weighs the real effective exchange rate using the volume of Central American trade (the main market for nontraditional exports) and running equation number 2. This results on an individual positive impact of integration on growth (although at 90 percent confidence).

vi) ***Periods of increasing enrollment in superior education and periods of lower inflation, are periods more favorable to higher rates of short-run growth.*** As education is not expected to have short-term effects on growth, the best interpretation of this correlation is that increasing enrollment in superior education works as a proxy of improved expectations, while inflation works as the main proxy for the quality of macroeconomics [14]. Other variables related to macroeconomics, namely the public sector deficit and the interest rate, proved to have some significance, but much weaker than inflation. Moreover, their inclusion resulted in simultaneity problems.

vii) ***Terms of trade and remittances did not show any evident impact on growth.*** Consistent with results by Sala-i-Martin (1994)[15], neither the terms of trade nor coffee prices relative to different subsets of import prices proved to be significant. Likewise, a direct impact on growth of remittances could not be identified.

viii) ***Attempts to introduce the war explicitly into the model in addition to the discount factor to determine the capital stock, using as proxies the migration rate and life expectancy, were fruitless***. Explanations for this are: a) the main explanatory variables share already a structural break conditioned by the war; b) relations may be nonlinear (as for some forms of capital distraction, explained in section 3; and, c) the proxies for the war were significantly affected by other factors as well. For example, life expectancy declined long before the civil war started. The migration rate appears to be a better proxy for the war in general.

In general, the coefficients may also reflect collinearity with variables excluded from the final equation, and even if these were identified, the potential loss of degrees of freedom would

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[14] In Fischer's words, "the negative relationship between growth and inflation is prima facie evidence that the quality of macroeconomics affects growth" (See Fischer, 1991).

[15] Terms of trade was the weakest explanatory variable from a sample of 59 variables tested by Sala-i-Martin in 30,856 cross-section regressions.

make their incorporation difficult, given the small sample size [16]. In an attempt to eliminate to the extent possible the impact of unforeseen collinearities, in spite of the overall good performance of the test-statistics, a trend variable is included as well as a dummy variable for the period in which deviations from the long-run trend based on equation 2 were more severe (not surprisingly, for 1984-1987, the core period of the civil war). As a result, equation 3 is obtained which show a negative impact captured by the trend and dummy variables. In this equation, the independent impact of Central American trade becomes much less significant[17], the coefficient of competitiveness declines substantially from the exceptionally high levels of the first two equations, and the impact of education appears to be stronger. These last two effects imply an improvement of the specification, for which it was decided to incorporate both dummies in the formulation of the error-correction model, and to remove the impact of Central American trade, to maintain the robustness of the test statistics. The coefficient of average inflation declines slightly, while a linear restriction imposing the same coefficient for short-run and long-run elasticities of capital is now rejected, as explained before.

Based on the unrestricted equation number 3, the final error-correction model is formulated. The results in terms of the Cobb-Douglas production function are the following:

$$Y = A\ K^{0.4907}\ L^{0.5093} \qquad (5)$$

$$Log\ y = Log\ A + 0.4907\ Log\ k$$

$$Log\ A = 5.3072 - 0.3407\ Log\ compe + 0.0426\ super - 0.1681\ dummy\ (1983-87) - 0.0267\ trend \qquad (6)$$

$$dLog\ y = 0.758\ dLog\ k - 0.25209\ (Log\ y[-1] - 0.4907\ Log\ k[-1] - Log\ A[-1]) + 0.13295\ dLog\ super - 0.002084\ Avg\ inflation \qquad (7)$$

Equation (5) expresses the production function as such. Equation (6) shows the variables that explain the evolution of total factor productivity (long run equation), and equation (7) shows the short-run dynamics.

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[16] This is specially true for a growth model, as in the words of Lucas (1986) "economic growth, being a summary measure of all of the activities of an entire society, necessarily depends, in some way, on everything that goes on in a society".

[17] Nevertheless, cointegration is accepted for the long-run relationship of GDP per worker with capital per worker, competitiveness, education and the volume of Central American trade, using the Johansen-Joselius procedure. Given the sample size, this evidence can not be taken as conclusive.

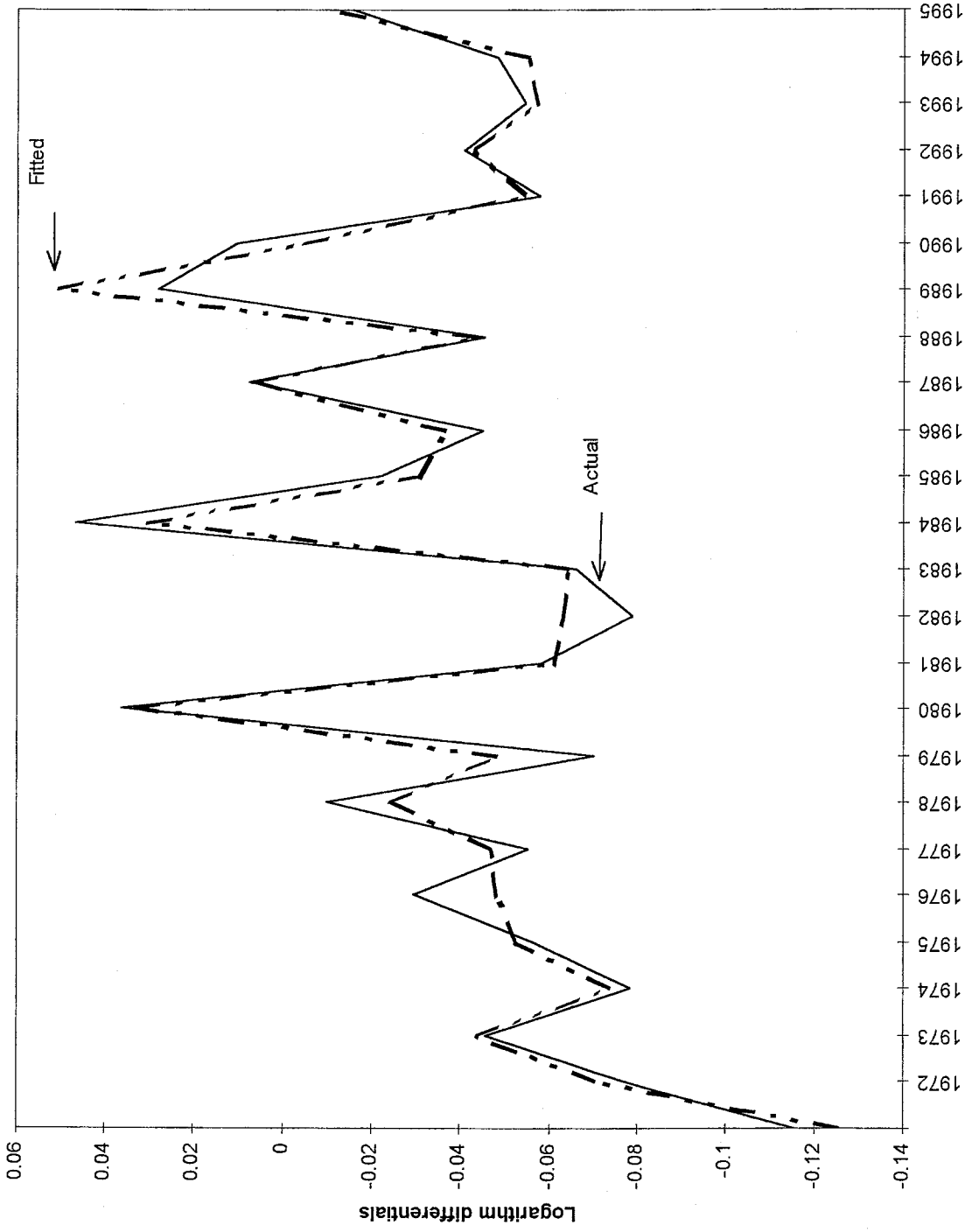


Figure 3. El Salvador: Actual vs. Fitted Growth of GDP per Worker

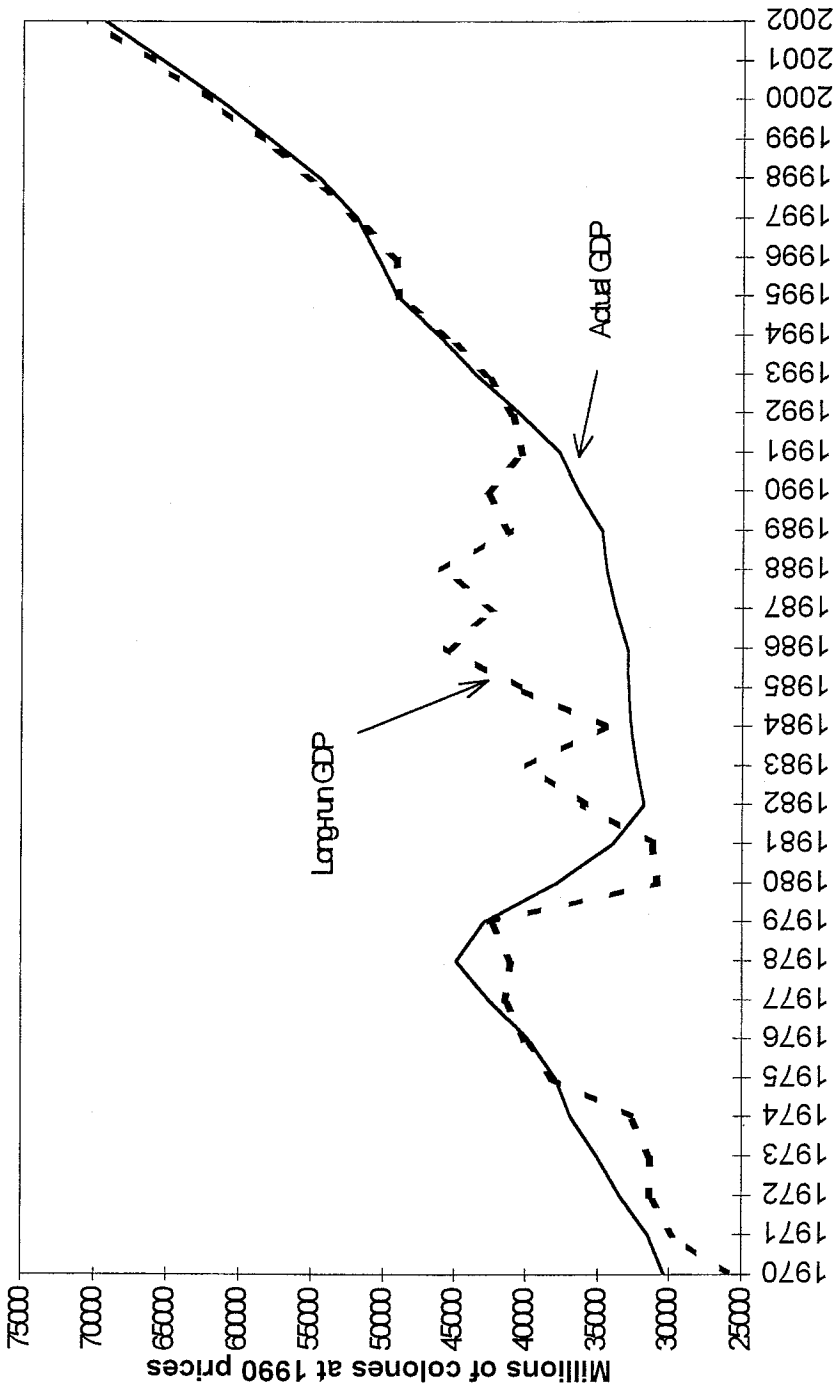
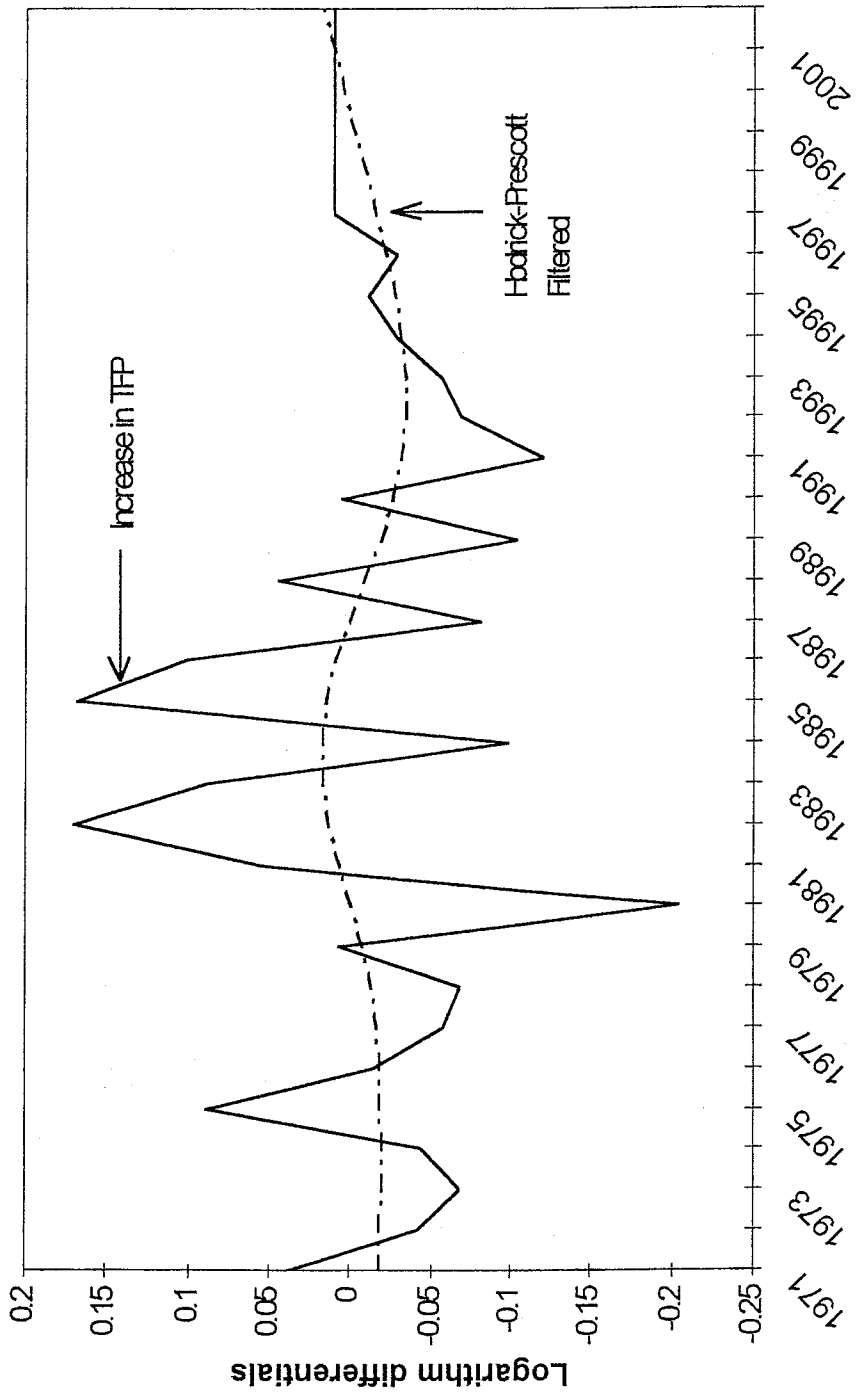


Figure 4. El Salvador: Actual vs. Long-run GD

Figure 5. El Salvador: Computed Total Factor Productivity Growth



Figures 3 to 5 show the fitness of the final equation, a comparison between the actual evolution of output and its estimated long-run path, and the evolution of total factor productivity (with an alternative view smoothed using the Hodrick-Prescott filter). The patterns are in general as expected. Stability of parameters is acceptable (Figure 6). What follows from these results is that: i) Overall fitness is robust, more so considering the roughness of the assumptions for the construction of the indexes of capital and labor [18]; ii) Deviations from the long-run trend are consistent with the transit from chaos to reform, with downward deviations in the war period and upward deviations for the reform period; iii) Deviations decline substantially in magnitude from the chaos period to the reform period, from an equivalent to 16 percent of long-run GDP during the intensification of the civil war to 2 percent as the economy moved quickly toward stability; iv) Total factor productivity growth appears volatile based on the results. A more realistic interpretation would be based on smoothening the results as in Figure 5: it shows a fluctuation around zero growth, with gradual improvements in the rate since 1993 although not yet positive until 1995, which may be a result of a process of reacommodation of resources to productive activities after the war.

V. SOURCES OF GROWTH 1970-1995 AND MEDIUM TERM PROSPECTS

A. Growth dynamics

The model predicts quite closely the rates of growth observed in the chaos period (average 1.0 percent annually forecasted vs. 1.1 percent observed) and the reform period (average 6.4 percent vs. 6.8 percent observed) (see Table 3). As Figure 4 shows, the economy was below their potential during the last part of the chaos period, which allowed for an extra impulse to growth coming from the correction term in the nineties (rebound effects from the war), that nonetheless was basically exhausted in 1993 [19]. As a result of this, the model predicts that for 1996 and 1997, the pace of growth may have decelerated, which actually occurred [20]. Macroeconomic conditions play a significant role affecting growth adversely in the chaos period. A period of negative correction of the rate of growth (1971-1982) is followed by positive corrections but huge downward deviations from the long-run trend (1983-1993). In the reform period, a declining adverse impact of macroeconomics reflected on a reduction of the average inflation rate, contributed to a convergence toward the long-run growth path.

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[18] Unless someone really believes that reporting to the Social Security will always be equivalent to 20 percent of the labor force, or that the impact of the war on capital would be incorporated fully by adding a factor to depreciation proportional to the migration rate!.

[19] It should be kept in mind that the pattern of the error-correction term must not be confused with the evolution of the rates of growth: If the long-run fundamentals continuously improve, even a negative correction may imply high rates of growth.

[20] GDP growth in 1996 and 1997 is estimated to have averaged 3 percent per year.

Table 3. El Salvador: Sources of Growth

	Percentage of annual growth explained						
Short-term	1971-1991	1992	1993	1994	1995	1992-1995	1996-2002
Explanatory variables							
Increase of capital	102.7	67.7	80.1	117.4	95.6	88.3	104.2
Of which increase of capital per worker	-228.4	-55.4	-59.9	-38.7	6.6	-37.3	63.8
Increase of labor	105.8	39.3	44.7	49.8	28.4	40.1	12.9
Macroeconomics	-276.9	-43.0	-34.4	-74.3	-33.7	-44.7	-21.9
Expectations (enrollment in superior educ.)	74.7	12.3	5.7	15.9	14.1	11.7	3.4
Correction	93.7	23.8	4.0	-8.9	-4.4	4.6	1.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Forecasted annual growth rate	1.0	7.0	6.8	5.2	6.5	6.4	4.9
Actual annual growth rate	1.1	7.5	7.4	6.1	6.3	6.8	

	Points of annual long-run growth explained		
Long-term determinants of growth	1971-1991	1992-1995	1996-2002
Capital	0.7	3.5	3.4
Labor	1.7	4.8	1.6
Total factor productivity	-1.2	-4.2	1.5
of which competitiveness	-0.7	-4.3	-1.8
of which education	2.5	4.1	3.5
other combined effects	-3.1	-4.0	-0.1
Long-run growth (average)	1.2	4.1	6.5
Assumptions			
Annual growth in labor force	4.9	11.1	2.7
Annual growth in capital stock	1.5	7.7	7.0
Enrollment in high school and superior education (average)	13.0	18.7	21.5
Annual real exchange rate appreciation	3.6	5.9	1.1
Average inflation	14.8	12.5	4.1

B. Long-run growth path

The estimated annual long-run growth rate of GDP goes from 2.1 percent in the chaos period to 5.0 percent in the reform period. The chaos period shows a negative evolution of total factor productivity, with education offsetting partially the adverse impact of competitiveness. In the reform period, contribution of total factor productivity to growth appears even more negative, reflecting measurement problems and frictions in the reacommodation of resources to productive use[21].

The ratio of capital per worker does not increase until 1995, reflecting the massive reincorporation of labor to productive use analyzed in section 2. In both the chaos and the reform periods, capital has a lower impact on growth than labor.

C. Projections

On the basis of: i) a moderation of the rate of incorporation of new labor force in 1996-2000 convergent to annual 3 percent until the year 2002; ii) an increase of the rate of capital accumulation of 7 percent per annum; iii) further improvements in education; iv) a reduction of the inflation rate to 3 percent for 1997-2002; v) no further loss of competitiveness [22]; the model predicts an average annual growth rate of about 5 percent for 1996-2002, with most of growth explained by investment and the consequent increase in the availability of capital per unit of labor force. An improvement in total factor productivity equivalent to 0.6 percent of GDP per year would result from education more than offsetting the impact of the accumulated exchange rate appreciation. This positive impact could be higher if other unidentified factors implicitly constant in the final equation show a dynamic behavior. More important, the long-run rate of growth would increase to around 6 percent toward the end of the decade, rate to which the economy would converge gradually based on the above-mentioned assumptions. Continuous improvement of macroeconomic conditions would minimize deviations from this upward path.

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[21] Results did not improve with alternative corrections to the data, neither by assuming constant GDP per worker for the reform period nor by using a Hodrick-Prescot filter to smooth out the labor series.

[22] If part of the explanation why central american integration magnifies the negative impact of exchange rate appreciation is that it was based more on trade deviation than on trade creation respect to the rest of the world, it can be safely assumed that this will not occur in the future, as renewed efforts to liberalize trade drastically, by reducing common external tariffs are taking place in recent times.

VI. Conclusions

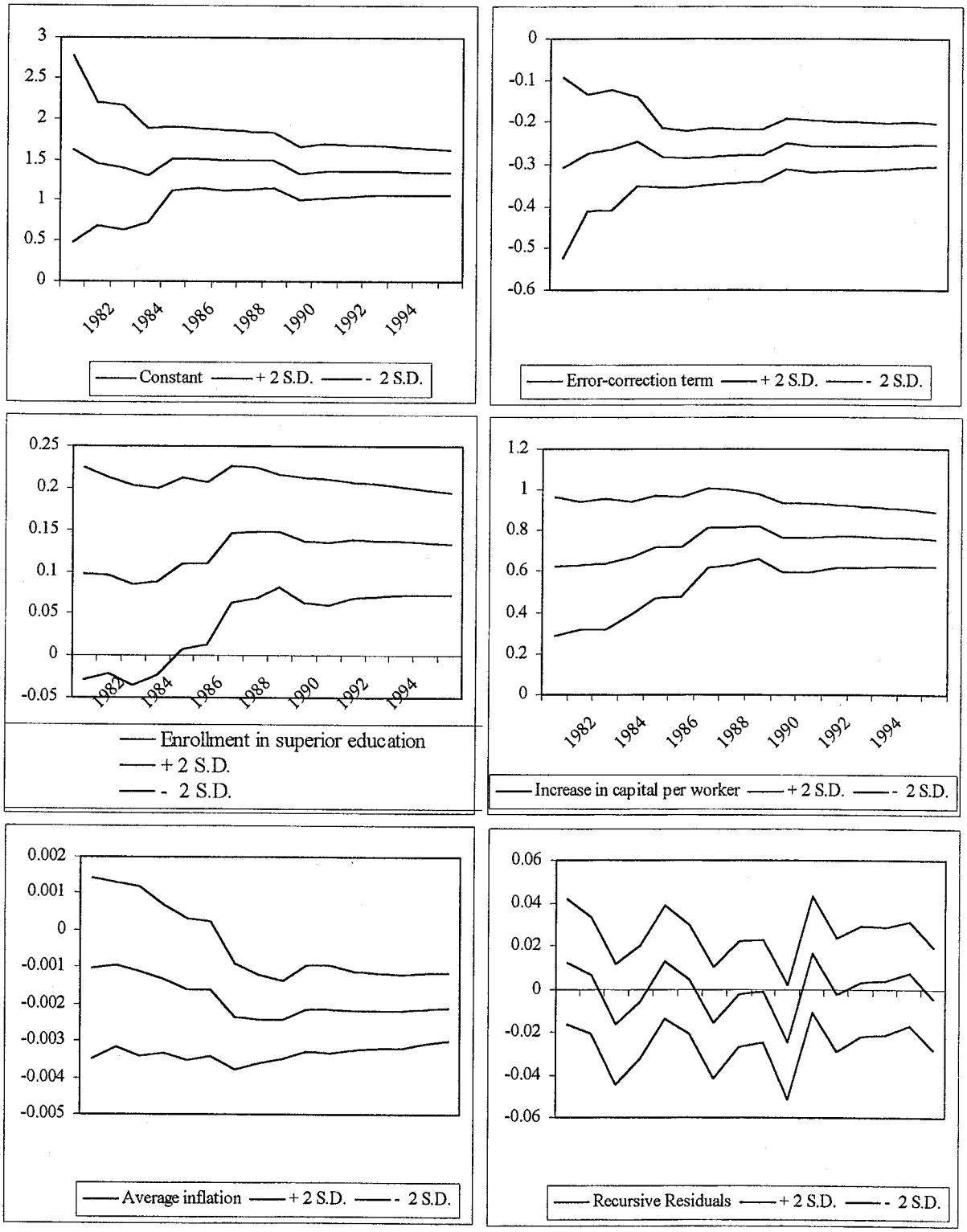
The error-correction model proves useful to identify determinants of growth in El Salvador, differentiating long-run factors from cyclical effects. The results are more remarkable considering the simplicity of the assumptions to infer capital and labor in the context of all sorts of distortions caused by the war.

The robustness of the impact of education on long-run growth and inflation on short-run fluctuations are the main reason for confidence in the overall results. A specification less restrictive than a Cobb-Douglass production function, which in this exercise imposes constant returns to scale for both the long run and the short run, together with improvements in the data like the addition of a quality factor to the measurement of labor and capital, may allow a higher degree of precision in the determination of the technical coefficients.

The strength of competitiveness as measured by the real effective exchange rate in the explanation of long-run growth, even after excluding undesired correlations to some extent by adding a trend, comes as a surprise and merits further exploration. The impact of integration with neighbor countries seems to have an impact, specially because a preliminary exercise on cointegration shows its significance together with education, competitiveness and inputs. In this respect, it is regrettable that this variable could not be included in the final formulation of the error-correction model.

In general, it appears reasonable to expect growth rates of about 5 percent per year for the medium term, if the current deficit of capital is reversed in the next years. Contribution of total factor productivity, although modest, would be finally positive after a prolonged period of uncertainty. Based on the obtained coefficients, long-run growth would converge to between 2 and 3 percent once the capital stock reaches acceptable levels. Nevertheless, if the required capitalization takes place, contribution of total factor productivity may be enhanced to sustain rates of growth further above population growth.

Figure 6: Recursive Coefficients and Recursive Residuals (Error-Correction model)



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