The Effects of External and Internal Shocks on Total Factor Productivity*

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Abstract

This paper examines structural changes that occur in the total factor productivity (TFP) within countries. It is possible that some episodes of high economic growth or economic decline are associated with permanent productivity shocks; therefore, this research has two objectives. The first one is to estimate the structural changes present in TFP for a sample of 77 countries between 1950(60) and 2000. The second one is to identify possible explanations for breaks. Two sources were analyzed: (i) episodes in political and economic history; (ii) changes in international trade - a measure of absorption of technology. The results suggest that about one-third of the TFP time-series present at least one structural break. Downwards breaks are more common, indicating that after a break the TFP has much difficulty to recover. When we investigated factors related with structural change, developed countries presented a break near the first oil shock while the developing countries' breaks are more spread along the decades. Thus, external strikes seem to be more relevant for developed countries. However, for each country and break date, it was possible to find an event close to the break date endogenously detected. Last, the relevance of international trade, measured by trade share percentage of GDP, seems to be limited to explain abrupt changes in TFP.

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1 Introduction

One of the main characteristics of modern economies is the large differences in per capita income among countries. Explaining these differences and their evolution over time is an extremely important issue. Economists have recognized that total factor productivity (TFP) acts as a determinant factor in the growth process. Hall and Jones (1999), Parente and Prescott (1999), Prescott (1998), Klenow and Rodriguez-Claire (1997), among others, show that there is strong evidence that TFP is considerably responsible for the differences in per capita income across countries.

A substantial part of the disparities in output levels can be partially explained by physical capital and education, but the largest part of these differences are explained by the Solow residual, that is, the TFP. In Hall and Jones (1999), for instance, the difference in capital accumulation, productivity and consequently in output per worker is the outcome of differences in institutions and governmental policies of the individual countries. The institutions and public policies structure that exist in each country are defined by the authors as the social infrastructure. Thus, this literature points to a strong correlation between output per worker and the social infrastructure indicator, in such a way that countries with public policies that are favorable to productive activities tend to produce more output per worker and to have larger TFP.

Using structural breaks technique, Ben-David and Papell (1998) proposed a test for determining the significance and the timing of slowdowns in economic growth, showing evidence that most industrialized countries experienced postwar growth slowdowns in the early 1970s, and that developing countries, in particular Latin American countries, tended to experience even more severe slowdowns.

More recently, Jones and Olken (2008) estimated structural breaks for income growth rates and employ growth accounting technique to investigate what occurs during various transitions. Their analysis suggests that changes in the rate of factor accumulation explain relatively little about the growth reversals. Instead, the growth reversals are largely due to shifts in the growth rate of productivity, and reallocations across sectors may be an important mechanism through which these productivity changes take place. Accelerations are coincident with major expansions in international trade, and relatively little change in investment, monetary policy or levels of conflict. Decelerations, on the other hand, are related with much sharper changes in investment, increases in monetary instability, and increases in conflict.

Motivated by the large disparity of economic performance in the medium and long term across countries and by the argument that differences in total factor productivity are in fact essential to explain these performance differences, this paper examines structural changes that occur in the TFP within countries. It is possible that some episodes of high economic growth or economic decline are associated with permanent productivity shocks; therefore, this research has two objectives. The first one is to estimate the structural changes present in the TFP for a sample of 77 countries between 1950(60) and 2000. The second one is to identify possible explanations for breaks. Two sources are analyzed. First, following Ben-David and Papell (1998), whenever possible, episodes in the political and economic history are examined. Second, analogously to Jones and Olken (2008), changes in the international trade are investigated, as this could be considered a measure of absorption of technology.[1] Therefore, this paper complements Jones and Olken (2008) and Ben-David and Papell (1998) by providing evidence of the type of shock that may have triggering the strikes in TFP and therefore in economic growth.

TFP is usually estimated as a residual using the index number technique.[2] This residual captures changes in the output that cannot be explained by variations in the quantities of inputs, capital and labor. Intuitively, the residual reflects an upward (or downward) shift in the production function. Many factors can cause this shift, such as technological innovation, organizational and institutional changes, demand fluctuations, changes in the factors composition, external shocks, omitted variables, measurement errors, among others.[3]

From the econometrical standpoint, these permanent shocks are represented by an alteration of the parameters of the model, i.e., a structural break. In order to determine the number of structural breaks and the dates on which they occurred, we follow the methodology of estimation and inference proposed by Bai and Perron (1998, 2003). The estimation method considers multiple structural breaks on unknown dates for a linear regression model. In our case the dependent variable is (log) TFP change while the regressor is a intercept; then, a structural break means a change in TFP growth rate.

From the economical standpoint, structural breaks may be triggered by external shocks such as oil embargos and shocks in the international interest rates; or internal political-institutional changes such as a newly adopted constitution, the beginning or end of a war, return to democracy, etc. As mentioned, abrupt changes in international trade may constitute a relevant shock too. Therefore, we analyzed two sources: (*i*) episodes in the political and economic history, (*ii*) changes in the international trade.

The results suggest that about one-third of the TFP time-series present at least one structural break, and downwards are more common. The majority of the breaks come from Advanced

[1] For a review, see Tybout (200)

[2] Different approaches were proposed by Lagos (2006), Parente and Prescott (1999), and Krusell and Rios-Rull (1996). The first study proposes an aggregative model of TFP considering a frictional labor market where production units are subject to idiosyncratic shocks in which jobs are created and destroyed. Therefore, the level of TFP is explicitly shown to depend on the underlying distribution of shocks as well as on all the characteristics of the labor market as summarized by the job-destruction decision. The last two studies propose a theory to explain how institutional arrangements affect TFP, introducing elements of strategic behavior in dynamic general equilibrium models. These studies ultimately try to explain why societies chose these institutions, in an explicit attempt to endogenize this choice.

[3] See Hulten (2001) for a more detailed discussion.

countries, Latin America and the Caribbean regions, although most of our sample comes from these regios. In any case, this means that structural breaks are not a particular phenomenon of developing countries. When we investigated factors related with structural change, developed countries presented a break near the first oil shock while the developing countries' breaks are more spread across time. Thus, external strikes seem to be more relevant for developed countries. On the other hand, the internal factors potentially related with structural changes may be political, economic or any type of conflict. For each country and break date, it was possible to find a event close to the break date endogenously detected. Finally, the relevance of international trade, measured by trade share percentage of GDP, seems to be limited. in other words, trade share are not able to explain the structural breaks of TFP.

The work is structured as follows. Section 2 presents the methodology used in the construction of the TFP series. Section 3 presents the econometric methodology for estimation and testing. Section 4 presents the results and, finally, Section 5 concludes the paper.

2 Construction of Total Factor Productivity

2.1 Main Assumptions

The TFP time-series for the 77 countries is estimated as residual by using a mincerian production function. The countries are listed, by region, in Table A1 in Appendix. First, we consider the hypothesis used in this calculation.[4]

The Solow neoclassical growth model assumes that there is a technological frontier that grows at a constant rate. This frontier causes the labor productivity to grow continually at this same rate. Therefore, in the long-run equilibrium, not only does labor productivity grow at a constant rate, but also income, capital per worker and output per worker, in order to keep the capital-output relation constant. In this equilibrium where capital, output and worker productivity grow at the same rate, the marginal product of capital, and consequently the market interest rate, remains constant. These characteristics seem to describe the United States during the twentieth century. Therefore, we assume the following:

1) The evolution of the technological frontier is given by the long-run growth rate of output per worker in the U.S.

2) The growth rate represents, *ceteris paribus*, the evolution of labor productivity of the different economies.

3) The production possibilities of the economies can be represented by a first degree homogeneous aggregated production function of capital and labor.

[4] We use the following filters to select the countries: (*i*) at least 40 years of information until 2000, from PWT 6.2, and; (*ii*) educational attainment of the total population aged 25 and over, since 1950(60) until 2000, from Barro and Lee's data set. Only 77 countries satisfied both criteria.

4) The parameters of the production function and the physical depreciation rate of capital are the same for all economies, with the exception of a multiplier term in the production function which is specific to each country, called Total Factor Productivity.

5) The impact of education on labor productivity is well described by the impact of education on wages. Similarly, the impact of capital on output is well described by the market remuneration of capital.

Hypothesis (1) follows from the observation of the U.S. economy growth path. Hypotheses (2) and (3) are intrinsic to the Solow growth model. Note that hypothesis (4) does not imply that the economies are equal. The assumption is that all existing differences across economies, whether they are institutional, natural resources, etc, imply differences in incentives for factor accumulation. Hypothesis (4) implies that economies respond to variations in factors, *ceteris paribus*, in the same way. An evidence of this fact is that capital share of income does not differ very much across economies, despite their different development levels (Gollin, 2002). Finally, hypothesis (5) implies that the impact of production factors accumulation, physical or human capital, on output is given by the private impact. If there are any externality that make the social benefit of these factors accumulation to be greater than the private benefit, this dislocation will be represented as an elevation of TFP. In addition, the variations of TFP also capture unproductive activities (corruption, crime, etc.), institutional changes (barriers to technology adoption, monopoly power, etc.) and organizational changes at the firm level and those that are specific to each economy which increases (or decreases) the productive efficiency. In addition, TFP, *ceteris paribus*, will be high for economies with high factors endowment.

2.2 Production

Suppose that the aggregate production can be represented by the following production function:

$$y_{jt} = A_{jt} f(k_{jt}, H_{jt}\lambda_t), \tag{1}$$

where y_{it} is the output per worker of economy j at time t. A_{jt} is the total factor productivity, k_{jt} is the capital per labor ratio, H_{jt} represents the impact of education on labor productivity and $\lambda_t = (1+g)^t$ represents the impact of the technological frontier evolution on labor productivity.

Taking the neoclassical model of factor accumulation as baseline, we consider that there is a technological frontier that grows at a rate g. In addition, we assume that the U.S. economy presents a path that is close to the balanced growth path of the Solow model. In other words, we assume that all capital accumulation per worker in the American economy from 1950-2000 was caused by increases in labor productivity and, therefore, the capital-labor ratio and the TFP remained constant in this economy. Consequently, in this exercise g will be equal to the annual growth rate of the output per worker in the U.S. economy.

We adopted the Cobb-Douglas (CD) function as a functional form:

$$y = Ak^{\alpha}(H\lambda)^{1-\alpha}, \tag{2}$$

where α is the capital share of income. The CD function implies that the capital-labor substitution elasticity is unitary.[5]

2.3 Education

There is a large amount of literature about returns of human capital accumulation, Ciccone and Peri (2006), Moretti (2004), and Bils and Klenow (2000) investigate the returns of education. Therefore, based on the labor economics literature that investigates the annual returns to education, we assume, according to Bils and Klenow (2000), that:

$$H_{jt} = e^{\phi(h_{it})}, \tag{3}$$

where h_{jt} are the average years of schooling of the economically active population (EAP). The function $\phi(h_{jt})$ is concave, similarly to the results of data for a cross-section of countries (Psacharopoulos, 1994). Bils and Klenow suggest that:

$$\phi(h) = \frac{\theta}{1-\psi}h^{1-\psi}, \tag{4}$$

with $\theta = 0.32$ and $\psi = 0.58$.

2.4 Capital

Another important factor affecting the production function (1) is the capital stock per worker. The capital at time t will be the capital at time $t-1$ depreciated by the physical depreciation rate, added to the investment at time $t-1$, formally written as:

$$K_t = (1-\delta)K_{t-1} + I_{t-1}, \tag{5}$$

where δ is the physical capital depreciation rate, I_{t-1} is the total investment at time $t-1$ and K_t is the aggregated capital stock at time t.

This method requires an initial value to the capital stock, K_0. In order to build K_0 we use the investment of the first years of the sample as a proxy for the investment in previous years. In addition, we assume that the investment grew at a rate given by of technological progress, g, and by population growth, n. Therefore, the total stock of initial capital is given by:

[5] In order to test the robustness of the results we also use a CES production function to calculate the TFP. The calculation is presented in the appendix, and since the results are essentially the same we do not present them.

$$K_0 = \frac{I_0}{g + n + ng + \delta}, \tag{6}$$

which is the sum of an infinite geometric progression (details in the appendix), where I_0 is the total initial investment. Usually, we consider I_0 as the average of investment in the first years. We use the first five observations to construct the ratio:

$$\frac{I_0}{L_{1950}} = \frac{1}{5}\left(\frac{I_{1950}}{L_{1950}} + \frac{I_{1951}}{(1+g)L_{1951}} + \frac{I_{1952}}{(1+g)^2 L_{1952}} + \frac{I_{1953}}{(1+g)^3 L_{1953}} + \frac{I_{1954}}{(1+g)^4 L_{1954}}\right), \tag{7}$$

where L_t is the economically active population. A common criticism is that this procedure overestimates the capital stock, because for some countries, the early 1950s was a period of post-war reconstruction and therefore a period in which investment was unusually high. This is the case for the Western European economies. An error in the capital stock causes the initial value of TFP to be underestimated, producing an overestimation for productivity increases after the 1950s. However, with an annual rate of depreciation at 7%, after the initial years, estimates are no longer sensible to the first value of the capital stock. In this way, even if the calculation of the initial capital stock is inaccurate, the evolution of TFP after the initial years is not affected by this issue.

2.5 Data-sets

We investigate the TFP evolution for a set of 77 countries. We use two databases, the Penn World Table (PWT) 6.2 and the Barro and Lee (2000) data-set, where the basic choice criterion was data availability.

The PWT is a database which contains several economic statistics for a large set of countries during the 1950-2000 period. The data for output and investment and the other national account statistics are estimated controlling for the price variation across economies. That is, the macroeconomic variables are calculated by using an international price index in order to correct systematic variations in the purchasing power across countries.

The data for output is the variable rgdpch#13 from the PWT. The data for economically active population is calculated by dividing the per capita product, rgdpch, by the product per worker, variable rgdpwok#25. For population, we use the POP#3 variable from the PWT. For investment as a share of GPD, we use the variable ki, which corrects for variations in the relative investment price across economies.

The data for average years of schooling for the EAP was obtained from Barro and Lee (2000). This database contains the years of schooling of the EAP from 1950(60) to 2000 in five-year intervals. The data for the missing years was obtained by interpolation. When necessary, to obtain the values for 1950 to 1959, we did a retroactive extrapolation using the growth rate of the data between 1960 and 1965.

2.6 Calibration

In order to obtain the TFP estimation as a residual, we will need to calibrate some of the parameters. To calculate K_0, we still need g and δ, as n is calculated for each country using the PWT population data. The calibration for these parameters is described below.

Following Jones and Olken (2008), the depreciation rate is assumed to be 7%. The choice of depreciation is not an easy task. Indeed, authors differ in their choices of the depreciation rate. Hall and Jones (1999) and Caselli (2005) adopted 6% while Easterly and Levine (2001) used 7%. In addition, Aguiar and Gopinath (2004) used 10%. However, as we are interested in comparing our results with Jones and Olken (2008), we follow their specification.

We adjust a determinist and continuous trend to the output per worker series for the U.S. economy, obtaining g equal to 1.53%. We employ the population growth rate for each country between 1950 and 2000 as a *proxy* for the population growth rate n, used in the calculation of the initial capital according to the methodology developed in subsection 2.4, expression (6). The production function is CD, then the capital share of income is constant and given by α. We use $\alpha = 0.4$.

2.7 TFP Calculation

Finally, we calculate the productivity for each country based on the following equation:

$$A_{jt} = \frac{y_{jt}}{k_{jt}^{\alpha}(H_{jt}\lambda_t)^{1-\alpha}}$$

for the CD production function, where A_{jt} is the total factor productivity of economy j at time t, y_{jt} is the output per worker, k_{jt} is the capital-labor ratio, H_{jt} represents the impact of schooling on labor productivity and $\lambda_t = (1+g)^t$ represents the impact of the technological frontier evolution on labor productivity.

3 Econometric Model

As usual, we assume that TFP of country j at period t is given by $A_{jt} = e^{\gamma t}$, where γ is the growth rate. Then, $\Delta \ln A_{jt} = \gamma$ and we estimated a model allowing structural breaks in the intercept:

$$\Delta \ln A_{jt} = C_{jt} + \varepsilon_{jt} \tag{8}$$

where C_{jt} and ε_{jt} are, respectively, the intercept and the error term of country j in period t. The error term is assumed to be independent and identically distributed with zero mean and variance σ_j^2. Thus, we use a log-linear model to analyze the TFP time-series for all the countries in the sample, and from this model we estimate and test the dates and the number of structural changes present in each series. Breaks have a direct interpretation: it means that TFP growth rate changed.

3.1 Estimation and Inference

The methods used for estimation and testing for the structural breaks in the TFP series were proposed by Bai and Perron (1998, 2003). In this section we describe them briefly. Consider the following regression with m breaks and $m+1$ regimes:

$$y_t = x_t'\beta + z_t'\delta_j + u_t \quad \text{and} \quad (t = T_{j-1}+1, ..., T_j), \tag{9}$$

for $j = 1,...m+1$. In this model, y_t is the dependent variable observed in time t; $x_t(p \times 1)$ and $z_t(q \times 1)$ are the independent variables, β and δ_j $(j = 1, ..., m+1)$ are the vectors of coefficients; u_t is the error term in time t. The indices $(T_1, ..., T_m)$, or the points of breaks, are treated as unknown, as a convention we set $T_0 = 0$ and $T_{m+1} = T$. The purpose is to estimate the unknown regression coefficients together with the break points when T observations on (y_t, x_t, z_t) are available. This is a partial structural change model, since β is not subject to shifts and is effectively estimated using the entire sample.

The multiple linear regression model (9) can be expressed in the following form:

$$Y = X\beta + \bar{Z}\delta + U, \tag{10}$$

where, $Y = (y_1, ..., y_T)'$, $X = (x_1, ..., x_T)'$, $U = (u_1, ..., u_T)'$, $\delta = (\delta_1', \delta_2', ..., \delta_{m+1}')$, and $\bar{Z}$ is the matrix with diagonally partitions Z at the m-partition $(T_1..., T_m)$, that is, $\bar{Z} = diag(Z_1, ..., Z_{m+1})$ with $Z_i = (z_{T_{i-1}+1}, ..., z_{T_i})'$. In general, the number of breaks m can be treat as an unknown variable with true value m^0.

The intuition for the estimation is the following: suppose we know the number of structural breaks *ex ante*, or we have an upper bound for it. In the case of one change, for example, we estimate the parameters β and δ by linear regression for all periods in the sample, with the exception of the first and the last ones. Then, we compute the sum of squared residuals (SSR). Finally, the estimated break point is the one which minimizes the computed sum of squared residuals. In the case with two breaks we estimate the linear regression for β and δ all combinations (or partitions) with two breaks and compute the sum of squared residuals for each estimate. Again, the estimated break points are the ones which minimize the computed sum of squared residuals. The procedure is the same for larger numbers of breaks.

Formally, for each m-partition $(T_1, ..., T_m)$, denoted $\{T_j\}$, the associated least squares estimates of β and δ_j are obtained by minimizing the SSR:

$$(Y - X\beta - \bar{Z}\delta)'(Y - X\beta - \bar{Z}\delta) = \sum_{i=1}^{m+1} \sum_{t=T_{1-1}+1}^{T_i} \left[y_t - x_t' - z_t'\delta_i\right]^2 . \tag{11}$$

Let $\hat{\beta}$ $(\{T_j\})$ and $\hat{\delta}(\{T_j\})$ denote the resulting estimates based on the m-partitions $(T_1, ..., T_m)$. Substituting them in the objective function and denoting the resulting SSR as $S_T(T_1, ..., T_m)$, the estimated break points $(\hat{T}_1, ..., \hat{T}_m)$ are such that

$$(\hat{T}_1, ..., \hat{T}_m) = argmin_{T_1,...,T_m} S_T(T_1, ..., T_m), \tag{12}$$

where the minimization is taken over all partitions $(T_1, ..., T_m)$ such that $T_i - T_{i-1} \geq q$. Finally, the regression parameters estimates are the associated least squares estimates at the estimated m-partition $\left\{\hat{T}_j\right\}$,that is, $\hat{\beta} = \hat{\beta}$ $(\left\{\hat{T}_j\right\})$, and $\hat{\delta} = \hat{\delta}(\left\{\hat{T}_j\right\})$.

Bai and Perron (1998) propose a test for the null hypothesis of l breaks against the alternative that an additional break exists. Test statistic for testing $H_0 : m = l$ versus $H_1 : m = l + 1$ is constructed using the difference between the SSR associated with l breaks and that associated with $l + 1$ breaks. The test amounts to the application of $(l + 1)$ tests of the null hypothesis of no structural breaks versus the alternative hypothesis of a single change. We conclude for the rejection in favor of a model with $(l + 1)$ breaks if the overall minimum value of the SSR (over all segments where an additional break is included) is sufficiently smaller than the SSR from the l break model. The break date thus selected is the one associated with this overall minimum. More precisely, the test is defined by the equation:

$$F_T(l + 1 \mid l) = \left\{ S_T\left(\hat{T}_1, ..., \hat{T}_l\right) - \min_{1\leq i\leq l+1} \inf_{\tau\in\Lambda_{i.\eta}} S_T\left(\hat{T}_1, ..., \hat{T}_{i-1}, \tau, \hat{T}_i, ..., \hat{T}_l\right) \right\} / \hat{\sigma}^2, \tag{13}$$

where $\Lambda_{i,\eta} = \left\{\tau; \hat{T}_{i-1} + (\hat{T}_i - \hat{T}_{i-1})\eta \leq \tau \leq \hat{T}_i - (\hat{T}_i - \hat{T}_{i-1})\eta\right\}$ and $\hat{\sigma}^2$ is a consistent estimator of σ^2 under the null hypothesis.

Intuitively, one can reject the model with l breaks in favor of a model with $(l + 1)$ breaks if the minimum SSR (over all segments including an additional break) is sufficiently lower than the SSR of the model with l breaks. Intuitively, $S_T(\hat{T}_1, ..., \hat{T}_l)$ is the SSR under the null hypothesis, that is, the SSR of the model adjusted with l breaks and the infimum of $S_T\left(\hat{T}_1, ..., \hat{T}_{i-1}, \tau, \hat{T}_i, ..., \hat{T}_l\right)$ is the lowest SSR considering the model with a additional break, if this additional break is capable of reducing the SSR enough then the test statistic $\sup LR_T(l+1 \mid l)$ increases and one can reject the null hypothesis of l structural breaks.

Bai and Perron (1998) also developed a class of tests - double maximum tests -, of no breaks, $m = 0$, against some fixed number of breaks, say $m = k$. They put forward two tests: the $UD\max$ and the $WD\max$.[6] As suggested by Bai and Perron (2003), while these tests found out if there is any break, in affirmative case, the sequential procedure found out the number of breaks.

We use the methods of estimation and test described in this section for estimating and testing the number of structural breaks in the TFP for 77 countries. Our model contains only one regressor: an intercept that can change over time. The main results from Jones and Olken (2008) for GDP were obtained using a size of 10%, a trimming parameter of 10% and the maximum number of breaks equal to 3. Following the recommendation of Bai and Perron (2003, p.15), if serial correlation is allowed, a larger trimming value may be needed. Thus, we adopted 20%. This change has an extra benefit. The eight to ten first observations can not have a break, but these are the years more sensitive to the choice of initial capital stock. Thus, we keep the size equal to 10% and the maximum number of breaks equal to 3, which seems to be reasonable because a fraction of breaks in income growth rate should not be caused by breaks in TFP. In others words, when a break in GDP is caused by a break in labor and/or capital, we should not expected a break in TFP.

4 Results

4.1 Break Dates

Following Bai and Perron's (2003, p.16) recommendations, we used the $UD\max$ and $WD\max$ tests to analyze whether there is at least one break - both tests test no structural breaks against an unknown number of breaks, given an upper bound. When a break is relevant at 10%, the sequential procedure based on $F(l+1|l)$, $l \geq 1$, is employed to determine the number of breaks.[7] The results for all estimations, that is, all the dates and numbers of structural breaks are described in Table A2 in the Appendix.

It was detected 35 structural breaks in 28 countries. Thus, about 1/3 of the countries showed at least one break. The distribution of the countries by the number of the breaks is reported in Table 1. The majority of countries with structural break have just one break (29% of the sample) and only in five countries it was found two breaks, say, Bolivia, Costa Rica, Iran, Nepal, and Pakistan. Guatemala was the only country with 3 breaks. Ben-David and Papell (1998) analyzed the GDP of 74 countries by means of a one break test. Their results suggested that

[6] To save space, we do not detail these tests.

[7] An alternative to select the number of breaks is the use of information criterion. Yao (1988) suggested the use of BIC while Liu et al. (1997) put forward a modified Schwarz criterion (LWZ). However, contrary to the information criteria, the sequential method is able to take into account the effect of serial correlation. Indeed, Perron (1997) showed by means of simulations that BIC and LWZ perform reasonable only when there is not serial correlation. Despite these problems, Table A.2 also reports the results from information criteria. Only in four cases one of the information criteria suggested a break that is not indicated by the sequential procedure.

54 countries present a structural break, around 2/3 of the sample. Jones and Olken (2008) analyzed the GDP growth for 125 countries, employing the Bai and Perron's (1998) test. They concluded that 48 countries have at least one break, approximately, 1/3 of the sample. Thus, our result seems to be in accordance with previous papers.

Table 1 - Countries Distribution by Number of Breaks

Number of Breaks	Zero	One	Two	Three	≥ 1
Number of Countries	49	22	5	1	28
Percentage of Countries	64%	29%	6%	1%	36%

Table 2 reports the distribution of structural breaks by decade and by the sign of the break. As a result from the trimming parameter, the 1950s and 1990s have almost no break. Indeed, the breaks are concentrated in the 1960s and 1970s. Regarding whether the breaks shift the TFP growth rate upwards or downwards, we classify the breaks into two categories, say UP and DOWN. Thus, separating UP breaks from DOWN breaks we see that the former case occurs only in 20% of the cases. In general, the growth rate of the TFP decreases when a structural break occurs. Ben-David and Papell (1998) found a positive break in GDP only in 15% of the cases. Jones and Olken (2008) obtained an up break in 41% of the cases.

Table 2 - Structural Breaks Distribution by Decade

	Structural Breaks by Decade					
	1950s	1960s	1970s	1980s	1990s	Total
Up-Breaks	1	1	1	4	0	7
	(3%)	(3%)	(3%)	(11%)	(0%)	(20%)
Down-Breaks	0	14	12	2	0	28
	(0%)	(40%)	(34%)	(6%)	(0%)	(80%)
Total-Breaks	1	15	13	6	0	35
	(3%)	(43%)	(37%)	(17%)	(0%)	(100%)

Finally, Table 3 reports the distribution of structural breaks by region considering the Advanced countries, East Asia and the Pacific, Latin America and the Caribbean, Middle East and North Africa, South Asia, Sub-Saharan Africa and Transitional Economies.[8] We have 77 countries in our sample. The majority of countries are Advanced countries (22), Latin America and the Caribbean (21) and Sub-Saharan Africa (15).[9] Latin America and the Caribbean region constitutes 27% of the countries, however this region contains 43% of the structural breaks.

[8]Table A1 in the Appendix reports countries' regions.

[9]About the other regions, Middle East and North Africa has 6 countries, South Asia has four, East Asia and the Pacific has eight while there is only one classified as Transitional Economies.

It is worth emphasizing that this phenomenon is not particular for developing countries, as 32% of the structural changes occur in the Advanced countries. Thus, changes in TFP are a phenomenon present in rich and poor countries, but it seems to be more frequent in the poor ones. Sub-Saharan Africa is represented by 15 countries, but only 2 breaks were detected - this result is in line with Jones and Olken (2008). The other regions have fewer countries and any generalization would be premature.

Table 3 - Structural Breaks Distribution by Region

Region	Countries		Countries With Breaks	
	Number	Percentage	Number	Percentage
Advanced countries	22	29%	9	32%
East Asia and the Pacific	8	10%	1	4%
Latin America and the Caribbean	21	27%	12	43%
Middle East and North Africa	6	8%	1	4%
South Asia	4	5%	2	7%
Sub-Saharan Africa	15	19%	2	7%
Transitional Economies	1	1%	1	4%
Total	77	100%	28	100%

4.2 Factors Related with Structural Breaks

This section attempts to shed light on the pattern found in previous section. We first do a qualitative analysis of the break dates, based on historical events that can, potentially, trigger a structural change in TFP. Of course, this analysis cannot be viewed as a causality test. To conduct this analysis we should take into account that Bai and Perron (1998) proved that, for each break k, $\hat{\lambda}_k \xrightarrow{P} \lambda_k^0$, where $\hat{\lambda}_k$ is the estimated of the ratio between the true date break and the sample size, $\lambda_k^0 = T_k^0/T$. However, for the estimated break date, $\hat{T}_k$, this result means that its deviation from the true value is bounded by a constant C that is independent of T with high probability. Thus, we look for external and internal factors close to $\hat{T}_k$, instead of just in the exact date of the break.

Shigehara (1992) found that almost all OECD countries experienced a slowdown in GDP between 1968 and 1975, concluding that the slowdown began around 1973, the year of the first oil embargo. In the biennium 1973-74, the Organization of the Petroleum Exporting Countries (OPEC) promoted a substantial increase in oil prices, which culminates in high inflation across both the developing and developed world. Ben-David and Pappel (1998) did not find a break in GDP of larger economies such as US, Canada and United Kingdom; however, for a large number of other OECD countries most breaks were endogenously chosen between 1970 and 1975, with half in either 1973 or 1974. Jones and Olken (2008) also documented an unusual propensity for down-breaks in the 1970s.

Figure 1 presents a histogram of breaks by decade. The Advanced economies are in the 1960's and 1970's. To be precise, Austria (1972), Belgium (1973), France (1969), Greece (1972), Italy (1969), Japan (1969), Portugal (1972), Sweden (1969) present a break between 1968 and 1975. The exception was Spain with a break in 1962.

Another relevant shock was the second oil shock (1978-79) and the onset of the debt crisis. The debt crisis took place due to both the oil shocks and the US tightening monetary policy that started early 1980. These events caused large current account deficits in developing countries and many Latin American countries had problems in honoring their debts in the international financial market. With the 1982 default in Mexico, capital flow to Latin America was drastically reduced and many countries in the region could not pay back their loans. Indeed, Ben-David and Pappel (1998) argued that the years between 1977 and 1983 were particularly important for Latin America countries.

In our case, the Latin America countries' breaks are more spread over time. Some are near the first oil shock - Brazil (1972), Guatemala (1973) and Peru (1973) - others are close to the second oil shock - Bolivia (1976), Ecuador (1976) and Colombia (1979) -, and some in the 1980s, Mexico (1980), Costa Rica (1981), Guatemala (1984) and Bolivia (1986). Indeed, Mexico and Costa Rica officially announced that they were not able to serve their debt in 1982 and 1981, respectively. Finally, the breaks in Costa Rica (1969), Guatemala (1959) and Nicaragua (1964) cannot be related to these aggregated shocks.

The Caribbean countries have breaks in the beginning of 1960s, Dominican Republic (1963), Jamaica (1963) and Trinidad & Tobago (1960). The African countries' breaks are located in the same decade, Togo (1968) and South Africa (1964). The Asian countries have not a concentration: Iran (1972, 1987), Nepal (1969, 1979), Pakistan (1968, 1987) and Philippines (1962).

[Insert Figure 1 - Structural Breaks by Decades]

Therefore, even taking into account that the above is a qualitative analysis, it is difficult to reject the idea that a common external shock may be relevant for some countries. Indeed, 46% of the break dates are located in the period 1972-1985. Of course, as internal shocks may happen in different countries in the same period, this number should be viewed as an upper bound for the effect of oil shocks and debt crisis.

The internal factors potentially related with structural changes may be political, economic or any type of conflict. Political factors include changes in government regimes or constitution, political independence and redemocratization while economic factors mean changes such as entering a trade block. A conflict may be a war or a revolution. Of course, as opposed to external shocks that affect various countries in a systematic fashion, the breaks associated with internal dynamics should not present strong regularities across countries.[10]

Table A3 in the Appendix reports internal shocks for each country for the years around the break date endogenously detected. Beginning with political factors, constitutional reforms seems to be important for Belgium, Colombia and Costa Rica, while an election has occurred near to a structural break in cases of Austria and Pakistan. For instance, in 1969 a constitutional amendment was approved in Costa Rica, limiting the presidents and delegates to one term. In Austria, in 1971 the elections of Socialists received an absolute majority of 93 seats and, therefore, were able to govern alone. Other types of political events are independence and coup d'etat. Jamaica gained independence in 1962, one year before the date of its structural break. We identify a coup d'etat in Dominican Republic, Ecuador, Greece and Guatemala.

Economic factors seem to be relevant too. Bolivia, Brazil and Greece present a break near to the ending of an 'economic miracle'. As mentioned, Mexico and Costa Rica officially announced that they were not able to serve their debt in 1982 and 1981, close to the years of the estimated breaks. Some countries experimented changes in international trade institutions, like Nicaragua, that joined the Central American Common Market, or Portugal that signed a free-trade agreement with the European Economic Community. On the other hand, Spain had a reduction of international trade near to the break date. Macroeconomic instability seems to be the case for Bolivia, Japan and Romania, while an Economic Reform seems to be the case for Peru, Philippines and Trinidad & Tobago. Last, a conflict was found for Guatemala, Iran, Italy, Nepal, Pakistan, South Africa and Togo.

Of course, some of these factors are inherently related. Some elections are followed by economic reforms. For instance, in Austria 1971 when the Socialists won the elections, they introduced social and labor reforms. Thus, a political event was followed by an economic event. Sometimes a conflict might cause economic and political changes. For instance, the Mexico-Guatemala conflict (December, 1958) caused a temporary termination of diplomatic relations and trade between Mexico and Guatemala. Therefore, calculating the frequency of political, economic and conflict shocks is not an easy task. However, for each break we classify the possible explanation in three types: Political, Economic and/or Conflict (see Table A3). Table 4 summarizes the findings. From 35 estimated breaks, 14 are associated with a political factor (40%), 19 are related to economic factors (54.3%) and 7 are linked with conflicts (20%). Obviously, the percentage sums more than 100%, because some shocks are related to more than one factor. Thus, each percentage should be viewed as an upper bound.

[10]It is very difficult to forecast how political factors affects TFP. At a first glance, if a country adopts a new constitution the impact on productivity should be positive. However, the institutional rearrangement and social conflicts could lead to a decline in productivity (Rodrik, 1999).

Table 4 - Internal Shocks by Type

Type	Number of Cases	Percentage of Cases
Political	14	40,0%
Economic	19	54,3%
Conflict	7	20,0%

Jones and Olken (2008) found that share of GDP traded rises substantially with up-breaks in economic growth; in contrast, growth collapses are not associated to systematic changes in trade share. Thus, trade share seems to be an important cause of accelerations. However, the evidence from our estimations shows a different picture. Table 4 suggests that political and conflict factors together are at least as relevant as economic factors. Hence, it is implausible that a single economic factor (trade) has a large explanatory power.

Thus, we also investigate whether the expansions in international trade (exports plus imports) have a pattern similar to TFP. Jones and Olken (2008) estimated the dates of breaks for GDP and used the same dates to analyze the behavior of the trade shares as percentage of GDP. They compare trade shares before and after some date to investigate the existence of a structural break. The analysis was done jointly for all countries using the average change of the trade share. However, to have a flavor of causality test, we should not impose in trade shares the same break date of the GDP growth. For instance, if we find that they have a break close to each other, but trade share has additional breaks, the idea of absorption of technology by trade is weakened.

Hence, using the trade share (% of GDP) we apply the Bai and Perron's (1998) procedure to our sample of 28 countries. We found that Austria, Belgium, France, Greece, Italy, Japan, Spain and Sweden reach the limit of 3 breaks. Analyzing these series the reason behind the results becomes obvious. The Advanced countries present an upward trend in trade shares, thus the Bai and Perron's (1998) overestimate the number of breaks in order to approximate an omitted time trend by a broken intercept. Since Jones and Olken (2008) investigated breaks in trade share for all countries jointly, it is not surprising that they concluded that accelerations are coincident with major expansions in international trade. Therefore, this asymmetric relation found by Jones and Olken (2008) may be artificial.

To avoid this problem, we test for structural break using the following model:

$$\Delta \ln TS_{jt} = C_{jt} + \varepsilon_{jt}$$

where TS_{jt}, C_{jt} and ε_{jt} are, respectively, the trade share of GDP, the intercept and the error term of country j in period t. Thus, we investigate if the growth rate of the trade share is stable or not. Table 5 reports the results. From 28 countries, only 7 present at least one structural break in trade share growth rate. In addition, in the majority of cases, the dates of breaks are far from the dates of TFP growth rate breaks. If we look for breaks near to each other and with the same signal we find: (*i*) Ecuador with a decrease in trade share growth in 1975 followed by a reduction of TFP growth in 1976; (*ii*) Guatemala with a decrease (increase) in trade share growth close to a decrease (increase) in TFP growth in 70s (80s). Thus, at least in the way we measure international trade, the potential for this factor to explain structural break in TFP is strongly limited.

Table 5 - Results from Structural Break Tests

Break Dates	$\Delta \ln TS_{jt}$		$\Delta \ln TFP_{jt}$		
Country	First	Second	First	Second	Third
Brazil	1966 U		1972 D		
Ecuador	1975 D	1984 D	1976 D		
France	1960 U		1969 D		
Guatemala	1977 D	1987 U	1959 U	1973 D	1984 U
Japan	1975 D		1969 D		
Mexico	1987 U		1980 D		
Romania	1992 U		1977 D		

Note: D (U) means a down (up) break.

There is a large literature relating international trade and economic growth or productivity gains. Frankel and Romer (1999) find evidence that a 25% expansion in the trade share would imply a 50-75% expansion in per-capita income. Madsen's (2007) results highlights the importance of international trade for TFP evolution. Micro-studies suggest trade intensity leads to productivity gains through intra-firm or intra-plant improvements in productivity (Pavcnik, 2002; Fernandes, 2003) and inter-firm reallocations within tradable industries (Bernard and Jensen, 1999; Aw et al, 2000). Indeed, analyzing Colombian reforms in the 1990s, Eslava et al (2004) results point out that the increase in aggregate productivity post-reform is completely accounted for by the improved allocation of activity. Analyses across industries also find a positive relation between trade and TFP (Bonelli, 1992). Our results are not against these previous papers. We are not arguing that international trade are not related to productivity. We just find evidence that structural breaks on TFP are not coincident with structural breaks in international trade.

Finally, we would like to explain what are the drivers of changes in TFP change. During the period analyzed, many countries experienced a political change and in some this change seems to trigger a new path for TFP while in others not. In 1977 Romania had a financial crisis and a break occurred in the same year on its TFP; however, other countries in our sample had similar problems and a break in TFP was not identified. Thus, our work does not identify sufficient conditions to change the TFP path. Of course, as TFP is the component of product not explained by capital and labor, including everything else, we should expect a great difficulty to explain why it exhibits structural changes.

5 Final Considerations

The purpose of this work is to present estimates for structural breaks in TFP within countries, and to identify, whenever possible, episodes in the history of these countries that may explain the structural breaks in question. The results suggest that about one-third of the TFP time-series present at least one structural break. Downwards breaks are more common than upwards breaks. Also, the breaks are spread among developed and developing countries.

When we analyzed factors related with structural change, developed countries presented breaks near the first oil shock while the developing countries' breaks are more spread over the time. Thus, external strikes seem to be more relevant for developed countries. On the other hand, we investigated internal factors potentially related with structural changes. We considered political and economic events, besides any type of conflict. For each country and break date, it was possible to find one such event close to the estimated break date.

Finally, the relevance of international trade, was analyzed, showing limited relevance to explain TFP's structural breaks (at least when measured as the ratio of volume of trade to GDP). This result is in sharp contrast to Jones and Olken (2008). However, it is important to mention that we take into account the existence of a linear trend in trade share of developed countries. Of course, we are not arguing that international trade has no impact on productivity, but that the former is not able to explain structural changes in the latter.

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7 Appendix

7.1 Constant elasticity substitution

In order to test the robusteness of the results we also employ a second production function, the constant elasticity substitution (CES):

$$y = A\left[(1-\alpha)(H\lambda)^{\frac{\sigma-1}{\sigma}} + \alpha k^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma-1}{\sigma}}, \tag{14}$$

where α is the distributive parameter of the CES and σ is the capital-labor substitution elasticity. In the CES, the share of capital in income is variable and is given by:

$$\alpha_K = \frac{k}{H\lambda}\frac{f'\left(\frac{k}{H\lambda}\right)}{f\left(\frac{k}{H\lambda}\right)} = \frac{\alpha}{\alpha + (1-\alpha)\left(\frac{H\lambda}{k}\right)^{\frac{\sigma-1}{\sigma}}}. \tag{15}$$

Another important statistic is the capital remuneration rate, gross of depreciation and taxes. The marginal product of capital is given by:

$$\alpha_{K,C} A \left(\frac{H\lambda}{k}\right)^{1-\alpha_{K,C}}, \tag{16}$$

if it is a Cobb-Douglas function, and by:

$$\alpha A \left[(1-\alpha)\left(\frac{H\lambda}{k}\right)^{\frac{\sigma-1}{\sigma}} + \alpha\right]^{\frac{\sigma-1}{\sigma}}, \tag{17}$$

if it is a CES function.

In the case of a CES production function, the capital share of income is variable and is given by:

$$\alpha_K = \frac{k}{H\lambda}\frac{f'\left(\frac{k}{H\lambda}\right)}{f\left(\frac{k}{H\lambda}\right)} = \frac{\alpha}{\alpha + (1-\alpha)\left(\frac{H\lambda}{k}\right)^{\frac{\sigma-1}{\sigma}}}. \tag{18}$$

We use $\alpha_K = 0.39$, which is in accordance with the observation of the American economy and it is close to the numbers obtained by Gollin (2002) for other economies, therefore:

$$\alpha_K = 0.39 \text{ and } \alpha = 0.958.$$

7.1.1 Capital-Labor Substitution Elasticity

The Solow growth model assumes that the society saves a constant fraction of the output. Therefore, there is no capital accumulation theory. A natural extension of the Solow model is the Cass-Koopmas version of the neoclassical model, in which families have infinite lifespans and make intertemporal decisions about consumption and savings in order to maximize consumption over time. In order to calibrate the substitution elasticity, we use the fact that it is the price elasticity of the long-run demand for capital. This long-run demand produces the following equation:

$$\mathrm{i} \equiv \frac{i}{g} = \frac{\delta + g}{A}\left[\frac{p(R+\delta)}{A\alpha}\right]^{-\sigma}, \tag{19}$$

where i is the output-investment relation, p is the relative capital (acquisition) price in consumption goods units and R is the capital lending price.

From equation (19) we can write for economy j:

$$\ln \mathrm{i} = \ln FE_j - \sigma \ln p_j, \tag{20}$$

where

$$\ln FE_j \equiv \ln \left[(\delta + g) \left(\frac{\alpha}{R_j + \delta} \right)^{\sigma} \right] - (1 - \sigma) \ln A_j,$$

which can be estimated by a fixed-effects dynamic panel technique. Pessoa et al (2003) estimated the price elasticity of the long-run demand for capital and found a value of 0.7. Therefore, in this research, we will use $\sigma = 0.7$. Note that lnFE acts only as a dummy variable, so it is not necessary, at first, to obtain data for A. We calculate the TFP in the CES production function case as,

$$A_{jt} = \frac{y_{jt}}{\left[(1-\alpha)(H_{jt}\lambda_t)^{\frac{\sigma-1}{\sigma}} + \alpha k_{jt}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma-1}{\sigma}}}.$$

7.2 K_0

Starting from the capital law of motion:

$$K_0 = (1-\delta)K_{-1} + I_{-1},$$

Substituting recursively

$$K_0 = (1-\delta)^T K_{-T} + \sum_{j=1}^{T} (1-\delta)^{j-1} I_{-j}$$

Assuming,

$$I_{-j} = I_0 (1+g)^{-j} (1+n)^{-j},$$

then

$$K_0 = (1-\delta)^T K_{-T} + \frac{I_0}{(1+g)(1+n)} \sum_{j=0}^{T-1} \left[\frac{1-\delta}{(1+g)(1+n)} \right]^j$$

Notice that $(1-\delta) < (1+g)(1+n)$, and taking the limit of the last equation:

$$K_0 = \frac{I_0}{(1+g)(1+n)} \frac{1}{1 - \frac{1-\delta}{(1+g)(1+n)}}$$

$$K_0 = \frac{I_0}{g+n+ng+\delta}$$

7.3 Tables

Table A1 - Countries by Region

Advanced Countries (22)					
Australia	Austria	Belgium	Canada	Denmark	Finland
France	Greece	Iceland	Ireland	Italy	Japan
Netherlands	New Zealand	Norway	Portugal	Spain	Sweden
Switzerland	Turkey	United Kingdom	United States		
East Asia and the Pacific (8)					
Hong Kong	Indonesia	Korea, Republic of	Malaysia	Philippines	Singapore
Taiwan	Thailand				
Latin America and the Carribean (21)					
Argentina	Barbados	Bolivia	Brazil	Chile	Colombia
Costa Rica	Dominican Republic	Ecuador	El Salvador	Guatemala	Honduras
Jamaica	Mexico	Nicaragua	Panama	Paraguay	Peru
Trinidad & Tobago	Uruguay	Venezuela			
Middle East and North Africa (6)					
Algeria	Iran	Israel	Jordan	Syria	Tunisia
South Asia (4)					
India	Nepal	Pakistan	Sri Lanka		
Sub-Saharan Africa (15)					
Cameroon	Ghana	Kenya	Lesotho	Malawi	Mali
Mauritius	Mozambique	Niger	Senegal	South Africa	Togo
Uganda	Zambia	Zimbabwe			
Transitional Economies (1)					
Romania					

Table A2 - Complete Results (Part I)

Country	Exist Break		Breaks	Dates			Inf. Criterion	
	Udmax	Wdmax		First	Second	Third	BIC	LWZ
Algeria			0				0	0
Argentina			0				0	0
Australia			0				0	0
Austria	Yes*	Yes*	1	1972 D			1	1
Barbados			0				0	0
Belgium	Yes**	Yes**	1	1973 D			1	0
Bolivia		Yes**	2	1976 D	1986 U		0	0
Brazil	Yes*	Yes*	1	1972 D			1	1
Cameroon			0				0	0
Canada			0				0	0
Chile			0				0	0
Colombia	Yes*	Yes*	1	1979 D			1	1
Costa Rica	Yes*	Yes*	2	1969 D	1981 U		1	0
Denmark			0				0	0
Dominican Rep.		Yes**	1	1963 D			0	0
Ecuador	Yes*	Yes*	1	1976 D			1	0
El Salvador			0				2	0
Finland			0				0	0
France	Yes*	Yes*	1	1969 D			1	1
Ghana			0				0	0
Greece	Yes*	Yes*	1	1972 D			1	0
Guatemala	Yes*	Yes*	3	1959 U	1973 D	1984 U	3	0
Honduras			0				0	0
Hong Kong			0				1	0
Iceland			0				0	0
India			0				0	0
Indonesia			0				0	0

Note: * (**) means significative at 5% (10%). D (U) means a down (up) break.

Table A2 - Complete Results (Part II)

Country	Exist Break		Breaks		Dates		Inf. Criterion	
	Udmax	Wdmax		First	Second	Third	BIC	LWZ
Iran	Yes*	Yes*	2	1972 D	1987 U		2	0
Ireland			0				1	0
Israel			0				0	0
Italy	Yes*	Yes*	1	1969 D			1	1
Jamaica	Yes*	Yes*	1	1963 D			1	1
Japan	Yes*	Yes*	1	1969 D			1	1
Jordan			0				0	0
Kenya			0				0	0
Korea, Rep. of			0				0	0
Lesotho			0				0	0
Malawi			0				0	0
Malaysia			0				0	0
Mali			0				0	0
Mauritius			0				1	0
Mexico	Yes**		1	1980 D			1	0
Mozambique			0				0	0
Nepal	Yes**	Yes**	2	1969 D	1979 U		2	0
Netherlands			0				0	0
New Zealand			0				0	0
Nicaragua	Yes*	Yes**	1	1964 D			1	0
Niger			0				0	0
Norway			0				0	0
Pakistan	Yes*	Yes*	2	1968 U	1987 D		1	1
Panama			0				0	0
Paraguay			0				0	0
Peru	Yes**		1	1973 D			1	0
Philippines	Yes**	Yes**	1	1962 D			0	0

Note: * (**) means significative at 5% (10%). D (U) means a down (up) break.

Table A2 - Complete Results (Part III)

Country	Exist Break		Breaks	Dates			Inf. Criterion	
	Udmax	Wdmax		First	Second	Third	BIC	LWZ
Portugal	Yes*	Yes*	1	1972 D			1	1
Romania	Yes*	Yes*	1	1977 D			2	2
Senegal			0				0	0
Singapore			0				0	0
South Africa	Yes*	Yes*	1	1964 D			1	1
Spain	Yes**	Yes*	1	1962 D			1	1
Sri lanka			0				0	0
Sweden	Yes*	Yes*	1	1969 D			1	0
Switzerland			0				0	0
Syria			0				0	0
Taiwan			0				0	0
Thailand			0				0	0
Togo	Yes*	Yes*	1	1968 D			2	0
Trinidad & Tobago	Yes*	Yes*	1	1960 D			2	0
Tunisia			0				0	0
Turkey			0				0	0
Uganda			0				0	0
United Kingdom			0				0	0
United States			0				0	0
Uruguay			0				0	0
Venezuela			0				0	0
Zambia			0				0	0
Zimbabwe			0				0	0

Note: * (**) means significative at 5% (10%). D (U) means a down (up) break.

Table A3 - Internal Shocks (Part I)

Country	Date	Possible Explanation	Type
Austria	1972	In 1971 the elections of Socialists received an absolute majority of 93 seats and were able to govern alone. Many social and labor reforms were introduced.	Political and Economic
Belgium	1973	Constitutional reforms; since around 1970, the significant national Belgian political parties have split to represent the political and linguistic interests of different communities	Political
Bolivia	1976	From 1971 to 1976 occured the Bolivian 'economic miracle'. After 1976 economic performance deteriorated and Banzer's government crisis took place in 1978.	Economic
Bolivia	1986	Since 1985, Bolivia has implemented a program of macroeconomic stabilization and structural reform, once there was 4000 percent inflation in the first seven months of 1985. In 1986, the president calls state of siege.	Economic
Brazil	1972	From 1969 to 1973 occured the Brazilian 'economic miracle'.	Economic
Colombia	1979	Constitutional Reform (1979)	Political
Costa Rica	1969	A constitutional amendment approved in 1969 limited presidents and delegates to one term	Political
Costa Rica	1981	In 1981 Costa Rica officially announced that it was not able to pay its debts.	Economic
Dominican Republic	1963	A democratically elected government under Juan Bosch took office in february (1963), but was overthrown in September.	Political
Ecuador	1976	The new president exiled José María Velasco to Argentina remaining in power until 1976, when he was removed by another military government	Political
France	1969	France had colonial possessions, since the beginning of the 17th century until the 1960s.	Economic
Greece	1972	A coup d'etat ocurred in 1967 and in 1973 ocurred a counter-coup. In 1974, as Turkey invaded the island of Cyprus, the regime collapsed.From 1950 to 1973, ocurred the Greek 'economic miracle'.	Political and Economic

Table A3 - Internal Shocks (Part II)

Country	Date	Possible Explanation	Type
Guatemala	1959	The Mexico-Guatemala conflict (December, 1958), caused a temporary termination of their diplomatic relations and trade.	Political, Economic and Conflict
Guatemala	1973	After years of armed conflict in Guatemala, 1973 opened a period of mass organizing around social and economic issues. However, in Guatemala City the cost of basic goods increased and salaries lost much of their purchasing power.	Conflict and Economic
Guatemala	1984	Military Coup (1981). In 1982, the four Guerrilla groups - EGP, ORPA, FAR and PGT - merged and formed the URNG.	Political
Iran	1972	The Fourth Development Plan (1968-73) accelerated economic growth and integrated sectoral and regional concerns into a national development program.	Economic
Iran	1987	Given the war, by late 1987, ocurred shortage of many goods high unemployment and a greater dependence than ever on oil and gas exports.	Conflict
Italy	1969	In 1969 ocurred expressive social protests and the Piazza Fontana bombing marked the beginning of a violent period.	Conflict
Jamaica	1963	In 1962 Jamaica gained independence	Political
Japan	1969	Japan was experiencing a period of rapid growth, however inflationary pressure emergedand balance of current account turned into a pattern of chronic surplus.	Economic
Mexico	1980	The government spent heavily on energy, transportation, and basic industries, partially financed by higher foreign borrowing, which increase vulnerability to external shocks.	Economic
Nepal	1969	Nepal canceled an arms agreement with India and ordered the Indians to withdraw their military mission from Katmandu and their listening posts from the Tibet-Nepal frontier.	Economic
Nepal	1979	Due to 1979 student protests, the monarchy concede to holding a referendum on the possibility of a multiparty system in the country	Political

Table A3 - Internal Shocks (Part III)

Country	Date	Possible Explanation	Type
Nicaragua	1964	In 1960 Nicaragua joined El Salvador, Guatemala and Honduras in the establishment of the Central American Common Market. In 1963 René Schick Gutiérrez won the presidential election.	Political and Economic
Pakistan	1968	In 1965 occurred the Second Kashmir War with India	Conflict
Pakistan	1987	1985 general elections.	Political
Peru	1973	Government radical reforms from 1968-1975, included agrarian reform and expropriation of foreign companies, culminating into a large state-owned sector.	Economic
Philippines	1962	In 1962 the government devalued the peso and abolished import controls and exchange licensing.	Economic
Portugal	1972	Portugal signed a free-trade agreement with the European Economic Community	Economic
Romania	1977	In 1977 occurred a financial crisis.	Economic
South Africa	1964	From 1964, the US and Britain discontinued their arms trade with South Africa. Also, Nelson Mandela was sentenced to life imprisonment and black protests against apartheid grew stronger and more violent.	Conflict
Spain	1962	A boom in the decade from 1962 to 1972, when the industrialization was based on the existence of a cowed labor force, a massive government protection against competition from imports and many industries belonged to the public sector.	Economic
Sweden	1969	Olof Palme, leader of the Swedish Social Democratic Party, became prime minister	Political
Togo	1968	Civil unrest (1971)	Conflict
Trinidad & Tobago	1960	In 1958 the government issued the first in a series of five-year plans. To attend the demand, the water, electricity, communication, and transportation systems were expanded. The establishment of the Industrial Development Corporation in 1959 served to expand the sector's role in the economy.	Economic