How Robust Is the Growth-Openness Relationship to the Inclusion of Standard Control Variables?
A Cross-Country Study over the Period 1970-2000
ما مدى تأثر علاقة الانفتاح والنمو ببعض محددات النمو الأخرى؟
نتائج دراسة ما بين البلدان خلال الفترة 1970-2000

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Abstract: The objective of this work is to investigate the robustness of the relationship between openness and growth to the inclusion of standard control variables. To this end, we use data on a set of countries over the period 1970-2000 to estimate an augmented Solow regression model, in which a measure of openness, due to Sachs and Warner (1995a), along with other variables, found to be robust in growth regressions based on different statistical criteria, are included. Among the indicators used to control the relationship between growth and openness in our regressions, we mention the black market premium, the share of primary goods exports to real GDP, the terms of trade volatility, and governance and institutions. The results obtained show that openness is generally positively linked with growth. The magnitude of the effect of openness on per capita GDP growth, and its statistical significance, depend, however, crucially on the controlling variable(s) being used.

Keywords : Growth, Openness, Cross-Country Studies, Control Variables.
JEL Codes : C21, F43, O57

الملخص

نهدف من خلال هذا البحث إلى معرفة مدى تأثر علاقة الانفتاح والنمو بتثبيت بعض المتغيرات المحددة للنمو. من أجل هذا، نقوم باستخدام بيانات إحصائية، خاصة بمجموعة من البلدان خلال الفترة 1970-2000، لتقدير نموذج مدعم لـ Solow يحتوي على مقياس للانفتاح، يعود لـ Sachs and Warner (1995a)، و متغيرات أخرى، وجد أنها مهمة في تحديد النمو. من بين المتغيرات المستعملة للتحكم في العلاقة ما بين الانفتاح والنمو في انحداراتنا نذكر علاوة السوق السوداء، نسبة صادرات المواد الأولية إلى الناتج الداخلي الخام، تطاير معدلات التبادل، والحاكمية والمؤسسات. تدل النتائج المتوصل إليها على أن العلاقة التي تربط ما بين الانفتاح ومعدل نمو الناتج الداخلي الخام الفردي هي علاقة موجبة ومعنوية إحصائيا، على العموم. لكنها تتأثر بتثبيت المتغيرات الأخرى، إلى درجة أنها تفقد أحيانا دلالتها الإحصائية، كما يظهر من تقدير معلمة مؤشر الانفتاح ومعنويته.

الكلمات المفتاح : نمو، انفتاح، دراسات ما بين البلدان، متغيرات التثبيت.

1. Introduction

There is not a consensus in growth theory regarding the effect of trade restrictions on economic growth. In exogenous growth models, a trade restriction has no effect on the long-run growth rate of output. However, there may be positive or negative growth effects, depending on how the long-run level of output is affected by the trade restriction, during the transition to the steady state. On the other hand, endogenous growth models based on non-diminishing returns to reproducible factors of production or on learning-by-doing presume that lower trade restrictions boost output growth in the world economy as a whole.

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A heated debate concerning the question of whether openness to international trade is beneficial for economic growth has also been going on. Theoretical work on this issue is usually based on the concept of comparative advantage and credits economic liberalization with at least a transitory positive effect on growth. Romer (1990), Grossman and Helpman (1990), and Pritchet (1991) are among those who stress the role of openness to international markets in enhancing growth. On the other hand, controversy is still surrounding the huge empirical work on the link between growth and openness.

While some authors have managed to find a significant positive relationship between growth and openness, others have pointed out various weaknesses affecting this type of empirical work, and thought to be behind the results obtained. Rodriguez and Rodrick (2000), among others, consider the errors made regarding the econometric methodologies employed in the analysis, and the inappropriately measured indicators on openness as two major shortcomings of this empirical work. They argue that these errors are exactly what lies behind the pretended growth-openness nexus

Regarding the issue of methodology, for instance, cross-country studies, carried out in the spirit of Barro (1991), are usually seen to be full of problems; in particular, those related to endogeniety and measurement errors, and the way they are treated. In this respect, Edwards (1998) argues that most of the cross-country studies are plagued by empirical and conceptual shortcomings. He states that simplicity of the theoretical frameworks used, their failure to bring forward the exact mechanism through which export expansion affect income growth, non inclusion of potential growth determinants, and problems related to endogeneity and measurement errors, all led to unconvincing and fragile results.

Case studies, on the other hand, lack statistical rigour and are often exposed to arbitrary case selection. Lack of time series long enough on some explanatory variables in some cases, and absence of regular periodical data on other variables, especially in developing countries, in other cases, are two major difficulties affecting the time series approach.

Despite the shortcomings of the first approach, it has been extensively used to investigate the issue of growth determinants. Following this approach, we use the Sachs Warner (1995a) openness index and other data on a set of countries over the period 1970-00 to investigate the robustness of the relationship between openness and growth to the inclusion of standard controls. The list of these controls includes the black market premium to reflect price distortions, the terms of trade as an indicator of macroeconomic stability, the share of primary exports in gross domestic product (GDP) to gauge reliance on primary goods exports, and governance and institutions. The results we have obtained show that (i) per capita GDP growth is generally positively and significantly linked to openness, indicating that the more open a country is, the faster it grows ; (ii) the effect of openness on per capita GDP growth declines, in magnitude and statistical significance, when we control for macroeconomic stability and institutions.

The rest of this work is organized in the following way. Related empirical literature is presented in section 2. The econometric model being used here to conduct the analysis, his variables, the estimation method, and tests, are introduced in section 3. The results are analyzed in section 4, whereas section 5 concludes.

2. Related Empirical Literature

Early developments in economic theory suggest the existence of a close tie between international trade and productivity. Many years ago, authors such as Romer (1990), Grossman and Helpman (1990), and Pritchet (1991) stressed the role of openness to international markets in enhancing growth. Recently, Warner (2003) reintroduces the idea that import restrictions can depress growth by increasing the cost of capital, and reducing the incentive to invest and grow. On the other hand, Bhagwati and Srinivasan (2002) point out two channels through which trade liberalization can raise growth : (i) greater variety in intermediate inputs ; and (ii) greater returns to investment through the access to a larger

global marketplace. Other channels such as improved technological transfer through international trade and improved incentives to innovate and upgrade in reaction to greater international competition are also stressed.

Empirically, the focus has typically been on the relationship between exports and growth, and to a lesser extent on the link between imports and growth and between total trade and growth. Sachs and Warner (1995a) follow another route in order to measure openness and, therefore, to deal with the growth-openness nexus. They set five criteria which are thought to cover the major types of trade restriction to classify countries into two groups: open countries and closed countries[1]. According to their criteria, a country is judged as one with a closed trade policy if it has at least one of the following characteristics. (i) Nontariff barriers covering 40 percent or more of trade ; (ii) average tariff rates of 40 percent or more ; (iii) a black market exchange rate that is depreciated by 20 percent or more relative to the official exchange rate, on average, during the 1970's or 1980's ; (iv) a socialist economy system ; and (v) a state monopoly on major Exports. An open economy is defined as one in which none of the five conditions applies. The reason for combining these indicators into a single dichotomous variable, according to which a country is either open or closed, is that they represent different ways in which policymakers can close their economy to international trade.

The major findings of Sachs and Warner (1995a) are that open economies, according to their criteria, outperformed closed economies over the period 1970-89 on three main dimensions of economic performance: economic growth, avoidance of extreme macroeconomic crises, and structural change. Furthermore, a close link between economic integration and economic convergence is established in the paper. Poor countries tend to grow faster than rich countries when they are linked to international trade, and integrated in the world economy. In contrast, rich and open economies are found to perform much better than poor and closed economies in the sample they used and over the period of their study.

The same evidence on openness is presented by Sala-i-Martin (1996, 1997) who finds openness to be strongly and robustly correlated with growth. Sachs and Warner (1997a, 1997b). These empirical findings, accord well with the idea that open economies might converge faster than closed economies, given that international mobility of capital and technology can speed up the transition to steady-state income.

In a more recent survey of empirical and theoretical literature, Anderson and Babula (2008) conclude that nearly all the empirical analyses confirm the link between openness and economic growth. Furthermore, Rizavi et al (2010) use a panel data set to investigate the relationship between trade and economic growth in India, Bangladesh, and Pakistan. They find that openness played an important role in shaping the economic growth of South Asia during the period 1980-2008.

Bülent U. (2012) carries out an empirical investigation, based on different measures of openness, to reassess the openness-growth nexus over a comparatively longer period that lasts from 1960 to 2000. He concludes that many of the variables he uses as measures of openness are positively and significantly correlated with long-run economic growth. He argues, however, that this result is sometimes due to the presence of a few outlying countries. He also notes that the openness variables become insignificant when controlling for variables such as institutions, population heterogeneity, geography, and macroeconomic stability.

The need to use detailed country-level case studies instead of cross-country regressions to better understand the link between openness and growth has also been highlighted. Chandra Pradhan N. (2011) follows this way and uses a time series approach to analyze the effect of openness on the Indian economy during the period 1970-09, focusing more on the liberalization period that began in the 1980's. The empirical testing of an export-led growth hypothesis he performs, based on various time series techniques, reveals both short and long-run relationship between export and growth.

The conclusion that openness is positively linked to growth has, however, been challenged in other writings. We mention in particular the article by Rodriguez and Rodrik (2000) who argue that famous empirical studies, such as the one done by Sachs and Warner (1995a) referred to previously, suffered from a number of methodological shortcomings, and that this resulted in the relationship between openness and growth being significant. They further provide specific evidence on the fact that derived results in many studies were ascribed to openness indicators being inappropriately measured, whereas more appropriate indicators failed to deliver such results.

Regarding the inappropriate measurement of openness, Rodriguez and Rodrik (2000) attribute the explanatory power of the Sacks and Warner openness measure, found to be robust in many studies, almost exclusively to the use of the State monopoly of exports and the black market premium variable in the openness index. A closer look at these two variables, however, reveal that they are not proxying trade policy, but rather are bringing in measurement errors that tend to bias the coefficients in favor of finding a growth-openness link.

Later, Baldwin (2003) proceeds in the same direction when examining the controversy that is still surrounding the nature of the relationship between growth and openness. He argues that (i) definitional issues regarding openness; (ii) differences in the quality and details of the data being analyzed; and (iii) differences in the econometric models and tests employed, are the main sources for the disagreement among economists on the relationship linking openness to international trade and growth.

In a reply to this criticism, Warner (2003) shows that the argument in Rodriguez and Rodrick (2000) can simply be misleading. He argues that it ignores crucial evidence because it is based on inferior specifications of empirical models that lack statistical power for testing the impact of trade restrictions on growth and development. He further states that introducing single measures of protectionism on a one by one basis, instead of an aggregate trade policy instrument, in growth regressions will have low statistical power for testing for protectionism in general, even though it may have high power for testing specific forms of protectionism.

Warner (2003) also criticizes the use of the share of imports plus exports to GDP as a measure of openness to international trade. He argues that using such a measure by Rodrick, Subramanian, and Trebbi (2002) can completely miss the point and classify an open country, for instance, as a highly protectionist economy. It is clear that such a measure of openness simply ignores geographic barriers to trade, and restrictions that can be imposed on access to foreign currency, for instance. In the latter case, Warner (2003) notes that blocking access to foreign currency or implementing measures that lead to higher prices for foreign currency can just be as effective as any tariff or quota in restricting trade. Similarly, relying on tariff rates as a sole indicator of trade restrictions, while ignoring the black market premium for instance, can result in classifying a closed economy as a relatively open one.

Rodriguez (2006) pushes the argument a little bit farther when he states that a close reading of the evidence presented in Warner (2003) does not alter the main conclusion in Rodriguez and Rodrik (2000) that standard measures of trade are uncorrelated with growth. According to this argument, a possible interpretation of the results obtained in favor of a link between openness and growth is simply indicative of the pitfalls of the use of cross-country regression analysis. We turn next to the econometric model used in our analysis.

3. The Econometric Model: Specification, Estimation, and Tests

We introduce here the econometric model being used to conduct the analysis of the relationship between openness to international trade and growth, its variables, the estimation technique employed, and the tests performed.

3.1 Specification

When trying to find a specification to use as a baseline for our model, we have to bear in mind that our interest lies in the growth openness nexus. Studies such as the ones by Rodriguez and Rodrick (2000), and Rodriguez (2006) have found the openness-growth relationship to depend crucially on the controlling variables used in the regression equation. The question that, however, remains is one of model uncertainty, that is how to chose among the long list of growth determinants, among which the controls we intend to use? In order to solve this difficulty, we use a specification that is theoretically as well as empirically justified. We start first by giving the specification, and then justify the use of the variables it includes.

In terms of empirical growth studies, the passage from theory to empirics is generally based on the following generic representation of the regression model due to Durlauf et al (2004)

$$\gamma_i = \lambda \log y_i(0) + \psi X_i + \Pi Z_i + \varepsilon_i ,$$

where γ_i is per capita GDP growth, $y_i(0)$ is initial per capita income, X_i contains a constant, an indicator of physical capital, another for human capital, and effective capital depreciation. The variables contained in $\log y_i(0)$ and X_i represent those growth determinants that are suggested by the Solow growth model, whereas Z_i represents those growth determinants that lie outside Solow's original theory.

In general, the above equation represents the baseline for much of what is known as growth econometrics. This type of regression is sometime named after Barro because of the extensive use that he has made of these regressions to study alternative growth determinants, starting with Barro (1991). Many other growth writers have also used it for the same purpose. In modern empirical analyses, the use of this generic representation has been generalized in a number of ways. In particular, it has been extended to deal with growth in time series and panel data settings. Other generalizations of this equation, such as (Barro, 1996)**,** have introduced nonlinearities and parameter heterogeneity. We turn now to the variables we use in our regressions.

3.2 The Solow Variables

The Solow variables we use here are initial per capita real GDP, the investment share, population growth, and human capital. The resulting model is the famous human capital augmented Solow model popularized in Mankiw, Romer, and Mankiw (1992), hereafter MRW (1992). Initial per capita real GDP or income is widely used in cross-country regressions, and is intended to reflect the convergence hypothesis, extensively analyzed in empirical work. The book by Barro and Sala-i-Martin (1995) is one often cited reference in this respect. We use initial per capita real GDP in a log form so that the rate of convergence can be inferred from its coefficient that is expected to be negative[ii].

As for the investment rate, neoclassical growth models predict that it affects the steady state level of output per effective worker but not its rate of growth. It has, however, a growth effect in transitional dynamics, and if the adjustment process to the new steady-state position takes a long time, as seems to be the case empirically, then the effect may last for a long time too. In contrast, in some endogenous growth models, such as those dealing with the influence of R&D on the rate of growth, changes in the rate of investment do affect the long-term growth. This variable is introduced in our equations in a log form, and is expected to have a positive sign.

The inclusion of population growth takes account of the argument that if there were no new investment and no physical depreciation, an increase in the number of workers results in a decline in capital per worker, and therefore in a drop in real output per worker and its rate of growth. This variable is not statistically significant whenever it is used in a regression equation. It is, therefore, excluded from most of our regressions on statistical grounds[iii].

Regarding the addition of human capital, it can be justified through the lines in Romer (1990) who develops a theoretical model in which an increase in total human capital leads to more than a proportional increase in human capital devoted to research and thus in

growth. Furthermore, in models with human capital and physical capital such as that of Lucas (1988), a higher value of human capital, keeping the stock of capital constant, tends to raise the growth rate. On the other hand, in models of technological change which make use of the positive link between human capital and the ability to absorb new technologies, a higher value of human capital raises the responsiveness of the growth rate to reductions in the initial level per capita output[iv]. In our case, the logarithm of secondary school enrollment in 1970 as a measure of human capital.

3.3 The Black Market Premium and the Terms of Trade Volatility

In his paper about the role of macroeconomic factors in growth, Fischer (1993) concludes that a stable macroeconomic framework, which he defines as a macroeconomic policy environment that is conducive to growth, is necessary though not sufficient for sustainable economic growth. He presents cross-sectional evidence which supports the view that growth is negatively associated with inflation and positively associated with good fiscal performance and undistorted foreign markets.

He further argues that the main reason macroeconomic instability matters for growth is through uncertainty which could affect growth in two ways. First, policy-induced macroeconomic uncertainty reduces the efficiency of the price mechanism and can adversely affect productivity and its growth if it is associated with high inflation or instability of the budget or the current account. Second, temporary uncertainty about the macroeconomy tends to reduce the rate of investment, as potential investors wait for the resolution of uncertainty before committing themselves.

Empirically, indicators such as the rate of inflation, the terms of trade and the black market premium have been extensively used to measure macroeconomic stability. The argument for the link between these indicators and economic growth is again given by Fischer (1993). Concerning inflation, he believes that its variability might serve as a more direct indicator of the uncertainty of the macroeconomic environment, and is expected to be negatively associated with growth.

On the other hand, an increase in the black market premium is an indicator of expectations of depreciation of the exchange rate and foreign exchange rationing. This suggests that capital accumulation and the black market premium are likely to be negatively related. Therefore, a negative link between growth and the black market premium can be established through the mechanisms of endogenous growth theory. Sala-i-Martin (1996, 1997), among others, finds the standard deviation of the black market premium to be negatively linked to growth.

Furthermore, Rodriguez and Rodrick (2000), for instance, argue that the black market premium has a dichotomous nature : (i) it can measure the extent of rationing in the market for foreign currency, given that foreign exchange restrictions act as a trade barrier ; (ii) it is also used as an indicator of sustained macroeconomic imbalances. On the other hand, high levels of black market premia can also be associated with higher corruption, a lesser reliable bureaucracy, and lower capacity for the enforcement of the rule of law, which are detrimental to growth in the long run. The results they obtain show that the black market premium is not a good measure of trade policy, because it is also a proxy for macroeconomic and political distress, and institutions. In our case, given that the black market premium is part of the openness index, we introduce it in one equation to see to which extent it affects the openness-growth nexus.

Concerning the terms of trade, Fischer (1993) states that improvements in the average terms of trade may be associated with higher levels of growth. However, empirical evidence, suggests that higher volatility in the terms of trade hampers the long-run growth process. In our case, we use the standard deviation of the terms of trade as a measure of external shocks, and we expect it to be negatively correlated with per capita GDP growth rate.

3.4 Natural Resource Exports

The use of natural resource exports in growth regressions is theoretically as well as empirically justified. Lane and Tornell (1995) show in a formal model that resource-rich economies are more exposed to extreme rent-seeking behavior than resource-poor economies, as national politics is oriented to grabbing the rents earned by the natural resource endowments. Another explanation relies more upon the ideas found in the development literature, and the Dutch Disease models. The argument here is that resource-based growth would be ineffective because the world prices of primary exports relative to manufactures show a deep tendency towards secular decline.
Empirically, Sachs and Warner (1995b) establish a negative relationship between growth and the initial ratio of natural resource exports to GDP. According to this result, economies with a high initial ratio of natural resource exports to GDP tend to have low subsequent growth rates. This relationship holds true even after controlling for other variables found to be important for growth, such as initial per capita income, trade policy, government efficiency, investment rates, and other variables. The findings in Sachs and Warner (1995b) regarding natural resource exports were later borne out in Sala-i-Martin (1996, 1997) who found the fraction of primary products in total exports to be robust. In our case, we use the share of primary exports in GDP in 1970 as a proxy for reliance on primary goods exports. We expect it to have a negative effect on growth.

3.5 Institutional Variables

Institutions and governance have been found to be directly as well as indirectly linked to income levels and growth. Rodrik, Subramanian and Trebbi (2002) establish a direct connection between institutions, governance and growth through transactions costs which can be much higher in an environment in which property rights are not properly protected, and the rule of law is not well enforced. In such an environment, economic agents tend to use inexpensive but less efficient technologies which make them less competitive. They may even resort to the black market economy and rely on bribery and corruption to facilitate their operations, as suggested by Busse et al. (2007), thereby leading to the rise of a rent seeking, informal economy.
An indirect link between governance and income levels and growth can be established through other growth determining factors such as trade, investment, infrastructure, and geography. For trade, for instance, which influences growth and vice versa, a better integration in the world economy can make a country take advantage of technology spillovers and knowledge information. However, as Kohsaka (2007) argues, benefits from lowering trade barriers in terms of growth and income levels can be suboptimal or unattainable in the absence of adequate institutions that practice good governance. Moreover, Anderson and Marcouiller (2002) show that weak institutions may act as significant barriers to trade, increasing trade costs, and thereby hampering growth.
For the purpose of this study and given the period in which we are interested, a recent source on institutions and governance is available to us. It concerns the data set gathered on institutional quality by Kaufmann, Kraay and Mastruzzi (2003). These data are produced for 198 countries on six indicators and concern the years 1996, 1998, 2000, and 2002. The six governance indicators are measured in units ranging from about -2.5 to 2.5, with higher values corresponding to better governance outcomes. We therefore expect these indicators, individually and as a composite index as well, to enter growth regression equations with a positive sign. A very brief description of these six measures is given below.
"Voice and Accountability" and "Political Stability and Absence of Violence" are intended to capture the process by which those in authority are selected and replaced. "Government Effectiveness" and "Regulatory Quality" are supposed to reflect the ability of the government to design and implement sound policies. Finally, the "Rule of Law" and "Control of Corruption" are assumed to summarize the respect of citizens and the state for the institutions which govern their interaction. In our case, all these indicators are used as averages over the four years 1996, 1998, 2000, and 2002[v].

3.2 The Sample, Estimation and Tests

The sample of countries we use in our estimations comprises 107 countries in total[vi], among which 81 are classified as developing countries, 9 belong to the MENA region, and 8 are oil exporting as per the World Bank classification of 2004. In addition, 31 countries are classified as non open according to the criteria set in Sachs and Warner (1995a).

Concerning estimation, we start by assuming away possible endogeneity of regressors[vii]. All that is left to worry about in this case is heteroscedasticity. The specification introduced in earlier is estimated by ordinary least squares (OLS) over the period 1970-00 when the hypothesis of heteroscedasticity is rejected. On the other hand, when the hypothesis of heteroscedasticity is not rejected, we use the White Hetroscedasticity Covariance Matrix Estimator, without going farther into the investigation of the form of the heteroscedasticity. The decision regarding which estimator to use is based on the White statistic, given by (nr^2). The remaining statistics present in our tables, are the usual t statistic associated with each estimated coefficient, the adjusted $\overline{R}^2$ and the overall F statistic.

5. Regression Results for Growth Rates

Table 1 shows the regression results obtained from the estimation of our growth generic equation. As a dependent variable, we use the growth rate of real per capita GDP growth rate $(PCGR)$. The openness variable is indicated by $OP7092$. The variables employed to represent the Solow theory are : the constant ; the logarithm of real per capita GDP in 1970, $(PCGDP70)$; the logarithm of the gross secondary school enrolment in 1970, $LSEC70$; the logarithm of the average investment ratio over the period 1970-00, $LINV7000$; and the average growth rate of total population over the period 1970-00, $GPOP$. Regarding the institutional controls we use here, $GOVERN$ is the simple arithmetic average of the six institutional indicators introduced earlier ; $EFFECT$ is "Government Effectiveness" ; $REQUA$ is "Regulatory Quality" ; and $RLAW$ is the "Rule of Law". For the remaining controls, $SXP70$ represents the share of primary exports in GDP in 1970 ; SDGTT denotes the terms of trade volatility ; and finally LBMP reflect the black market premium[viii].

Eq. 1 shows the results of the estimated augmented Solow growth model. We recall that this model was first estimated by MRW (1992), and the added human capital was found to be positively and significantly correlated with per capita GDP growth. In our case, the White statistic indicates that the hypothesis of homoscedasticity is not rejected, and therefore a simple OLS is applied to this equation. The results show that all major variables included in Eq. 1, except population growth and the constant, are highly significant and enter the estimated equation with the theoretically predicted signs.

We note in particular that the hypothesis of conditional convergence is satisfied as indicated by the negative sign of the estimated coefficient on $LPCGDP70$. The speed of convergence implied by the estimated coefficient on $LPCGDP70$ is consequently around 0.010, which means that the average economy in our sample needs about 66 years to close up half of the distance that separates its initial position from its steady state position. Equivalently, the value of this estimated coefficient implies that doubling initial per capita GDP reduces subsequent growth by 0.62 percentage points $(= \ln(2)\, x0.009x100)$.

The variable openness ($OP7092$) is entered starting from Eq. 2. In this equation, and Eq. 3, no other variables, except the Solow variables, are controlled for. We recall that openness is measured as the fraction of the number of years over which a country is classified as open to the total number of years over the period 1970-92. As we argued earlier, we expect this variable to enter each estimated equation with a positive sign, indicating that the more open to international trade a country is the faster it grows. This prediction is generally confirmed in our estimated equations. We note, however, that the statistical significance of the coefficient on $OP7092$ and its estimated value depend crucially on the variables we control for in the estimated equation[ix].

In Eq. 2, for instance, openness is highly significant and adds much to the explanation of per capita GDP growth differences, as indicated by the rise in the adjusted R^2 which passes to 0.63 from 0.52, in the case of the MRW model in Eq. 1. The inclusion of openness in the estimated equation has also promoted convergence as evidenced by the speed of convergence which stands now at 0.017 meaning that our average country needs now only 40 years to close half the distance that separates its initial position from its steady state position. The estimated coefficient on $OP7092$ implies that a country that is open to international trade during the entire period 1970-00, that is a country for which $OP7092$ is equal to 1, is estimated to grow faster than a country that is completely closed to international trade over the same period, and for which $OP7092$ is zero, by about 2.1 percentage points on annual average.

The main conclusion drawn in Eq. 2 remains practically unchanged when we net out the effect of the share of primary exports in GDP, $SXP70$, as shown by the results in Eqs. 4 and 5. As a matter of fact, this variable is always highly significant, and is therefore retained in most of the estimated equations on statistical grounds[x]. The explanation of this result can be found in the simple correlation between the share of primary exports in GDP and our measure of openness which amounts to -0.27 in our sample. In the worst case, Eq. 4 where population ($GPOP$) is retained, the estimated coefficient on $OP7092$ implies that a completely open country is expected to grow faster than a closed country by 1.9 percentage points on annual average.

The results we have so far analyzed are similar to the ones obtained by Sachs and Warner (1995a) who estimate the net effect from a point increase in openness on annual growth to be around 2.45 percentage points in one of their regression equations. In that regression, they control for a set of growth determinants that includes, among others, primary and secondary school enrolment, the investment ratio, and three measures of political instability. The same authors, Sachs and Warner (1995b), find this effect to be around 1.94 percentage points when they partial out the effect of the terms of trade volatility, bureaucracy, and the share of primary exports in GDP, in addition to the investment ratio, and initial per capita income.

The results indicate, however, a clear change in the partial effect of openness on growth, when we include the terms of trade volatility, the black market premium, and institutional indicators. The estimated coefficient on openness drops down sizably and becomes insignificant at the 5% level in some equations, as in Eq. 9. In this equation, beside the Solow variables, except population growth, we control for the terms of trade volatility ($SDGTT$), the share of primary exports in GDP, $SXP70$, and Government Effectiveness ($EFFECT$), all of which are significant, at least at the 5% level. Furthermore, the estimated coefficient on openness, although positive, indicates that an open country is now expected to grow faster than a closed country by only 0.83 percentage points, as compared to 2.2 percentage points in Eq. 3. Equivalently, a one standard-deviation rise in openness, which is equivalent to 0.4 in our sample, is estimated to increase per capita GDP growth by 0.33 percentage points only in the former case, as compared to 0.88 percentage points in the latter case.

This is a clear indication that the estimated coefficient on openness in our growth regressions, and thereby openness itself, is not that robust to alterations in specifications as claimed by some authors like Warner (2003), for instance. Our explanation of this result is that it arises mainly from high correlation between the openness index and the controls being used here. These are respectively 0.80 between openness and government effectiveness, and -0.63 between openness and the standard deviation of the growth rate of the terms of trade, in our simple. These results are consistent with the findings in Rodriguez and Rodrick (2000) and Rodriguez (2006). In particular, we note that given the high correlations between our measure of openness and macroeconomic stability and institutions, openness can be seen, to some extent, as a proxy for these two variables.

The question that however remains is which of these controls, macroeconomic stability, institutions, or reliance on primary goods exports is most likely to be the principal responsible for the relationship between openness and growth ? We investigate this matter by first regressing the openness index on all the remaining controls used here. For institutions, we use the composite index, *GOVERN*. It is only the latter that happens to be partially significantly correlated with our openness index, indicating that institutions are possibly responsible for a major part of the significant effect of openness on growth in our growth regressions. Second, we run separate regressions in which per capita *GDP* growth is explained by the Solow variables, the openness index, and one control variable at a time. The result is that the drop in the estimated coefficient on openness and in its significance is usually higher when the institutional indicators are employed as compared with the other controls, indicating again that institutions may be behind the effect of openness on Growth[xi].

To summarize our main conclusion, we say that our estimated equations suggest that openness may be seen, to some extent, as a proxy for other correlated policies such as institutional strength, and to a lesser degree overall macroeconomic stability. This result is consistent with at least part of the views we presented earlier. We recall, for instance, that Kohsaka (2007) argues that benefits from lowering trade barriers in terms of growth and income levels can be suboptimal or unattainable in the absence of adequate institutions that practice good governance. Furthermore, Anderson and Marcouiller (2002), express the view that weak institutions may act as significant barriers to trade, as shown by increasing trade costs, and thereby hampering growth.

7. Conclusions

The focus in this work has been on how robust is the openness-growth relationship to the inclusion of standard controls. As we have already mentioned, there is a controversy surrounding this question, especially in empirical literature. Some writers have found this relationship to be robust, while others have pointed methodological and measurement errors as possibly being behind this robustness.

In order to address this question we first run a regression in which we control for the Solow variables only. The results we have obtained from this regression reveal the existence of a positive and significant link between per capita *GDP* growth and the Sachs and Warner (1995a) openness indicator, leading to a promotion of convergence, as compared to the MRW model. We then went on to controlling for institutions, macroeconomic stability and the share of primary goods exports in GDP.

The results show that reliance on primary goods exports does not seem to alter much the relationship between growth and openness. The inclusion of institutions, the black market premium, and the terms of trade volatility lead, however, to clear changes in the partial correlation between openness and growth. The drop in the coefficient on openness, in terms of value and significance, becomes consequently particularly pronounced. The interpretation of these results is that openness to international trade does not seem to be a robust explanatory variable in our growth regressions. This result is consistent with part of the empirical findings regarding this question, while it is not with others.

This work can be improved by the use of panel data to solve the heterogeneity problem that is found to be associated with cross-sectional studies. Sometimes a dynamic panel framework may be needed, and the use of GMM in such a case can contribute to the solution of other problems that may arise in such a framework. Finally, the period of time can be extended to the recent past to see whether the results obtained still apply.

Appendix : Tables, List of Countries, Variables and Data Sources

Table 1 : Regression Results

Vble / Eq.	1	2	3	4	5	6
C	-0.04 (-1.63)	-0.01 (-0.51)	-0.02 (-0.89)	-0.01 (-0.54)	-0.02 (-0.76)	-0.006 (-0.31)
LPCGDP70	-0.0090*** (-3.47)	-0.013*** (-5.34)	-0.13*** (-5.28)	-0.013*** (-5.81)	-0.013*** (-5.85)	-0.012*** (-6.04)
LSEC70	0.0080*** (3.04)	0.0070*** (2.72)	0.0076*** (3.34)	0.0066*** (2.90)	0.0071*** (3.35)	0.0050** (2.31)
LINV7000	0.037**** (6.16)	0.040*** (6.06)	0.034*** (6.00)	0.040*** (6.91)	0.038*** (6.99)	0.039*** (7.71)
GPOP	-0.43* (-1.84)	-0.21 (-0.92)		-0.12 (-0.53)		
SDGTT						-0.074*** (-3.92)
SDLTT						
LBMP						
OP7092		0.021*** (4.61)	0.022*** (5.04)	0.019*** (4.26)	0.020*** (4.72)	0.013*** (3.31)
SXP70				-0.060*** (-4.48)	-0.057*** (-4.57)	-0.053*** (-4.06)
GOVERN						
EFFECT						
RLAW						
REQUA						
N	92	86	86	83	83	81
$\overline{R}^2$	0.52	0.63	0.63	0.70	0.70	0.75
F	25.77 (0.000)	29.85 (0.000)	37.17 (0.000)	33.04 (0.000)	39.97 (0.000)	41.87 (0.000)
nr^2	18.20 (0.20)	16.47 (0.69)	10.74 (0.71)	15.80 (0.96)	13.76 (0.84)	21.99 (0.74)
$\hat{\beta}$	0.010	0.017	0.016	0.017	0.017	0.016
H.T	66.22	40.10	43.06	40.27	41.31	43.66

Table 1 : Regression Results (continued)

Vble / Eq.	7	8	9	10	11	12
C	-0.023 (-1.01)	0.013 (0.55)	0.013 (0.63)	0.009 (0.41)	0.022 (0.99)	0.012 (0.55)
LPCGDP70	-0.012*** (-5.34)	-0.015*** (-7.22)	-0.015*** (-6.76)	-0.014*** (-8.18)	-0.015*** (-7.14)	-0.015*** (-6.52)
LSEC70	0.0080*** (3.72)	0.0060** (2.47)	0.0050** (2.43)	0.0046** (2.46)	0.0045** (2.29)	0.0047** (2.33)
LINV7000	0.036*** (6.47)	0.035*** (6.06)	0.037*** (7.60)	0.038*** (6.91)	0.036*** (7.48)	0.038*** (7.70)
GPOP						
SDGTT		-0.063** (-2.60)	-0.054** (-2.54)	-0.060*** (-2.96)	-0.060*** (-3.02)	-0.058*** (-2.89)
LBMP	-0.012** (-2.30)					
OP7092	0.016*** (3.35)	0.010** (2.49)	0.0083* (1.89)	0.0093** (2.31)	0.0090** (2.21)	0.010** (2.21)
SXP70			-0.053*** (-4.14)	-0.053*** (-5.20)	-0.055*** (-4.43)	-0.054*** (-4.28)
GOVERN						0.0060**

						(2.18)
EFFECT		0.0057* (1.94)	0.0059** (2.51)			
RLAW				0.0061* (1.79)		
REQUA					0.0078*** (3.14)	
N	84	83	80	81	80	81
$\overline{R}^2$	0.66	0.71	0.76	0.76	0.77	0.77
F	32.99 (0.000)	35.09 (0.000)	37.90 (0.000)	38.34 (0.000)	40.08 (0.000)	38.38 (0.000)
nr^2	16.64 (0.67)	42.21 (0.03)	40.69 (0.23)	47.66 (0.075)	35.28 (0.45)	40.64 (0.24)
$\hat{\beta}$	0.016	0.020	0.020	0.019	0.020	0.019
H.T	43.53	34.63	34.92	37.30	33.47	35.44

Notes :

Variables are described below.
Annual per capita *GDP* growth (*PCGR*) is the dependant variable.
Figures between brackets under the estimated coefficients are t-ratios, whereas those below F, and nr^2 are p-values
$\hat{\beta}$ is the implied speed of convergence.
H.T. is the number of years necessary for an average economy to close the gap between its initial and steady-state position.
***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

List of Countries Used in the Study

Algeria, Argentina, Australia, Austria, Bangladesh, Barbados, Belgium, Belize, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Congo Dem. Rep. (Zaire), Congo Rep. (Congo), Costa Rica, Cote d'Ivoire, Denmark, Dominican Republic, Ecuador, Dominican Republic, Ecuador, Egypt, El Salvador, Fiji, Finland, France, Gabon, Gambia, Georgia, Ghana, Greece, Guatemala, Guyana, Haiti, Honduras, Hong Kong, Hungry, Iceland, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Korea Rep., Latvia, Lesotho, Liberia, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mexico, Morocco, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Rwanda, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, South Africa, Spain, Sri Lanka, St. Vincent and the Grenadines, Sudan, Sweden, Switzerland, Syria, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela, Zambia, Zimbabwe.

Variables Definition and Data Sources

EFFECT : Government effectiveness is measured in units ranging from about -2.5 to 2.5, and averaged over the years 1996, 1998, 2000, and 2002. Source: Kaufmann et al (2003), "Governance Matters III: Governance Indicators for 1996-2002," World Bank Policy Research Department Working Paper.
GOVERN **:** The arithmetic average over the period 1996-02 of the six indicators introduced in the text. It is measured in units ranging from about -2.5 to 2.5. Source: Kaufmann et al (2003).
GPOP : The average growth rate of total population over the period 1970-00, calculated in the same way as PCGR. Source: WDI (2004).

***LBMP*:** The natural logarithm of the quantity (1+BMP/100) where BMP is the black market premium. The variable BMP is measured as (Parallel Xrate/Official Xrate -1)x100 where Xrate stands for exchange rate. Source: Global Development Network Growth Database (Easterly June 01).
LINV7000 : The natural logarithm of average investment ratio at current local prices over the period 1970-00. Source: WDI (2004).
LPCGDP70 : The natural logarithm of real per capita *GDP* in 1970 in 1996 international prices. Source: the PWT 6.1.
LSEC70 : The natural logarithm of the gross secondary school enrolment in 1970. Source: WDI (2004)
OP7092 : The fraction of years during the period 1970-92 in which the country is rated an open economy according to the criteria in Sachs and Warner (1995a). Source: Sachs and Warner (1995a), "Economic Reform and the Process of Global Integration," Brookings Papers on Economic Activity, 1, 1995, 1-95.
PCGR **:** Real per capita *GDP* growth rate calculated as the difference between the natural logarithm of per capita real *GDP* in 2000 and the natural logarithm of per capita *GDP* in 1970 divided by 30. Source: PWT 6.1. The real per capita series corresponds to the series named rgdpl in the PWT 6.1 data base which stands for the Laspeyres real *GDP* per capita in 1996 international prices.
REGQUA : Regulatory quality is measured in units ranging from about -2.5 to 2.5, and averaged over the years 1996, 1998, 2000, and 2002. Source: Kaufmann et al (2003), "Governance Matters III: Governance Indicators for 1996-2002," World Bank Policy Research Department Working Paper.
RLAW : Rule of law is measured in units ranging from about -2.5 to 2.5, and averaged over the years 1996, 1998, 2000, and 2002. Source: Kaufmann et al (2003), "Governance Matters III : Governance Indicators for 1996-2002," World Bank Policy Research Department Working Paper.
SDGTT: The standard deviation of the growth rate of the terms of trade over the period 1971-99. The terms of trade are defined as the ratio of the export price index to the import price index. Source: Global Development Network Growth Database (Easterly June 01).
SXP70 : The share of primary exports in GDP in 1970. Source: Sachs and Warner (1997b), "Sources of Slow Economic Growth in African Economies", Institute for International Development and Center for International Development, Harvard University.

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Notes

[i] See Sachs and Warner (1995a), p. 22.

[ii] Variables used in the regression equations of this work and data sources are described at the end of this work.

[iii] Population growth and the constant are always statistically insignificant in our estimated regressions. The reason may be multicolinearity that we found present in many estimated regressions using standard colinearilty tests. In most cases, it appears as if the constant that is responsible for this problem ; that is to say that some of the included variables may not vary a lot across countries, and thus are correlated with the constant. It is, however, worth noting that as long as our main variables remain significant, multicolinearity is not a problem by itself.

[iv] See Barro and Sala-i-Martin (1995), Chapter 8, for more details concerning this point**.**

[v] For reasons of lack of data availability and because institutions tend to change slowly over time, we use these indicators averages over the period 1996-02 as proxies for a country's level of institutional development over the period 1970-00. We can interpret our results as assessing the long-term relationship between institutions, which evolve slowly overtime, and economic growth, which is volatile in the short-run but more precisely measured in the long-run, over the span of several decades. See Taveras 2004 p-54 who does the same thing.

[vi] The sample size used to estimate each equation is less than 107 depending on data availability. The set of countries used in this study is presented in the appendix.

[vii] Endogeneity can be dealt with through an instrumental variable method, as usually done in such a case.

[viii] Because of a lack of space, we do not present the results regarding political stability, corruption, and voice and accountability. These are, however, equally represented in the composite index *GOVERN*.

[ix] We have to be careful as we compare results from different equations with different sample sizes. The right procedure would be to unify the sample (and its sample), then proceed into estimation and comparison.

[x] The fact that the effect of this variable remains practically unchanged, in terms of value and significance, may indicate that this variable is also a robust determinant of growth. As a matter of fact, it has been found to be robust by the standards in Sala-i-Martin (1996,1997).

[xi] These regressions are not presented here for lack of space, but can be supplied if requested.