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Abstract

In spite of the wave of liberalization undertaken during the last decades, the debate, among economists, on the links and causality between openness, growth and income distribution is still open. Empirical results most often suggest that, in the long run, more outward-oriented countries register better economic growth performance. However, this empirical evidence continues to be questioned for at least two main reasons: there are still some discussions and doubts on the way countries' openness is measured on the one hand, the debate on the estimation methodology is still open on the other hand. The aim of this paper is to contribute to this debate by proposing a more elaborated way of measuring openness taking into account two additional dimensions of countries' integration in world trade: quality and diversification. Our results confirm that countries exporting higher quality products and countries exporting more diversified products grow more rapidly. The impact of the trade dependency ratio is found to be non-linear: it is lower (even negative) for countries which exports are slightly diversified or concentrated on low quality products.

Key words: growth, openness, diversification, quality, dynamic panel estimation

JEL: F43, O11, O40,

1 – Introduction

In spite of the wave of liberalizations undertaken during the last 30 years, the debate on the links and causality between openness, growth and income distribution is still open (Rodriguez and Rodrik, 2001). Empirical evidence tends to show that in the long run more outward-oriented countries register higher economic growth performances (e. g., among others, Sachs and Warner, 1995; Edwards, 1998; Frankel and Romer, 1999; Dollar and Kraay, 2004; Lee *et al.*, 2004). More recently, using broader databases and cross-section or panel-data estimations, Chang et *al*. (2009) and Freund and Bolaky (2008) also show that trade openness has a positive effect on income and that this positive relationship is enhanced by complementary policies.

According to some authors however (e.g., Rodriguez and Rodrik, 2001) the debate on the causality between trade openness and growth is still far from being closed since most of the work supporting this empirical evidence suffer from, at least, two serious shortcomings that make their results to be questioned. The first shortcoming lies in the way trade openness is measured. The second one results from retained estimation methods.

Reviewing the existing literature on openness and growth shows that there is not a clear definition of trade openness. For many authors trade openness implicitly refers to trade policy orientation and what they are interested in is to assess the impact of trade policy or trade liberalization on economic growth. For other authors however, trade openness is a more complex notion covering not only the trade policy orientation of countries but also a set of other domestic policies (such as macroeconomic policies or policies related to law and institutions for instance) which altogether make the country more or less outward oriented. In such a case, what the authors are interested in is to measure the impact of global policy orientation on economic growth. Finally, one may adopt an even more global view of trade openness covering not only the policy dimension but also all other non-policy factors that clearly have an impact on trade and on the outward orientation of countries. Factors such as geography and infrastructures, for instance, do affect trade and the outward orientation of countries, whatever their policy orientation.

Many different measures of trade openness have been proposed and used in empirical analyses of the relationship between openness and growth. They more or less relate to the three alternative definitions of openness mentioned above. In line with the trade policy orientation definition, some authors have retained measures based on trade restrictions/distortions, such as average tariff rates[1], average coverage of quantitative barriers, frequency of non-tariff barriers or collected tariff ratios (see, e.g., Pritchett, 1996; Harrison, 1996; Edwards, 1998, Yanikkaya, 2003). Obviously these indicators are very imperfect partial measures of the overall restrictions/distortions induced by trade policies. Furthermore, data required to compute such indicators are most often available for only a limited set of countries and years. Corresponding to the global policy orientation definition, various "qualitative" indices allowing for classifying countries according to their trade and global policy regime have been proposed (see, e.g., the 1987 World Development Report outward orientation index, the Sachs and Warner, 1995, openness index or the Wacziarg and Welch, 2003, Sachs, Warner, Wacziarg and Welch openness index). Such indices unfortunately provide only a very rough classification of countries (from rather closed to rather open). Also many of the data required to construct these indices are available only for a few countries and at one point in time. Finally, measures based on trade volumes, which have been very commonly used in empirical analyses, rather relate to the most global definition of trade openness. Trade dependency ratios are the most popular of these measures (see, e.g., Frankel and Romer, 1999; Irwin and Tervio, 2002; Frankel and Rose, 2002; Dollar and Kraay, 2004). Their main advantage is that the data required to compute them are available for nearly all countries and over a rather long period. Their main weakness is that they are outcome-based measures and as such are the result of very complex interactions between numerous factors so that it is never clear finally what such measures empirically capture exactly. Another limitation of these trade dependency ratios lies in their endogeneity in growth regressions, which requires specific estimation techniques (such as instrumental variables techniques as in Frankel and Romer, 1999, and Irwin and Tervio, 2002, or identification through heteroskedasticity techniques as in Lee *et al.*, 2004).

This last limitation may in fact be extended to all trade openness measures and constitutes the second shortcomings in existing empirical evidence on openness and growth that has been pointed out by Rodriguez and Rodrik (2001). As argued by Lee *et al.* (2004), all measures of openness are generally closely linked to the growth rate. Hence, this is likely that all measures of openness are jointly endogenous with economic growth, which may cause biases in estimation resulting from simultaneous or reverse causation. Various methods have been used

[1] And/or other characteristics of the tariff distribution: tariff dispersion, frequency of tariff picks, etc.

to remedy this problem and there is still a debate among scientists about which method is the most appropriate (see, e.g., Dollar and Kray, 2004, and Lee *et al*., 2004).

In this paper, we adopt the most global definition of trade openness and our aim is to contribute to the on-going debate on the growth effect of trade openness. Relative to the existing literature, our contribution is the following. Firstly, we argue that trade openness is a multidimensional concept that cannot be summarized to a single measure such as the most commonly used trade share (calculated as the sum of imports and exports over GDP). Secondly, recent developments in growth theory and in international economics have provided new insights on the relationship between trade and growth, which call for additional measures of trade openness. Hence, we propose a more elaborated way of measuring openness taking into account two additional dimensions of countries' integration in world trade: quality and diversification.

Endogenous growth theory has provided results on the positive growth effect of trade through innovation incentives, technology diffusion and knowledge dissemination (see, e.g., Young, 1991; Grossman and Helpman, 1991). Inspired from these theoretical developments, Hausmann *et al*. (2007) proposed an analytical framework linking the type of goods (as defined in terms of productivity level) a country specializes in to its rate of economic growth. In order to test empirically for this relationship, they then defined an index aimed at capturing the productivity level (or the quality) of the basket of goods exported by each country. Their growth regression results showed that countries exporting goods with higher productivity levels (or higher quality goods) have higher growth performances. These results suggest that what countries export matter as regards the growth effect of trade. Hence our measurement of trade openness should consider this quality dimension as a complement to the volume (or the dependency) dimension.

Monopolistic competition trade models with heterogenous firm and endogenous productivity provide theoretical results supporting the positive growth effect of trade through both increased variety of products and improved productivity due to the exit of less efficient firms (e.g., Melitz, 2003). Based on this literature, Feenstra and Kee (2008) developed a model allowing to link, for each country, relative export variety to average productivity and then to GDP growth. Using Feenstra (1994)'s index of export variety, they tested this relationship on the basis of exports to the US for a panel of 48 countries over the period 1980-2000. Their empirical results indicated that there is a positive and significant relationship between export variety and average productivity. Once again these results suggest that the structure of countries' exports matter regarding the growth effect of trade. Hence, our measurement of trade openness should also consider this variety/diversification dimension.

Our empirical application draws on the Frankel and Rose (2002)'s model, which has been extended to take into account our set of three indicators of trade openness: trade dependency ratio, export quality index and export variety index. Estimations are performed on annual data over the period 1995-2009 for an unbalanced panel of 157 countries. We use a generalized method of moments (GMM) estimation approach developed for dynamic panel data models in order to deal with potential endogeneity biases due to omitted variables, simultaneity and measurement error.

Our results confirm that countries exporting higher quality products and countries exporting more diversified products grow more rapidly. The impact of the trade dependency ratio is found to be non-linear: it is lower (even negative) for countries which exports are slightly diversified or concentrated on low quality products.

The remainder of the article is organized as follows. In the next section, we present the specification of performed growth regressions and the retained econometric methodology. Section 3 reports and discusses empirical results, while section 4 concludes.

2 – Specification of growth regressions and econometric methodology

Inspired from the Frankel and Rose (2002)'s approach we retain the following specification:

$$\begin{aligned}\ln\left(\frac{GDP}{pop}\right)_{i,t} &= \beta_0 + \beta_1 \ln\left(\frac{GDP}{pop}\right)_{i,t-1} + \beta_2 n_{i,t} + \beta_3 \ln\left(\frac{I}{GDP}\right)_{i,t} + \beta_4\ school_{i,t} + \beta_5 inst_{i,t} \\ &\quad + \beta_6 \ln\left(\frac{X+M}{GDP}\right)_{i,t} + \beta_7\ Z_{i,t} + \nu_{i,t}\end{aligned} \tag{1}$$

where the dependent variable is the logarithm of GDP per capita of country *i* for the year *t*, with *GDP* corresponding to gross domestic product and *pop* to the total population. Explanatory variables that derive from neoclassical growth theory appear on the first line of equation (1): *n* is the annual growth rate of the population of country *i*, (*I/GDP)* and *school* correspond respectively to the investment ratio and the level of education to account for human capital investment. The variable *inst* is an institutional variable which is a proxy for the quality of institutions. Variables of particular interest are reported on the second line of equation (1). Aggregates exports and imports are denominated *X* and *M*. Dividing the sum of them by *GDP*, obtain the usually called openness ratio that, in the following, we will refer as the trade dependency or the trade ratio. *Z* denotes other variables that may influence GDP per capita like, typically here, our two additional trade openness measures: the export quality and the export variety/diversification indices.

The export quality index is computed according to the Haussmann *et al*. (2007)'s approach. In order to test for the robustness of the estimated relationship between export diversification/variety and growth, we consider four alternative export diversification/variety indicators: the usual Herfindhal and Theil concentration indices, the number of active export lines and the export variety index based on the extensive margin as used in Feenstra and Kee (2008). Extensive details on the definition and computation of these indices can be found in Vijil *et al*. (2011).

Finally, to account for potential non linearity in the relationship between the trade ratio and the growth rate, Z may also include interactive variables between this trade ratio and the export quality or the diversification/variety indices.

More specifically, three alternative specifications are considered:

- a basic specification:

$$\begin{aligned}\ln\left(\frac{GDP}{pop}\right)_{i,t} &= \beta_0 + \alpha \ln\left(\frac{GDP}{pop}\right)_{i,t-1} + \beta_1 n_{i,t} + \beta_2 \ln\left(\frac{I}{GDP}\right)_{i,t} + \beta_3\ school_{i,t} + \beta_4 inst_{i,t} \\ &\quad + \beta_5 \ln\left(\frac{X+M}{GDP}\right)_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{2}$$

- an extended specification with the export quality index (*quality*):

$$\begin{aligned}\ln\left(\frac{GDP}{pop}\right)_{i,t} &= \beta_0 + \alpha \ln\left(\frac{GDP}{pop}\right)_{i,t-1} + \beta_1 n_{i,t} + \beta_2 \ln\left(\frac{I}{GDP}\right)_{i,t} + \beta_3\ school_{i,t} + \beta_4 inst_{i,t} + \beta_5 \ln\left(\frac{X+M}{GDP}\right)_{i,t} \\ &\quad + \beta_6 \ln(quality)_{i,t} + \beta_7 \ln\left(\frac{X+M}{GDP}\right)_{i,t} * \ln(quality)_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{3}$$

- an extended specification with the alternative export diversification/variety indices (*diversification*):

$$\ln\left(\frac{GDP}{pop}\right)_{i,t} = \beta_0 + \alpha \ln\left(\frac{GDP}{pop}\right)_{i,t-1} + \beta_1 n_{i,t} + \beta_2 \ln\left(\frac{I}{GDP}\right)_{i,t} + \beta_3\ school_{i,t} + \beta_4 inst_{i,t} + \beta_5 \ln\left(\frac{X+M}{GDP}\right)_{i,t} + \beta_6 diversification_{i,t} + \beta_7 \ln\left(\frac{X+M}{GDP}\right)_{i,t} * diversification_{i,t} + \varepsilon_{i,t} \quad (4)$$

Our empirical application is based on 157 pooled cross-country data over the period 1995-2009. As most explanatory variables are likely to be jointly endogenous with economic growth, we use the GMM estimators developed for dynamic panel data models (Arellano and Bond, 1991; Arellano and Bover, 1995). Within the GMM approach, one may choose the difference estimator, which considers the regression equation in differences, or an estimator combining the regression equation in differences and the regression equation in levels into one system. Following Arellano and Bover (1995), Blundell and Bond (1998) and Chang *et al*. (2009), we also retain the system approach. Indeed, this estimator is more suitable when the explanatory variables are highly persistent over time, like in the case of growth models (Bond *et al.* 2001), or when the heterogeneity is relatively important.

Departing from this general model:

$$y_{i,t} = \alpha\ y_{i,t-1} + \beta' X_{i,t} + \eta_i + \tau_t + \nu_{i,t} \quad (5)$$

$$\varepsilon_{i,t} = \eta_i + \nu_{i,t}$$

$\mathrm{E}[\eta_i] = \mathrm{E}[\nu_{i,t}] = \mathrm{E}[\eta_i \nu_{i,t}] = 0$ for i =,…,N and t =2,…,T.

Where y is the dependant variable, X is the vector of explanatory variables, η_i and τ_t denote respectively unobserved country- and time-effect and $\nu_{i,t}$ is the idiosyncratic disturbance term, system-GMM estimator implies running a GMM procedure on the following system of equations,

$$y_{i,t} - y_{i,t-1} = \alpha\ (y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (\nu_{i,t} - \nu_{i,t-1}) \quad (6)$$

$$y_{i,t} = \alpha\ y_{i,t-1} + \beta' X_{i,t} + \eta_i + \tau_t + \nu_{i,t} \quad (7)$$

Nevertheless, instead of doing a “first-difference transformation” as is usually the case to remove the unobserved individual effect in equation (6), we perform a “forward orthogonal deviation" transformation. That is, for a variable w the transformation will be: $w_{i,t+1} \equiv c_{it}\left(w_{it} - \frac{1}{T_{it}} \sum_{s \rangle t} w_{is} \right)$ where the sum is taken over all available future observations T_{it}, and c_{it} is $\sqrt{T_{it}/(T_{it}+1)}$. This way of dealing with heterogeneity allows us to preserve sample size in our unbalanced panel while still been able to use past values of explanatory variables as instruments (Arellano and Bover, 1995).

On the assumption of absence of serial correlation in the idiosyncratic disturbance term $\nu_{i,t}$

$$\mathrm{E}\left[\nu_{i,t}\nu_{i,s}\right] = 0 \text{ for } i = 1, \ldots., \mathrm{N} \text{ and } s \neq t,$$

and that the initial conditions are predetermined

$$\mathrm{E}\left[y_{i,1}\nu_{i,s}\right] = 0 \text{ for } i =, \ldots, \mathrm{N} \text{ and } t = 2, \ldots, \mathrm{T}.$$

the differenced equation (6) can be instrumented by lagged levels of explanatory variables (Arellano and Bond, 1991), using the following moment conditions:

$$\mathrm{E}\left[y_{i,t-2} * \left(\nu_{i,t} - \nu_{i,t-1}\right)\right] = 0 \qquad (8)$$

$$\mathrm{E}\left[X_{i,t-2} * \left(\nu_{i,t} - \nu_{i,t-1}\right)\right] = 0 \qquad (9)$$

For t=3,…,T.

Furthermore, under the additional assumption that for each country *i*, the correlation between the explanatory variables and the country-specific effect is constant over all periods (Arellano and Bover, 1995; Blundell and Bond, 1998), the regression in levels (7) can use the additional moments conditions:

$$\mathrm{E}\left[\left(y_{i,t-1} - y_{i,t-2}\right) * \left(\eta_i + \nu_{i,t}\right)\right] = 0$$

$$\mathrm{E}\left[\left(X_{i,t-1} - X_{i,t-2}\right) * \left(\eta_i + \nu_{i,t}\right)\right] = 0$$

This assumption that past changes in explanatory variables are uncorrelated with the fixed effect and the current error in level are only valid under the hypothesis described above about the initial conditions of the data generating process. For example, this means that in an empirical growth model, deviations of $y_{i,1}$ from long-run steady-state values, controlling for the covariates $X_{i,1}$, must not depend on fixed-effects. Bond *et al.* (2001) argue that this assumption may be valid in Solow growth frameworks, thus allowing us to use the System-GMM estimator in our model. Again, there is also a need of absence of serial correlation in the idiosyncratic disturbance term $v_{i,t}$.

Furthermore, under the assumption that among our explanatory variables, both the population growth rate and the time-specific effect are likely to be strictly exogenous, the contemporaneous observations of these exogenous variables are used as additional instruments (Arellano and Bover,1995; Blundell and Bond ,1998).

Finally, in order to test for the appropriateness of our retained instruments in the growth regressions, we consider two specification tests. The first one is the Hansen test of over-identification for which the null hypothesis is that the chosen instruments are valid. Because this test can be seriously weakened with instrument proliferation, we decide to collapse the instrument matrix in order to reduce their number (Roodman, 2007). The second one examines whether the idiosyncratic disturbance term $v_{i,t}$ is serially correlated. The test is performed on the first-differenced error term (that is, the residual of equation (6) in differences) and the null hypothesis is that the latter is second-order uncorrelated. In both cases, failure to reject the null hypothesis gives support to the retained specification.

3 – Data and results

3.1. Data

We use annual data over the period 1995-2009 for an unbalanced panel of 157 countries. Most required data are extracted from the World Bank WDI (World Development Indicators) database. This is the case for the following variables. The dependent variable is computed using the GDP per capita based on purchasing power parity (expressed in constant 2005 US dollars). The annual population growth rate (*n*) is calculated based on total population figures (midyear estimates). The investment ratio (*I/GDP*) is proxied through the gross fixed capital formation in percentage of GDP, while the gross enrolment ratio at secondary level is used as a proxy for secondary education level (*school*). Finally, the trade ratio (*X+M/GDP*) is computed using GDP as well as values of exports and imports of goods and services in current USD dollars.

Remaining explanatory variables rely on data issued from various other databases. For the institutional variable *inst*, which is supposed to measure the quality of institutions, we use the rule of law estimate provided by the World Bank Governance Indicators database. This estimate captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.

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The export quality index and the alternative export diversification/variety indices are computed based on export values in current US dollars extracted from both the WDI database and the CEPII international trade database BACI (at a HS6 disaggregated level). Further details on the definition and computation of these indicators can be found in Vijil *et al*. (2011).

Table 1 summarizes some basic descriptive statistics for all variables used in growth regressions.

Table 1. Descriptive statistics for used variables

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
GDP per capita (PPP constant US$)	2488	10161.83	11937.56	150.81	84043.17
Annual population growth rate (%)	2547	0.01	0.01	-0.04	0.13
Investment ratio (%)	2344	22.12	8.39	-23.76	113.58
Secondary schooling (%)	1868	72.64	32.02	5.17	161.78
Rule of law	1980	-0.10	1.00	-2.69	1.96
Trade ratio	2451	0.87	0.47	0.15	4.38
Export quality index (cur.US dollars)	2928	74337.27	31608.83	9532.60	187607.2
Herfindahl index	2928	0.17	0.20	0.01	1
Theil index	2928	4.84	1.68	1.56	8.52
Number active export lines	2928	1989.80	1666.77	1	5015
Export variety index	2928	0.60	0.29	0.01	1

Source: Authors' calculations

3.2. Empirical results

Regression results are reported in Table 2. The results of the basic regression with the trade ratio as the single trade openness measure (corresponding to equation specification (2)) are presented in the first column. The results of the regression extended to the export quality index as an additional measure of trade openness (corresponding to equation specification (3)) are reported in the second column. The last four columns of Table 2 present the results of the regression extended to the diversification/variety index (corresponding to equation specification (4)), each column reporting the results obtained with each of the four alternative retained indices.

Results of the basic regression (2) are consistent with the previous empirical literature: all estimated coefficient have the expected sign. One may notice however that few of these coefficients are significant: this is the case for the lagged GDP per capita, the investment ratio and the trade ratio variables only. As in Frankel and Rose (2002), the population growth rate is found to have a negative but non-significant growth effect. However, contrary to Frankel and Rose (2002) and Chang *et al.* (2009) our results suggest that secondary education level would not significantly affect growth. As in previous studies the trade ratio is found to have a positive impact on growth, with a coefficient significant at the 5% level. Finally, Hansen and AR(2) specification tests indicate that in both cases the null hypothesis cannot be rejected, which gives support to our retained specification.

These basic results still hold for alternative specifications (3) and (4) except for the coefficient of the trade ratio. Indeed, corresponding results in Table 2 show that an interesting pattern of non linearity in the growth effect of the trade ratio emerges when additional measures of trade openness are considered.

More specifically, we see in specification (3) that the coefficient of the trade ratio becomes significantly negative while the coefficient of the cross variable between both trade openness indicators is significantly positive, suggesting a non linearity in the growth effect of the trade ratio: for countries which exports are concentrated on low quality products (i.e., export quality index lower than exp(0.793/0.072) = 60 711 current US dollars, increasing the share of trade in GDP has a negative impact on growth; at reverse, this impact is positive for countries registering an export quality index which is higher than this threshold; in that case, the higher the export quality index, the greater the positive growth effect of the trade ratio. This last result suggests that the beneficial growth impact of increasing trade share is higher when countries' exports are concentrated on higher quality products. One may interestingly notice that in our sample, countries exhibiting the lowest export quality index belong in majority to the Low Income Countries category as defined by the World Bank[2], and that most of them exhibit an export quality index which is lower than the 60 711 current US dollars calculated threshold (the list of these countries may be found in Vijil *et al.*, 2011).

Results are similar when considering the diversification/variety dimension of trade openness. Last column of Table 2 shows that the coefficient of the export variety index is positive and significant, suggesting, as stated by Feenstra and Kee (2008), that countries exporting more

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[2] The World Bank classifies countries according to their yearly Gross National Income (GNI) per capita, computed using the World Bank Atlas method. For 2008, the groups are: low income (LIC) with a $975 GNI per capita or less; lower middle income (LMIC) with a $976 to $3 855 GNI per capita; upper middle income (UMIC) with a $3 856 to $11 905 GNI per capita and high income (HIC) with a $11 906 or more GNI per capita.

diversified products grow more rapidly. As in the previous case, the coefficient of the trade ratio becomes negative and significant while the coefficient of the interaction effect is positive and significant, suggesting that the growth effect of the trade ratio is non-linear. More specifically, increasing the trade ratio induces higher growth rate only for countries which export variety index is greater than 0.79 (i.e., 0.114/0.144). In that case, there is some pattern of complementarities between trade volume and trade (export) variety in the sense that both contribute jointly to increasing growth. Inversely, for countries with an export variety index below the 0.79 threshold, increasing the trade ratio is likely to be detrimental in terms of growth rate. One may relate this last result to the discussions on the so-called "natural resource curse" issue (and its "Dutch disease" part). As explained in Lederman and Maloney (2008), a number of studies have shown empirical evidence of a negative relationship between natural resource abundance and economic growth performances of countries. Various channels through which this negative relationship would operate have been proposed. Among them some directly relate to the idea of a negative growth impact of concentration in export. Finally, one may notice that in our sample, nearly all countries belonging to the Low Income Countries category exhibit an export variety index lower than the 0.79 calculated threshold (Vijil *et al*., 2011).

Similar results are obtained when the export variety index is replaced by the number of active export lines or by the Theil concentration index. In this last case however, the interpretation of coefficients is reversed since the higher the index, the higher the concentration, thus the lower the diversification. Hence, the negative sign of the coefficient of the Theil index indicates a negative effect of export concentration, hence a positive effect of export diversification on growth. In the same way, the negative coefficient of the cross variable between the trade ratio and the Theil index indicates a joint positive effect of trade volume and trade product diversification on growth.[3]

[3] Similar results are obtained with the Herfindhal index. However, in this case the coefficient of the trade ratio is non-significant. We thus do not comment this equation's results.

Table 2. Growth regressions results

Explanatory variables	(2)	(3)	(4)			
Constant	-0.159 (0.097)	-0.623 (0.335)*	-0.194 (0.128)	-0.264 (0.200)	-0.498 (0.167)***	-0.087 (0.215)
GDP per capita (log, lagged value)	0.990 (0.009)***	0.970 (0.018)***	0.976 (0.010)***	0.979 (0.017)***	0.954 (0.019)***	0.960 (0.015)***
Annual population growth rate	-0.505 (0.349)	-0.320 (0.405)	-0.434 (0.554)	0.052 (0.481)	-0.199 (0.551)	-0.138 (0.533)
Investment ratio (log)	0.055 (0.016)***	0.053 (0.024)**	0.064 (0.022)***	0.070 (0.026)***	0.069 (0.020)***	0.058 (0.033)*
Secondary schooling (log)	0.016 (0.016)	0.049 (0.024)**	0.044 (0.022)**	0.059 (0.023)**	0.062 (0.029)**	0.061 (0.027)**
Rule of law	-0.008 (0.007)	-0.004 (0.015)	0.001 (0.014)	-0.011 (0.016)	0.003 (0.018)	0.008 (0.016)
Trade ratio (log)	0.043 (0.017)**	-0.793 (0.398)**	-0.017 (0.031)	0.104 (0.054)*	-0.381 (0.201)*	-0.114 (0.078)
Export quality index (log)		0.044 (0.037)				
Trade ratio (log) X Export quality index (log)		0.072 (0.035)**				
Herfindhal index			-0.063 (0.125)			
Trade ratio (log) X Herfindhal index			-0.058 (0.126)			
Theil index				-0.012 (0.010)		
Trade ratio (log) X Theil index				-0.028 (0.011)**		
Number of active export lines					0.051 (0.019)***	
Trade ratio (log) X Number of active export lines					0.049 (0.026)*	
Export variety index						0.077 (0.028)***
Trade ratio (log) X Export variety index						0.144 (0.084)*
Observations	1228	801	801	801	801	801
Number of countries[1]	157	113	113	113	113	113
Hansen test p-value	0.299	0.235	0.194	0.397	0.386	0.296
AR(2) test p-value	0.138	0.459	0.419	0.382	0.372	0.393

Robust standard errors in parentheses
* significant at 10% level ; ** significant at 5% level ; *** significant at 1% level
[1] As regard specifications (3) and (4), major oil exporter countries have been removed from the sample. These countries exhibit very high quality export baskets and low export diversification/variety indices (in fact very high concentration –Herfindhal and Theil- indices and very low number of active lines and export variety index), which biases the estimation results (for more detailed discussion, see Vijil *et al.*, 2011).
Estimation method: two-step GMM system (Arellando and Bover, 1995; Blundell and Bond, 1998) with Windmeijer (2005) correction.
Instruments used:

Difference equation is instrumented by 3rd and further lags of the level of predermined and weakly exogenous explanatory variables, contemporaneous population growth rate and time dummies. Instruments are collapsed.

Level equation is instrumented by 3rd and further lags of first-differentiated predermined and weakly exogenous explanatory variables, contemporaneous population growth rate and time dummies. Instruments are collapsed.

Source: Authors' calculations.

4 - Conclusion

This paper investigates the relationship between trade openness and growth. Starting from the idea that trade openness cannot be fully characterized through trade volumes only we propose to account for two additional dimensions: trade quality and trade diversification. Then, standard growth regressions are performed where, among the explanatory variables, the commonly used trade ratio is complemented by the Haussmann *et al*. (2007)'s export quality index or the Feenstra (1994)'s export variety index. Our empirical application is based on annual data over the period 1995-2009 for an unbalanced panel of 157 countries. As most explanatory variables are likely to be jointly endogenous with economic growth, we use the system GMM estimator developed for dynamic panel data models.

Our empirical results show clearly that countries exporting higher quality products or more diversified products grow more rapidly. Furthermore, our results indicate that an interesting pattern of non linearity in the growth effect of the trade ratio emerges when export quality or export diversification measures of trade openness are considered. We show that increasing trade volumes as a percentage of GDP may be detrimental to growth when countries' exports are highly concentrated on low quality products or on a few products only. At reverse, providing that exports are concentrated on high quality products or sufficiently diversified, increasing trade share is always beneficial to growth.

Such results clearly show that the relationship between trade openness and growth is not straightforward and that the growth effect of trade is very difficult to capture empirically. Our paper calls for a more careful definition as well as measurement of trade openness.

To this regard, there is not so much good reason to limit our analysis to export quality and diversification indices. Indeed theoretical literature shows that as regards the growth effect of trade quality and diversification, the import dimension also matters. Hence, this calls for further investigations taking into account both import and export quality and diversification dimensions.

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