Export Diversification and Economic Growth:

Evidence from Cross-Country Analysis

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Abstract

The present paper investigates the export-growth relationship taking into account both diversification and nature of export composition. In a sample of sixty five countries for the period 1965-2005 the dynamic panel estimation reveals that export diversification and composition are important determinants of economic growth after controlling for the impacts of other variables like lagged growth, exports, investment, and infrastructure. Moreover, the relationship between export concentration and income is found to be nonlinear. These results hold even when the dataset is classified in four sub-panels based on export-economic growth relation establishing their robustness. It is also found that economic growth across countries increases with diversification of export up to a critical level of export concentration which is then reversed with increasing specialization leading to higher growth. These results on export-economic growth relationship have immense implications for growth.

JEL Classification: F43, O57, H54

Key Words: Economic Growth, Export Diversification, Specialization, Infrastructure

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1. Introduction

The paper investigates export-growth relationship taking into account both export diversification and composition. Whereas the theoretical and empirical literature on export-led growth is large[1], only a handful of empirical studies examine the role of diversification and nature of export composition. Both the productivity theory of Adam Smith and arguments of trade as engine of growth emphasize upon the importance of production specialization and trade. The basic argument lies in the static gains from trade emanating from production specialization according to comparative advantage, and dynamic gains from trade emanating from division of labour and exploitation of economies of scale. The structuralist theories cast serious doubts on such theoretical proposition of specialization driving growth with developing countries experiencing secular deterioration in their terms of trade during the 1950s and 1960s. Thus change in the composition of export from primary to manufactured products, known as vertical diversification, is required in order to achieve sustainable growth (Chenery, 1979; Syrquin, 1989, Agosin, 2007).

These theoretical conjectures essentially suggest two things. First, narrow specialization especially in primary and agricultural goods may make countries vulnerable to external shocks and thus retard their growth through terms of trade deterioration. With the deterioration in the terms of trade of primary products vis-à-vis manufacture products, the trading terms of the developing nations against their developed counterparts also decline (Sarkar, 1986). Most of the sub-Saharan African countries in particular depending heavily on two or three commodities for most of their export earnings are glaring examples. The larger the number of goods exported by a country, movements in the prices of individual goods will offset each other and country's export price level will tend to be relatively stable. Export diversification, thus, helps in stabilizing export earnings in the long run (Michaely, 1962; Acharyya, 2007). Second, the nature and composition of export baskets may matter. Neither specialization nor diversification aids growth as long as exports comprise of predominantly low value added commodities (Rodrik, 2006; Acharyya, 2007).

[1] Some of the worth mentioning studies in this context are studies by Dollar (1992), Edwards (1992), Sachs and Warner (1995), Frankel and Romer (1999), Dollar and Kraay (2001) establishing positive association between greater trade openness and faster growth. Rodriguez and Rodrik (2000), however, pointed out that many of these studies have not taken into account other factors (like geographical location, size of the domestic economy) which might have influenced economic growth

However, the empirical studies linking export diversification and growth, especially at the cross-country level are still limited.[2] Lederman and Maloney (2007) in a cross-country framework found evidences that export concentration was negatively related to growth during 1975-1999. After controlling for the effects of factors like investment and rule of law, Agosin (2007) found that export diversification, alone and interacted with per capita export growth (a measure of diversification-weighted export growth rate) are highly significant in explaining per capita GDP growth over the period 1980-2003 in Asia and Latin America. He concluded export diversification to be an important factor to the differences in growth performance of Asia relative to Latin America. In a dynamic growth framework Hesse (2008) established a nonlinearity in the relationship between export diversification and economic growth for the period 1962-2000 with developing countries benefiting from diversifying their exports whereas the advanced countries perform better with export specialization.

The present paper examines the robustness of these earlier analyses in terms of both an extended period of study and a new control variable that captures infrastructural development of the countries. We also reexamine whether diversification in exports augments growth or not for separate country groups classified into four sub-panels based on the difference in export-economic growth relation. The paper also investigates the impact of export composition in addition to export diversification. However, when infrastructure is included as a control variable along with domestic investment to avoid multicollinearity a two-stage estimation process is adopted. First the impact of exports on growth is estimated controlling for the impacts of lagged growth and investment and then the impact of infrastructure and diversification and composition indices on the trade-induced growth component are estimated.

In a sample of sixty five countries the GMM dynamic panel results confirm the positive association between export diversification and economic growth during 1965-2005. Moreover, the relationship is found to be nonlinear which is supportive of the existing literature (Hesse, 2008). The nonlinearity exists in separate country groups and also when the impact of infrastructure is controlled for which establishes the robustness of the results. The nonlinear relationship between export diversification and economic growth implies that economic growth increases with export diversification up to a critical level of export concentration. Beyond that critical level increasing specialization leads to higher growth. The paper also identifies the critical

[2]Country specific studies like studies by Herzer and Nowak-Lehmann (2006) examined the experience of Chile, Bebczuk and Berrettoni analyzed export diversification in Argentina at firm level, Naude and Rossouw (2008) found evidences that export diversification Granger causes GDP per capita in South Africa during 1962-2000 and also a U-shaped relation between per capita GDP and export specialization in South Africa in a Computable General Equilibrium framework.

level of export concentration which has important policy implications because once the critical level of export specialization is found; the trade policies can accordingly be formulated to make the trade-growth nexus stronger. The present study, however, does not confirm one of the findings of Agosin (2007) that the effect of diversification is stronger when a country's exports are growing rapidly. Rather the present study reveals that the effect of export diversification is stronger when export of a country is greater than the world average export.

The paper is structured as follows. Section 2 provides some preliminary observations on export diversification and economic growth across countries for some years. The next section presents the export-economic growth association during 1965-2005 depending upon which countries are classified in four sub-samples. The analysis in Sections 2 and 3 are based on exploratory data analysis. Section 4 describes the analytical framework of the study, the variables to be included in the model, the empirical methodology and data sources. Section 5 discusses the results of the empirical estimations and also finds out the critical level of export concentration using the estimation results. Finally, the concluding section summarizes the findings and puts forth the policy implications that emerge from the study.

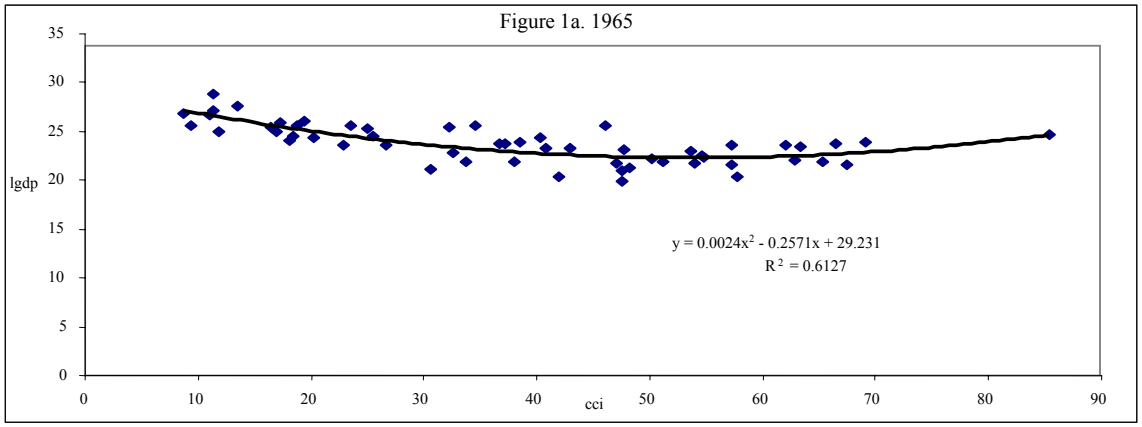
2. Export Diversification and Growth: Some Preliminary Observations

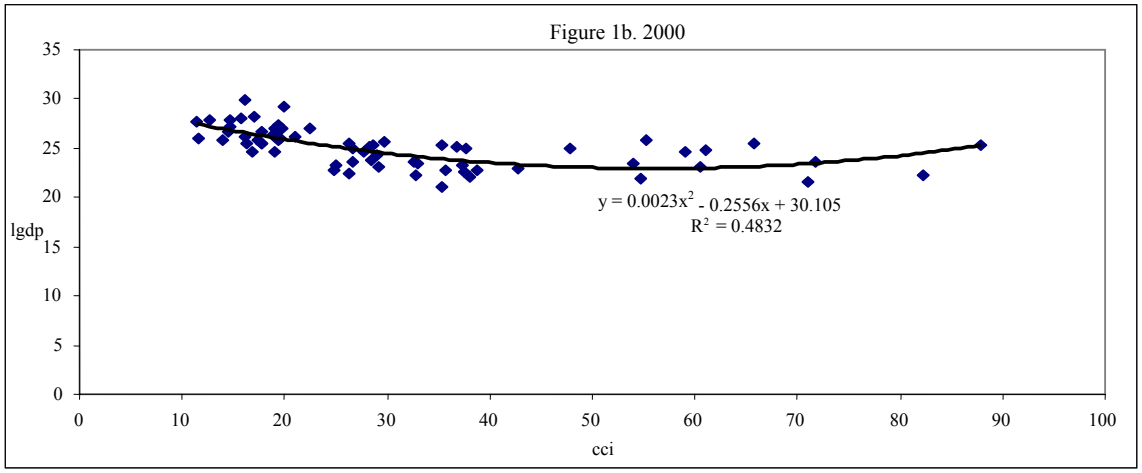
This section deals with the measurement of export diversification and provides a snapshot of export diversification and economic growth relationship for all the countries in different years. Diversification of exports can be measured by calculating any of the concentration indices like Herfindahl index, Hirschmann index. In the present analysis diversification of export basket has been captured through Hirschman's (1945) commodity concentration index (CCI) as in Michaely (1962) and Acharyya (2007). The index is defined in such a way that lower is the value of this index more diversified is the export basket.

The relationship between export diversification and GDP (natural logarithm) for two years 1965 and 2000 across countries are plotted in Figure 1a and 1b. Though most of the early theories predicted a monotonic relationship between diversification and growth some recent studies like studies by Imbs and Wacziarg (2003) and Hesse (2008) found evidences of a U-shaped pattern. The plots here are also indicative of a non linear relationship between the two. The nonlinearity implies that though diversification is associated with growth, countries specialize only after a threshold level of export concentration has been reached. However, the spread of the sample differs in the two years. For 2000 countries are mostly bunched on the left compared to countries

evenly spread on both sides of the plot for 1965. This implies that most countries included in the sample have diversified their exports over the years since lower value of CCI indicates more diversified export structure.

Figure1. Relationship between log of GDP and CCI for all the countries in the sample

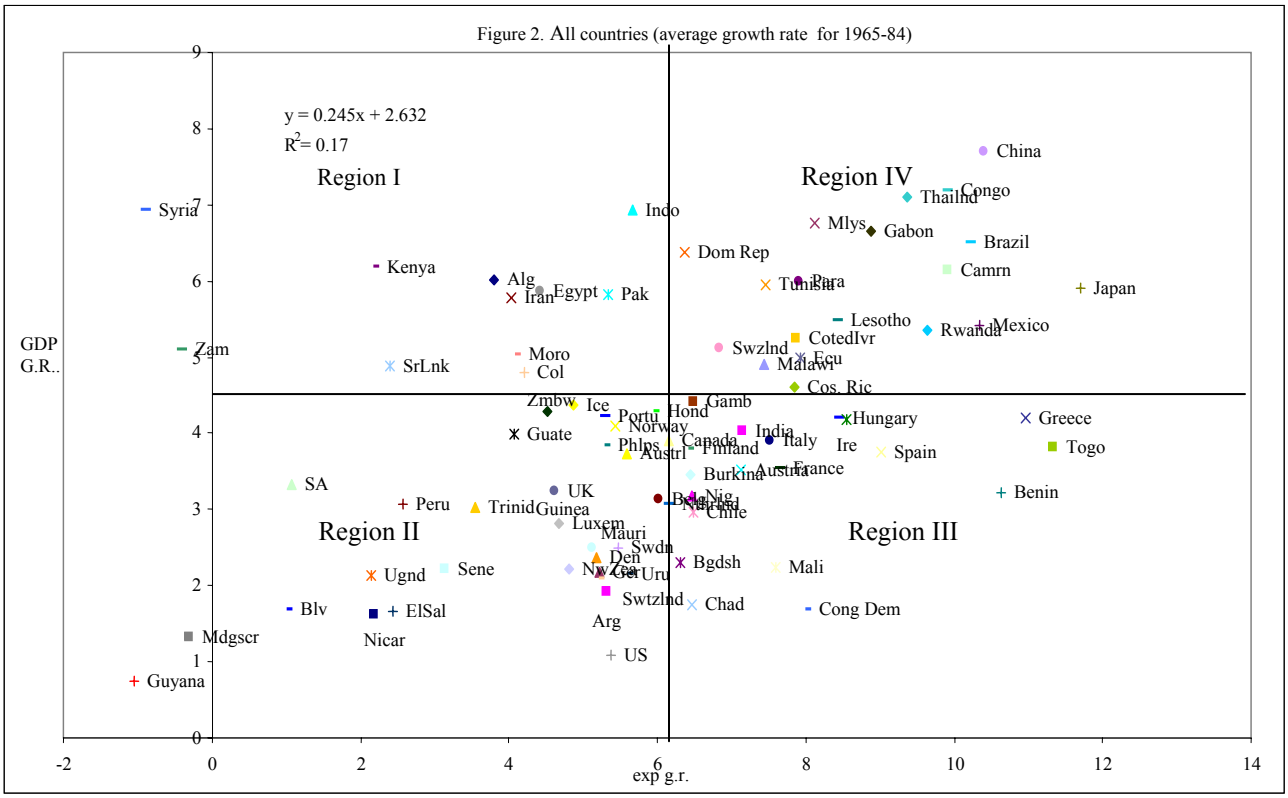




3. The export-economic growth association during 1965-2005

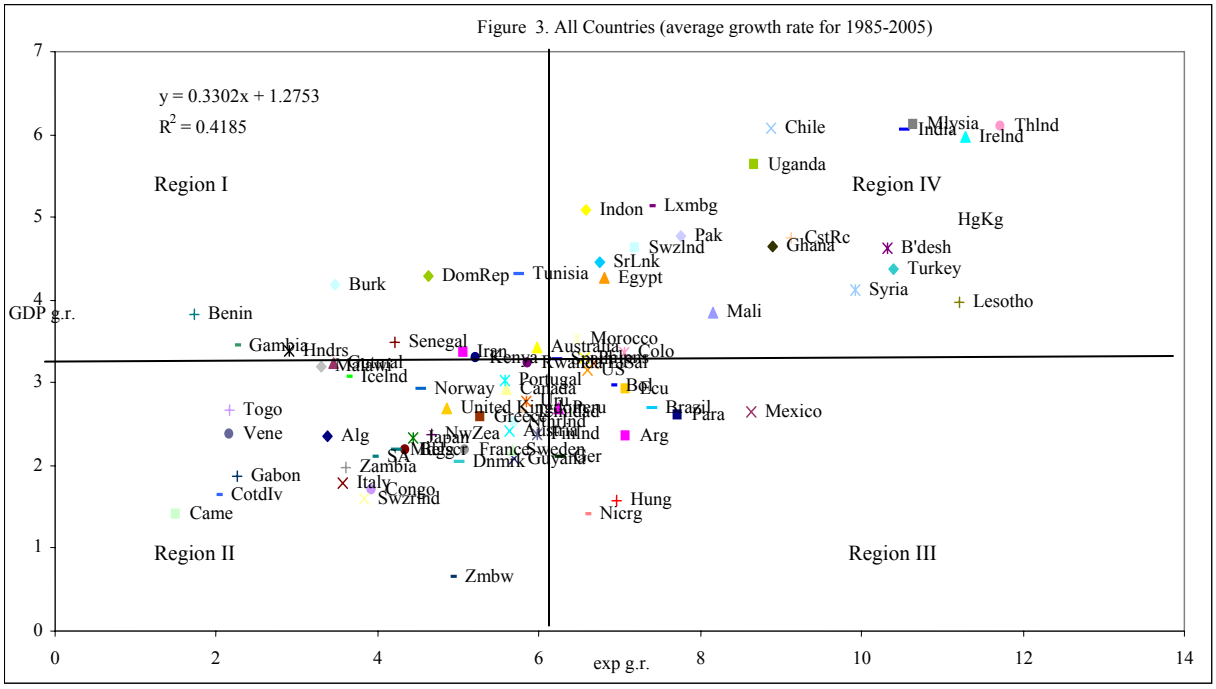
The objective in this section is to explore the export-economic growth nexus across countries during 1965-2005. The dataset includes all countries (eighty six) with available data on GDP and export for this time period. However, instead of carrying out the analysis for the entire time period as a whole, the export-growth relationship is investigated by sub-dividing the entire time period into almost two phases: 1965-1984 and 1985-2005. However, Krugman et al. (1995)

had a somewhat different viewpoint.[3] Prior to going into the detail of the export-economic growth analysis, box plots are drawn for the two sub-periods with growth rates of GDP and export to identify outliers in the sample. It is found that the samples have positively skewed distributions, though marginally, with a few high growing countries (like China, Korea) pulling up each group's mean above the median value. There are some negative outliers as well in the sample (like Venezuela, Ghana, Congo Democratic Republic, Mauritania).[4]



[3] This is because the world economy was in post oil shock recession till 1984 and there was a revival thereafter.

[4] When the distribution of growth rate of GDP is considered Botswana and China are the two positive outliers whereas Congo Democratic Republic is the negative outlier. With respect to growth rate of export Botswana, China, Korea, Chad, Guinea-Bissau are the positive outliers and Venezuela, Mauritania are the negative outliers.



Plotting the countries in scatter diagrams also helps in classifying countries for analytical purposes. Figures 2 and 3 describe export-economic growth association without the outlier countries in the two sub-periods[5]. The association between export and economic growth is positive for the countries which are in the lower left (Region II) and upper right quadrant (Region IV) of the scatter diagrams. The correlation coefficients between export and GDP growth are 0.8 and 0.84 in the two sub-periods for this group of countries. While positive relation between trade-growth is predicted,[6] the relationship is negative for countries in the other two quadrants- upper left quadrant (Region I) and lower right hand quadrant (Region III). The correlation coefficients are -0.64 and -0.6 in the two periods. For the countries in Region I growth in GDP is not due to export. In both the periods many African countries like Algeria, Benin, Egypt, Morocco, Nigeria, Senegal, Tunisia etc are in this region. But for countries in Region III growth in export has not led to growth in income. Some high income countries like Germany, US, Netherlands are in Region III. Standard trade theory (like the Heckscher-Ohlin-Samuelson theory) predicts that as the relative price of the exportables increase, export-oriented sector tries to expand production. Thus

[5] Though for the time being China and Korea are excluded from the sample, a separate analysis is intended to be done including these two countries because of their interesting growth performances.

[6] Apart from its favourable impact on balance-of-payments export creates demand for a country's output, leads to resource allocation according to comparative advantage, allows exploitation of economies of scale, improves productivity and output growth, leads to technological improvements, learning by doing gains, generates employment etc.

movement of resources away from sectors with comparative disadvantage may reduce output there. On the whole, if the decline in production in the import competing sectors is so large to outweigh the positive gains from export, economic growth may slow down.

It is evident from Figures 2 and 3 that the R^2 values have improved from 1965-2005 to 1985-2005. Thus the export-growth association became stronger after the world economy revived from the post oil shock recession after 1984. This is quite expected because many developing countries started integrating with the world economy during the period.

In cross country studies, countries are usually classified on the basis of size, income level, natural resource endowment, inflow of foreign capital and trade orientation index. The present study, however, adopts a different approach by categorizing countries on the basis of export-economic growth relation. The scatter plots in Figures 2 and 3 is sub-divided into four quadrants for the two sub-periods, thus classifying the sample in four groups of countries depending on the export-economic growth association. The first and second groups comprise of all those countries where the export-economic growth association is positive and negative in the two sub periods, respectively. The two other groups are the transitional countries- those where the export-growth association changed from negative to positive or vice versa.

4. Model Specification, Methodology and Data Sources

To investigate into the impact of export diversification on income a dynamic framework is adopted by including a lagged dependent variable as a regressor in addition to other explanatory variables. Such a dynamic framework not only takes care of the specification bias that would have resulted without the inclusion of a lagged dependent variable and provides consistent estimator of other parameters but also captures the persistence in GDP growth. In what follows is a description of the model specification used in estimation.

4.1. Model Specification

Consider the following cross country growth equation:

$$Y_{ct} = \alpha_0 + \alpha_1 Y_{c\,t-k} + \alpha_2 X_{ct} + \eta_c + u_{ct} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where Y_{ct} is the natural log of GDP in country c at time t, $Y_{c,t-k}$ is lag of Y_{ct} years ago (k=1 in the present case), X_{ct} is a set of potential explanatory variables. The term η_c is an unobserved country specific time-invariant effect. For example, the impact of geography, the role of institutions do

not change much over time but varies across countries. u_{ct} is the random disturbance term that varies across both countries and years and is assumed to be uncorrelated over time.

Export diversification, as measured by the commodity concentration index (CCI), is included as an explanatory variable. The evidence of non-linearity in the relationship between export diversification and income is taken into account by adding a squared term in the basic specification of equation (1). Agosin (2007) takes an interaction term of diversification with rate of growth of export the significance of which implies that the effect of diversification is stronger when a country's exports are growing rapidly than alone. However, the present study emphasizes the role of export volume over growth rate of export. To assess the importance of volume of exports an interaction term relating export diversification and a dummy variable representing export of a country relative to the world average export is also included in the model. The variable D_x is defined in the following way:

$$D_x = \begin{cases} 1 \text{ if export of a country is greater than world average export} \\ 0 \text{ otherwise} \end{cases}$$

Apart from export diversification the impact of composition of exports is also investigated. This is done using high technology exports as percentage of manufacturing exports (denoted as HTX) as another explanatory variables.

In the present analysis investment, export, infrastructure are taken as the control variables. The role of investment as a determinant of income has been recognized in many theories starting from the Harrod-Domar model to the more recent endogenous growth theories. Infrastructure also plays an important role in economic growth as better infrastructure reduces cost, raises productivity and augments growth (World Development Report, 1994). The role of infrastructure as a determinant of economic growth has been supported by empirical literature as well (World Development Report, 1994; Sahoo and Saxena, 1999). Being public good infrastructure can give rise to increasing returns to scale (Barro, 1990). As infrastructure can be physical, financial and energy by nature, so no single variable can capture the overall quality of infrastructure. In order to arrive at a single infrastructure variable, an index, Infrastructure Stock Index or ISI is constructed taking account of all these characteristics using the Principal Component Analysis (PCA)

following the methodology of Johnson and Wicherm (2006)[7]. However, it should be noted that not all the explanatory variables are taken together; rather alternative specifications are estimated with different explanatory variables.

4.2 Methodology

Even though the objective of the study warrants a cross-section regression, it is inappropriate in estimating equation (1). This is on account of the following shortcomings:

First, the cross section estimator will be consistent if the unobserved effect is assumed to be uncorrelated with the explanatory variables. However, this assumption is violated in the dynamic framework because in that case

$E[\eta c\, Y_{c\, t-k}]=E[\eta c(\alpha_1 Y_{c\, t-2k} + \alpha_2 X_{c\, t-k} + \eta_c + u_{ct-k})] \neq 0$

where the last inequality follows from the assumption that at least $E(\eta_c^2) \neq 0$.

Secondly, cross section growth regression cannot take into account the problem of endogeneity of the explanatory variables.

In order to take account of the above mentioned inadequacies a dynamic panel model is estimated using Generalized Method of Moments (GMM) developed by Arellano and Bond (1991) and Arellano and Bover (1995). The GMM estimator overcomes the gaps in the OLS estimator in the conventional cross-sectional regressions. The estimation process involves taking first differences of the regression equation which removes the unobserved country-specific time-invariant effects. As a result, there will be no omitted variable bias across time-invariant factors.

The following equation with lagged endogenous variable is estimated:

$$Y_{ct} - Y_{c,t-k} = \alpha_1(Y_{c\, t-k} - Y_{c\, t-2k}) + \alpha_2 (X_{ct} - X_{c\, t-k}) + (u_{ct} - u_{ct-K}) \quad \text{……………………………….(2)}$$

The inconsistency problem arising from the endogeneity of the explanatory variables is tackled using lagged values of the explanatory variables as instruments.

This method has the obvious advantage of taking into account of time-invariant variables which are possibly omitted otherwise. First differencing eliminates the effect of these omitted time-invariant country characteristics as noted by Dollar and Kraay (2001).

[7] The infrastructure index or ISI constructed here involves six infrastructural variables: air transport, freight (million tons per km), air transport, passengers carried (per 1000 population), telephone mainlines (per 1,000 people), irrigated land (% of cropland), domestic credit provided by banking sector (% of GDP) and electric power consumption (kWh per capita).

Further the GMM estimator provides consistent estimator as long as the following identifying assumptions are satisfied: first, there should be no k-order serial correlation in the errors, that is, $E[u_{ct} \; u_{ct-K} \;] = 0$ and second, lagged values of the dependent variable and other explanatory variables in level are valid instruments.

There are two types of GMM estimators that have been frequently used for growth regressions. While the first-difference GMM estimator, developed by Arellano and Bond (1991), uses first-differenced equations with suitable lagged levels as instruments. On the other hand, the system GMM estimator, developed by Arellano and Bover (1995) and Blundell and Bond (1998), uses in addition equations in levels with lagged differences as instruments. Many explanatory variables such as output are highly persistent, so their lagged levels might be very weak instruments for the first differenced equations. In that case the system GMM model is more suited to estimate growth equations (Blundell and Bond, 1998). To investigate the dynamic specification of the cross country growth equation the present study employs the system GMM method developed by Arellano and Bover (1995) which takes orthogonal deviations in the variables. In order to ensure that the model is properly identified and to test the dynamic specification of the model, Arellano and Bond (1991) recommend the use of the Sargan test for the validity of the instrumental variables.

As has already been noted all the explanatory variables are not taken together in one specification. For instance, investment and infrastructure are correlated (the coefficient of correlation being 0.71 for the sample of sixty five countries) giving rise to the possibility of multicollinearity. So these two variables are not taken together in one model. Instead an alternate estimation procedure is used when infrastructure is taken as an explanatory variable. The alternate formulation consists of two steps: first, the log of GDP is regressed on its own lagged value, log of export and log of gross capital formation. That is, the following equation is estimated:

$$Y_{ct} = \beta_0 + \beta_1 Y_{c,t-k} + \beta_2 XP_{ct} + \beta_3 I_{ct} + \eta_c + u_{ct} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where XP_{ct} is the natural logarithm of exports of goods and services in country c at time t and I_{ct} is the natural logarithm of gross capital formation in country c at time t.

Second, the estimated coefficient of export obtained from this estimation is multiplied with log of GDP. $Y^*\hat{\beta}_2$, is interpreted as the trade-induced growth component, that is, the effect of export on income, controlling for the effects of lagged income and investment. This new variable, denoted as $Y^*\hat{\beta}_2$ is regressed on its own lagged value, infrastructure stock index (ISI), export specialization (CCI), the squared export specialization and HTX. CCI^2 is introduced as an

explanatory variable to account for non-linearity in relationship. The following cross-country equation is estimated:

$$Y^* \hat{\beta}_{2ct} = \delta_0 + \delta_1 Y^* \hat{\beta}_{2ct-k} + \delta_2 ISI_{ct} + \delta_3 CCI_{ct} + \delta_3 CCI^2_{ct} + \delta_3 HTX_{ct} + \eta_c + u_{ct} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Both equations (3) and (4) are estimated using the system-GMM estimation method proposed by Arellano and Bover (1995) as in equation (1).

The critical value of export concentration can also be calculated for each set of estimates, by setting the derivative of log of GDP with respect to export concentration to zero. The first order condition of optimization is used to arrive at the critical value of export concentration (CCI*). Equation (1) can be written in the following way when the explanatory variables include the lagged dependent variable, export concentration and squared export concentration, and control variables like export and gross capital formation:

$$Y_{ct} = \alpha_0 + \alpha_1 Y_{c\,t-k} + \alpha_2 CCI_{ct} + \alpha_3 CCI^2_{ct} + \alpha_4 I_{ct} + \alpha_5 XP_{ct} + \eta_c + u_{ct} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)'$$

Partially differentiating this equation with respect to CCI and equating that to zero yields the critical value of CCI in the following way:

$$\frac{\partial Y}{\partial CCI} = \alpha_2 + 2\alpha_3 CCI = 0$$

$$CCI^* = -\frac{\alpha_2}{2\alpha_3} > 0$$

The nonlinearity in the relationship between export concentration and GDP implies that income falls with export concentration up to a critical level and then with specialization income increases. The critical level of CCI, CCI*, is that level of export concentration at which turnaround in GDP occurs. The estimated coefficient of export concentration is negative as lower is the value of CCI more diversified will be the export basket and higher will be GDP growth. But the squared term of export concentration is positive. Thus the critical level of export concentration is a positive number.

Further, it can be checked that the second order condition for minimization is also satisfied with the second partial derivative of log of GDP with respect to export concentration given by the estimated coefficient of squared export concentration is positive:

$$\frac{\partial^2 Y}{\partial CCI^2} = 2\alpha_3 > 0$$

4.3. Data Sources

The data on cross country GDP (constant 2000 US$), exports (constant 2000 US$), gross capital formation (constant 2000 US$), and the infrastructural variables are obtained from World Bank's World Development Indicators (WDI CD Rom 2007). However, data on most infrastructure variable were available from 1975 onwards. The measures of export diversification and composition, CCI and HTX of the individual countries of the sample with respect to the world market has been calculated using World Bank data (World Integrated Trade Solution or WITS data) at the SITC-1 four digit classification level from 1965 to 2005. The variable capturing the export of a country relative to the world market is obtained from WDI 2007.

However, data on some variables including infrastructure variables and diversification and composition of exports were not available for some countries. As a result, some countries were eliminated reducing the sample size to 65, which are then classified in four sub-samples- positive relation (23 countries), negative to positive relation (23 countries), positive to negative relation (15 countries) and negative relation (4 countries). As data for certain cross section units in the sample are missing in some years, the dataset is an unbalanced panel.

5. Estimation Results

The GMM dynamic panel estimation results for the separate country groups and for the sample as a whole, as reported in Tables 3-7, reflect the effect of changes in various explanatory variables like export and investment on changes in income. These estimation results however do not bring into forth the effect of any time-invariant omitted variable including economic geography or institutional quality. Two period lag of the dependent variable and all the predetermined variables have been used as instruments[8]. The instrumentation strategy takes care of the possibility of endogeneity of the explanatory variables. In all the estimations except for the group with negative relationship[9] the Sargan tests for over identifying restrictions give p-values that show the validity of the instruments.

[8] Akaike Information Criterion (AIC) has been used to determine the optimum lag length.

[9] The number of cross section is very small (only 4) in the country group where export-growth association was negative throughout. The Sargan statistic rejects the accuracy of the instruments raising doubts on the estimates. Hence the estimation results for this particular group of countries are not reported.

By estimating different sub-samples separately this paper tries to solve the "lump-together" problem inherent in estimates of panel data. Other than the aforementioned four groups separate estimation is also done by excluding the African countries from the all-country group. [10] It is found that the coefficient of lagged income is high being significant at 1% in all the estimations for separate individual country groups. This shows the persistence of growth across country groups. Both export and investment have the predicted positive and significant impact on growth in all the cases.

Even though lagged income, exports and investment are found to impact on economic growth across country groups, the impact of export diversification on economic growth is no less important. The impact of CCI is found to be negative and significant in all the country groups except for the group with export-economic growth relationship changing from being positive to negative. This estimation is done controlling for other variables including lagged income, export and investment. The negative sign of the coefficient of CCI implies that export concentration adversely affects economic growth. However, as is evident from Figure 1, the relationship between export diversification and income is nonlinear. Taking account of non-linearity by including a squared term of export concentration along with the linear term, the results improve across country groups. The squared term as well as the linear term is significant in all the estimations but the squared term impacts on economic growth positively whereas the linear term has negative impact on growth. Therefore, the GMM estimation results confirm the nonlinear association between export diversification and growth. The nonlinearity implies that though export diversification has positive impact on income but beyond a certain level of export concentration the trend is reversed so that export specialization leads to growth. Moreover, the nonlinearity exists in all the estimations.

The interaction term of export concentration with a variable measuring a country's export volume relative to world average export has also been included.[11] In all the estimations the interaction term is significant with negative sign meaning that the favourable effect of export diversification

[10] This is because economic performance of the African economies since the early seventies has been worse compared to developing countries and least developed countries in other regions and often contradicted the explanations offered by the empirical growth literature.

[11] In the OLS as well as instrumental variable estimation methods Agosin (2007) found that an interaction term of diversification with rate of growth of export was significant implying that the effect of diversification is stronger when a country's exports are growing rapidly than alone. However, the interaction term is found to be insignificant in the GMM dynamic panel estimation with a larger set of sixty five countries even for the period 1980-2005. The 'diversification-weighted' export growth was found to be significant only if the dataset is limited to Asia and Latin America.

on growth is stronger when exports of a country is greater than world average export. If export of a country grows at a very fast rate but the volume of export is low compared to other globalizing counties as was the case with India and other emerging economies it is better to incorporate the volume of exports than its growth rate.[12]

The impact of export composition, captured by high technology exports as percentage of manufacturing exports, on economic growth is positive and significant in case where only a linear specification in export concentration is considered both in the pooled sample as well as in the group for which export-growth relation changed from being negative to positive. The positive sign implies that the larger the share of high technology exports, higher will be economic growth. However, as is evident from Tables 3-7, the variable ceases to be significant when the non-linear specification in export concentration is considered. The effect of export composition on growth thus weakens in a non-linear specification in export composition.

Accounting for the impact of infrastructure through an alternative specification presented in equations (3) and (4) gives somewhat different results. In all the cases, the null hypothesis in Sargan test fails to be rejected implying validity of the instruments. The values of the estimated coefficients of exports, $\hat{\beta}_2$, obtained from equation (3) for different country groups are given in Table 8 in the Appendix[13]. $Y^*\hat{\beta}_2$ can be interpreted as the trade induced effect on economic growth, controlling for the effects of other explanatory variables. The GMM dynamic panel results of equation (4) presented in Table 9 show that the coefficients of the lagged value of the dependent variable is high and significant in all the cases. Infrastructure also has expected positive impact on growth for all the country groups. The significance of the squared export concentration confirms nonlinearity of export diversification and growth relationship in this alternative specification as well. Export composition, in this alternative specification, has positive significant impact on growth. This contrasts the results of the earlier specification showing the insignificance of export composition. On the whole, the alternative specification yields improved estimates of the variables.

[12] Interaction of relative export growth rates with the dummy variable representing a country's share in total world export is also intended to be done to incorporate a measure of a country's comparative advantage.

[13] The estimation results of equation (3) are not reported. All the explanatory variables-lagged income, export, investment are significant in all the estimations except for the group where export-economic growth relation is negative throughout. For this particular group export is insignificant as is expected since the export-growth association is negative for these countries. So this alternative specification is not estimated for this country group. In all other casers the Sargan tests of over identifying restrictions are satisfied implying the validity of the instruments.

Therefore export diversification has significant impact on economic growth and the relationship is nonlinear. The impact of export composition is found to improve in the two-stage estimation process when the impact of exports on growth is estimated first and infrastructure is included as a control variable. Infrastructure also has a significant positive impact on economic growth. The results of individual country groups as well as for the pooled sample excluding African countries are not very different from each other implying their robustness.

The nonlinearity between export concentration and income implies that given other factors, economic growth across countries increase with diversification of export basket up to a critical level of export concentration. The pattern reverses showing increasing specialization being related to higher growth. The U-shaped relationship between concentration and income is evident in Figure 4. Income falls with concentration up to a critical level and then with specialization income increases. The export concentration level at which turnaround in GDP occurs is the critical level of CCI, CCI*.

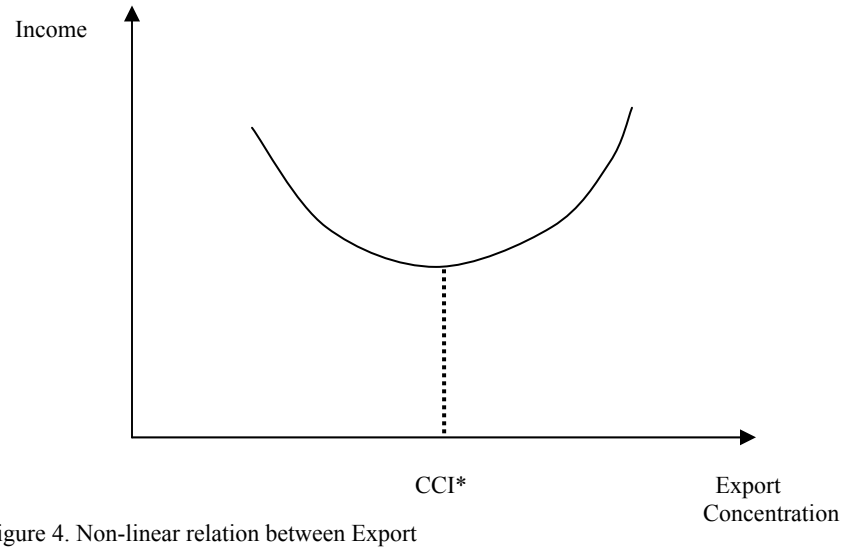


Figure 4. Non-linear relation between Export Concentration and Income

The coefficients obtained from the GMM dynamic panel estimations have been used to compute the critical level of specialization at which the point of minimum income occurs. The critical values of CCI for different country groups are given in Table 10:

Table 10. Critical Values of export concentration for different country groups

Country group	The critical values of CCI
All country	51.9
All country without Africa	60.24
Positive Relation	45.54
Negative to Positive Relation	79.37
Positive to Negative Relation	36.23

It is evident from Table 10 that the critical level of export concentration differs from one group of countries to others. Comparison of the critical levels across country groups reveals that in the group where the export growth-economic growth relationship changed from being positive to negative the turning point is reached much earlier- at a CCI value of 36.23. This particular group includes developed economies like USA, Australia, Germany etc and ten Latin American countries. The developed countries are generally predicted to specialize (Imbs and Waczirag, 2003) and the Latin American countries also have concentrated export structure. For this particular group, force of specialization dominates over diversification much earlier and hence the critical level of export concentration, CCI*, is lower than that for other group of countries. In contrast, the group where export growth-economic growth relationship changes from being negative to positive, specialization is associated with growth only at a very high value of CCI 79.37. This group consists of many of the developing countries including some of the fast growing Asian countries like India, Indonesia, Sri Lanka which have diversified their export structure over time[14]. Thus for this group export diversification drives growth till a very high level of export concentration.

On the whole, the trade-growth relationship is much more nuanced in this exercise. Economic growth not only depends on higher trade, but export diversification or specialisation is the key to growth. A U-shaped relationship between export concentration and income is found to exist in separate country groups as well as in the pooled sample. These results are arrived at controlling for other determinants of growth including lagged growth, investment, exports and infrastructure. The present study confirms export diversification to be an important determinant of economic growth across countries as in the studies by Agosin (2007), Lederman and Maloney (2007), Hesse (2008). Moreover, the relationship between the two is non-linear as found by Hesse (2008). The

[14] Agosin (2007) attributed export diversification to be an important factor to the differences in growth performance of Latin America compared to Asia.

present study not only confirms non-linearity but also identifies the critical level of export concentration. The present paper investigates the relationship between export diversification and economic growth for separate country groups classified into four sub-panels based on export growth-economic growth association. The study also controls for the effect of one of the important determent of economic growth, infrastructure, which other studies have not taken into account. However, the present paper differs with one of the findings of Agosin (2007) that the effect of diversification is stronger when exports grow at a faster rate. Rather the study finds the importance of export volume. Export diversification is found to have stronger impact on economic growth when export of a country is greater than world average export. The paper also establishes the importance of export composition. However, one caveat of the present study is that human capital like education, skill formation which is considered to be an important determinant of economic growth in the endogenous growth theories could not be included because of lack of availability of data.

6. Conclusion

The present study reconciles various theoretical arguments regarding export diversification and specialization. In a sample of sixty five countries for the period 1965-2005 the GMM dynamic panel estimation reveals that export diversification is associated with economic growth after controlling for the variables like lagged growth, investment, exports and infrastructure. The study also confirms that the relationship between export concentration and income is nonlinear as implied by the significance of the squared term of export concentration. The impact of export diversification is also found to be stronger when exports of a country are greater than world average export. Moreover, the paper to some extent solves the problem of using panel data by classifying countries into four sub-panels based on the difference in export-economic growth relation as panel data treats all the cross-section units as a whole, not as separate units. The study establishes that export diversification had significant impact on economic growth and the relationship between the two is non-linear when all the countries are considered and for the individual country groups. However, the impact of export composition on economic growth is not significant in all the estimations, especially when the nonlinearity between income and export concentration is taken into account. In the alternative specification where the dependent variable is the trade-induced growth component the significance of composition of export improves. Further, the estimation results are used to calculate the critical level of export concentration corresponding to minimum GDP. These critical values are different for each country group with

the lowest for the group in which the export growth-economic growth relationship changed from being positive to negative and the highest for the group where the relationship changed from negative to positive.

The nonlinearity between export concentration and income established by the present study has important policy implications. Economic growth increases with diversification up to a critical level of export concentration beyond which specialization is related to higher growth. Therefore, depending on the critical level of export concentration appropriate policies should accordingly be formulated to achieve the desirable pattern and composition of export for different groups of countries and strengthen the export growth–economic growth nexus. The policy implications from these findings suggest an emphasis on diversifying exports when the observed level of export concentration is less than the critical level. But when it exceeds the critical level countries can specialize by achieving more efficient production pattern. A prerequisite for export diversification would be to diversify the production structure of the domestic economy. This implies rather than relying on endowment based comparative advantage policies should be formulated to create comparative advantage by employing human capital as emphasized by the endogenous growth theories. Development of infrastructure should also be given importance as it leads to reduction in transactions cost to trade. In the developing countries there is need for appropriate policies for the development of financial sector, coordination of investments between different sectors and advancement of science and technology for innovation and information spillovers to generate dynamic comparative advantages and create conditions for higher growth.

Appendix

A.1. Table 2. List of counties

Positive Relation in both periods	**Negative to Positive Relation**
Cameroon	Algeria
Congo, Rep.	Austria
Costa Rica	Bangladesh
Cote d'Ivoire	Canada
Denmark	Chile
Gabon	Colombia
Greece	Egypt, Arab Rep.
Guatemala	Finland
Hong Kong, China	France
Hungary	Iceland
Ireland	India
Japan	Indonesia
Malaysia	Italy
New Zealand	Morocco
Norway	Netherlands
Philippines	Pakistan
South Africa	Portugal
Sweden	Spain
Switzerland	Sri Lanka
Thailand	Syrian Arab Republic
Trinidad and Tobago	Togo
United Kingdom	Zambia
Uruguay	Zimbabwe
Lesotho*	Belgium*
Luxembourg*	Mali*
Malawi*	
Rwanda*	**Positive to Negative Relation**
Swaziland*	Argentina
Uganda*	Australia
	Bolivia
	Brazil
Negative Relation in both periods	Dominican Republic
Benin	Ecuador
Honduras	El Salvador
Iran, Islamic Rep.	Germany
Kenya	Hungary
Burkina Faso*	Mexico
Nigeria*	Nicaragua
	Paraguay
	Peru
	Tunisia
	United States
	Gambia*
	Senegal*

* These countries are not included in final estimation due to unavailability of data on various aspects.

A.2. Estimation Results

Table 3. All Country Group (65 Countries):

Explanatory Variable	(1) 1965-2005	(2) 1965-2005	(3) 1965-2005	(4) 1965-2005	(5) 1965-2005
Y(-1)	0.86* (0.00)	0.84* (0.00)	0.84* (0.00)	0.86* (0.00)	0.86* (0.00)
XP	0.03** (0.002)	0.03* (0.00)	0.08* (0.00)	0.03* (0.00)	0.03* (0.00)
I	0.07* (0.00)	0.06* (0.00)	0.04* (0.00)	0.08* (0.00)	0.07* (0.00)
CCI	-0.0008** (0.001)	-0.003* (0.00)		-0.0008** (0.001)	-0.003** (0.004)
CCI^2		2.89E-05* (0.00)			2.13E-05*** (0.04)
$CCI*D_X$			-0.002* (0.00)		
HTX				0.0002* (0.00)	2.56E-05*** (0.08)

Dependent variable: Y= log of GDP (constant 2000 US $)
Explanatory variables: XP= log of exports of goods and services (constant 200 US$)
I= log of investment as proxied by gross capital formation
CCI= commodity concentration index
HTX= high-technology exports as percentage of manufacturing exports
Note: 1. p values in parentheses,
2.* denotes significant at 1%, ** denotes significant at 5%, *** denotes significant at 10%.

Table 4. All Country without Africa (51 Countries):

Explanatory Variable	(1) 1965-2005	(2) 1965-2005	(3) 1965-2005	(4) 1965-2005	(5) 1965-2005
Y(-1)	0.81* (0.00)	0.83* (0.00)	0.83* (0.00)	0.82* (0.00)	0.82* (0.00)
XP	0.07* (0.00)	0.04* (0.00)	0.07* (0.00)	0.03* (0.00)	0.04* (0.00)
I	0.05* (0.00)	0.1* (0.00)	0.04* (0.00)	0.1* (0.00)	0.1* (0.00)
CCI	-0.0003* (0.00)	-0.002* (0.00)		-0.0001*** (0.08)	-0.002* (0.00)
CCI^2		1.66E-05* (0.00)			2.24E-05* (0.00)
$CCI* D_X$			-0.002* (0.00)		
HTX				0.0004* (0.00)	0.0002 (0.1)

Dependent variable: Y= log of GDP (constant 2000 US $)
Note: 1. p values in parentheses,
2.* denotes significant at 1%, ** denotes significant at 5%, *** denotes significant at 10%.

Table 5. Positive Relation Group (23 Countries):

Explanatory Variable	(1) 1965-2005	(2) 1965-2005	(3) 1965-2005	(4) 1965-2005	(5) 1965-2005
Y(-1)	0.82* (0.00)	0.67* (0.00)	0.78* (0.00)	0.65* (0.00)	0.6* (0.00)
XP	0.05** (0.001)	0.14* (0.00)	0.05* (0.00)	0.18* (0.00)	0.2* (0.00)
I	0.09* (0.00)	0.11* (0.00)	0.1* (0.00)	0.1* (0.00)	0.08* (0.00)
CCI	-0.002*** (0.04)	-0.005* (0.00)		-0.001*** (0.07)	-0.01* (0.00)
CCI^2		5.49E-05* (0.0002)			9.78E-05** (0.001)
CCI* D_X			-0.001* (0.0001)		
HTX				-0.0003 (0.3)	-0.0008 (0.1)

Table 6. Negative to Positive Relation Group (23 Countries):

Explanatory Variable	(1) 1965-2005	(2) 1965-2005	(3) 1965-2005	(4) 1965-2005	(5) 1965-2005
Y(-1)	0.76 (0.00)	0.86* (0.00)	0.74* (0.00)	0.87* (0.00)	0.88* (0.00)
XP	0.1* (0.00)	0.06* (0.00)	0.12* (0.00)	0.04* (0.00)	0.04* (0.00)
I	0.08 (0.00)	0.04* (0.00)	0.1* (0.00)	0.05* (0.00)	0.05* (0.00)
CCI	-0.003*** (0.06)	-0.004** (0.005)		-0.001* (0.00)	-0.003*** (0.08)
CCI^2		2.52E-05*** (0.04)			1.32E-05*** (0.03)
CCI* D_X			-0.003** (0.006)		
HTX				0.0006* (0.00)	0.0003 (0.4)

Table 7. Positive to Negative Relation Group (15 Countries):

Explanatory Variable	(1) 1965-2005	(2) 1965-2005	(3) 1965-2005	(4) 1965-2005	(5) 1965-2005
Y(-1)	0.82* (0.00)	0.81* (0.00)	0.78* (0.00)	0.73* (0.00)	0.68* (0.00)
XP	0.03* (0.00)	0.06* (0.00)	0.04* (0.00)	0.09*** (0.01)	0.17*** (0.06)
I	0.1* (0.00)	0.09* (0.00)	0.1* (0.00)	0.12* (0.00)	0.08*** (0.03)
CCI	-9.79E-05 (0.5)	-0.002*** (0.02)		-0.0004 (0.8)	-0.006 (0.4)
CCI^2		2.76E-05*** (0.01)			6.03E-05 (0.4)
CCI* D_X			-0.001* (0.00)		
HTX				0.0002 (0.6)	0.0007 (0.5)

Dependent variable: Y= log of GDP (constant 2000 US $)
Note: 1. p values in parentheses,
2.* denotes significant at 1%, ** denotes significant at 5%, *** denotes significant at 10%.

Table 8. The estimated coefficient of export of equation (3) for different country groups

Country group	Value of the estimated coefficient of export
All country	0.08
All country without Africa	0.08
Positive Relation	0.13
Negative to Positive Relation	0.15
Positive to Negative Relation	0.06

Table 9.

Explanatory Variable	**All Country 65 Countries, 1975-2005**	**All Country without Africa 51 Countries, 1975-2005**	**Positive Relation 23 Countries, 1975-2005**	**Negative to Positive Relation 23 Countries, 1975-2005**	**Positive to Negative Relation 15 Countries, 1975-2005**
$Y^*\hat{\beta}_2(-1)$	0.96* (0.00)	0.95* (0.00)	0.88* (0.00)	0.98* (0.00)	0.98* (0.00)
ISI	0.004** (0.001)	0.003* (0.00)	0.01** (0.003)	0.002*** (0.01)	0.004*** (0.06)
CCI	-0.0004* (0.00)	-0.0002* (0.00)	-0.001* (0.00)	-0.0001** (0.001)	-0.0004** (0.005)
CCI^2	3.31E-06* (0.00)	0.0002*** (0.06)	7.60E-06** (0.002)	3.22E-07*** (0.02)	3.59E-06*** (0.08)
HTX	8.98E-05* (0.00)	0.00012* (0.00)	0.0001*** (0.04)	0.0001** (0.001)	2.96E-05*** (0.04)

Dependent variable: log of GDP (constant 2000 US $) multiplied by the estimated coefficient of export
Explanatory variables: ISI= Infrastructure Stock Index
CCI= commodity concentration index
HTX= high-technology exports as percentage of manufacturing exports
Note: 1. p values in parentheses,
2.* denotes significant at 1%, ** denotes significant at 5%, *** denotes significant at 10%.

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