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Exports and Economic Growth: An Empirical Investigation Using Panel Data

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ABSTRACT

An augmented neoclassical production function developed by Feder (1982) is used to explore the presence of marginal externality effects of exports and intersectoral factor productivity differentials between exporting and nonexporting sectors. The parametric differences among countries are investigated. We estimate coefficients for marginal externalities of exports and the intersectoral factor productivity differentials using cross-country and panel data for 69 low- and middle-income countries. The fixed and random effects models are used to appraise the existence of parametric differences among the nations. This paper also examines the robustness of the linkages between export-expansion and economic growth by using different levels of aggregation of cross-country and panel data sets.

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1. Introduction

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July 1995

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Exports and Economic Growth: An Empirical Investigation Using Panel Data

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An augmented neoclassical production function developed by Feder (1982) is used to explore the presence of marginal externality effects of exports and intersectoral factor productivity differentials between exporting and non-exporting sectors. The parametric differences among countries are investigated. We estimate coefficients for marginal externalities of exports and the intersectoral factor productivity differentials using cross-country and panel data for 69 low and middle income countries. The fixed and random effects models are used to appraise the existence of parametric differences among the nations. This paper also examines the robustness of the linkages between export-expansion and economic growth by using different levels of aggregation of cross-country and panel data sets.

I. Introduction

There has been increasing interest among development economists in the study of the relationship between export-expansion and economic growth. Advocates of export-oriented policies argue that the exporting sector has positive spillover effects on the rest of the economy. The exporting sector experiences greater factor productivity, efficient resource allocation, more rapid technological innovations, optimal capacity utilization, and higher economies of scale (Balassa, 1978, Krueger, 1980). Exporting may reduce X-inefficiency, improve product quality, and prevent the emergence of welfare-reducing domestic monopolies. On the other hand, Singer (1964) and Prebisch (1962) indicate that export expansion has a limited role in the economic growth of developing countries. Instead, they propagate "balanced growth" and "import substitution"

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approaches. Another view on trade is that it is a mechanism of exploiting the abundant resources of less developed countries (LDCs) by the developed countries, and hence, it results in the development of underdevelopment (Wilber & Jameson, 1987). Such divergence in the theoretical positions on the export-growth relationship has resulted in extensive empirical investigation of this proposition.

The linkages between export expansion and economic growth have been studied using several econometric tools. Michaely (1977), Balassa (1978), Tyler (1981), and Heller and Porter (1978) estimate the correlation coefficient between economic growth and export expansion using cross-section data. In many instances, such investigations indicate that export expansion is positively correlated with economic growth. Sheehey (1990) criticizes such analyses and suggests that there is a built-in correlation between exports and GDP. Jung and Marshall (1985) state that the ordinary correlation between export expansion and output growth is unable to discriminate between the export- promotion and the internally generated export hypotheses. It is also pointed out that correlation coefficient analyses do not have a firm theoretical basis (Edwards, 1993).

Michalopoulos and Jay (1973), Ram (1985), and Kavoussi (1984) use an export-augmented production function model to investigate the export-growth relationship in developing countries. These studies explain the externality effects of exports on the rest of the economy. Feder (1982) modifies the augmented production function to incorporate the mechanism such as the intersectoral relative factor productivity differential and the marginal externalities through which exports affect growth. He uses the modified augmented neoclassical production function and estimates the model using cross-section data from 1964 to 1973 for 31 semi-industrialized countries. Ram (1987) uses Feder's augmented production function with both cross-country and time-series data to study the possible parametric differences among 88 countries for two sub-periods of 1960-72 and 1973-82. Ram's (1987) results show that about 80 percent of the time-series regression analysis for individual countries have positive coefficient for exports, of which 50 percent have significant coefficients. The middle-income LDCs (less developed countries) have larger export coefficients than the low income LDCs. The cross-country regression results reinforce the results of time-series analyses. His results also indicate that cross-country analyses may provide significant F-statistics, whereas time-series provide insignificant F-statistics for those individual countries, pointing towards possible parametric differences among countries.

Jung and Marshall (1985), testing for causality using the Granger causality test for 37 developing countries for the period 1951-81, find evidence of unidirectional exports-to-growth causality only for four countries. Ahmad and Kwan (1991) examine the issue of export-led growth among 47 African nations. Their study indicates that no causal link exists between export and economic growth in African nations. In an investigation, Sung-Shen, Biswas, and Tribedy (1990) bring to surface previous studies examining the causal relation using time-series data which have ignored the trend properties of the data set and have arbitrarily chosen the number of lags of the explanatory variables. They incorporate tests for stationarity and methods of deciding appropriate number of lags in the causality tests and show that there is a bidirectional relation between export expansion and GDP growth in Japan, Korea, and Taiwan. The causality between exports and economic growth is also investigated using the vector autoregression (VAR) framework. Sharma, Norris, and Cheung (1991) investigate the causal relationships between growth, exports, and factor inputs in five industrialized countries over the period 1960-87 by analyzing a four-variable VAR model for each country. They conclude that Germany and Japan support export-led growth hypothesis and that the UK and that the US have reverse causality.

In summary, the empirical investigations of the export-growth relationship using the neoclassical production function indicate that exports create positive externalities and that there exists productivity differential in favor of the exporting sector (Feder, 1982, Ram, 1987). However, questions have been raised concerning the level of aggregation of the data set and the inability of separate analysis of cross-section and time- series data sets to reveal the existence of intercountry differences in behavior, technologies, and institutions. Ram (1987) attempts to address the issue of parametric differences by considering the estimation results of both cross-country and time-series models together.

Most empirical investigations conclude that export-expansion and economic growth are positively related, but the issue of parametric differences among nations has not been resolved. In addition, the level of aggregation of data sets used in previous studies raises a concern whether the recommendations of these studies can be extended to all low- and middle-income countries (Dodaro, 1993). Furthermore, Levine and Renelt (1992) caution that cross-country regression examining the empirical linkages between long-run growth rates and a host of macrovariables and political and institutional indicators are found to be sensitive to small changes in the conditioning sets. In this paper, we extend the earlier works using annual cross-country and panel data for 69 countries for the period of 1961-92. We examine whether the regression estimates display the robustness by changing the level of aggregation[2] of the data sets based on ex-post stratification criterion[3]. We also test for the existence of parametric differences across nations using the panel data.

This paper is organized as follows. Section II presents the model and describes the data used in this study. Section III explains the econometric issues examined in the paper and section IV presents the empirical results. Section V presents the summary and conclusions.

II. The Model and the Data

A. The Model

A neoclassical production function is used to account for the contributions of labor and capital inputs to economic growth. Exports are included as one of the inputs to account for their contributions to the overall GDP. As hypothesized earlier, exports have positive externalities on the rest of the economy and have intersectoral factor productivity differential. Thus it is plausible to specify a neoclassical production function with exports as one of the inputs considered to account for growth in the output (Balassa, 1978, Michalopoulos and Jay, 1973). The model used in the study

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[2] "Every model is an approximation to the unknown, but true, underlying system of the economy. Models estimated at different levels of aggregation are different approximation of the same system (Klein & Young, 1980)." By working with desegregated data, we attempt to study and compare the strength of export-expansion and economic growth linkages in different groups of countries.

[3] Countries are stratified into low-income economies with 1986 GNP per person of $425 or less, lower middle-income economies with 1986 GNP ranging between $1,810 per person and $425, and upper middle-income economies comprised of countries with 1986 GNP per person of $1,810 or more (World Development Report, 1988).

is represented by equation (1).

(1) $$Y = f\,(\,L,\ K,\ X\,)$$

where Y is the aggregate output, L and K are labor and capital inputs respectively, and X is exports. With some manipulations, the above equation can be given the following econometric specification:

(2) $$\dot{Y} = \beta_o + \beta_l\,\dot{L} + \alpha_k\left(\frac{I}{Y}\right) + \beta_x\,\dot{X} + u$$

where the variables with a dot over indicate the rate of change in the variables, and $\frac{I}{Y}$ is the investment-output ratio. A constant β_o and a classical stochastic disturbance u terms are included in the model. In the above equation, β_l and β_x are the elasticities of output with respect to labor and exports, and α_k is the marginal product of capital. The above model has the flexibility to include other non-conventional inputs such as the size of government.

To estimate the coefficients for marginal externalities and intersectoral productivity differentials, an augmented growth model developed by Feder (1982)[4] is adopted. This formulation makes some simplifying assumptions: (a) the economy is divided into two sectors, namely export and non-export, (b) output in the exporting sector has positive externalities on the non-exporting sector, and (c) exporting and non-exporting sectors have different relative marginal productivities. The econometric form of the model is as follows:

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[4] See Feder (1982) for derivation of the model.

$$(3) \qquad \dot{Y} = \alpha_o + \alpha_1 \left(\frac{I}{Y}\right) + \beta_l \dot{L} + \left(\frac{\delta}{1+\delta} + F_x\right) \left(\dot{X} \frac{X}{Y}\right) + \epsilon$$

where δ denotes the intersectoral relative factor productivity differential, α_o is the intercept, α_l is the marginal product of the capital, β_l is the elasticity of the output with respect to labor, F_x indicates the marginal externalities effect of the exporting sector on the rest of the economy, and ϵ is the classical stochastic disturbance term.

The econometric model represented by equation 2 presents the aggregate effects of the exporting sector on the non-exporting sector and lacks the ability to explain the mechanism through which exports affect output. The model presented by equation 3 overcomes this limitation. However, the coefficients for these mechanisms cannot be estimated separately. To estimate these coefficients, further modification of equation 3 is suggested by Feder (1983). Equation 4 presents the econometric model which can estimate marginal externalities of exports and intersectoral factor productivity differential coefficient.

$$(4) \qquad \dot{Y} = \alpha_o + \alpha_1 \left(\frac{I}{Y}\right) + \beta_l \dot{L} + \left(\frac{\delta}{1+\delta} - \theta\right) \left(\dot{X} \frac{X}{Y}\right) + \theta \dot{X} + v$$

where α_o is the intercept term, α_l is the marginal product of capital, β_l is the elasticity of the output with respect to labor, θ is the marginal externalities of exports, and v is the stochastic disturbance term. However, it is difficult to include other unconventional inputs along with exports in the model shown by equation 4.

Before we proceed further, it would be appropriate to explain why we use a common production function for all countries. Hayami and Ruttan (1985) hypothesize the existence of a metaproduction curve to represent the technical change in the agricultural sector in which research is conducted by public institution. They state that the metaproduction curve is the envelope of the most efficient production points available in the world. In this study, we assume the existence of a metaproduction function that can be regarded as an envelope of commonly conceived neoclassical production functions of different countries.

B. Data

Annual observations on nominal GDP, exports of goods and services, gross domestic investment, population, and GDP overall deflator for 69 countries for the period 1960-1992 are obtained from the World Bank's Socioeconomic Time-Series Access & Retrieval System (STARS, 1992). For Taiwan, the data are obtained from Taiwan Statistical Data Book (1993), published by the Council for Economic Planning and Development, Republic of China. It is generally difficult to obtain reliable data on labor force for many of the low income countries, and population data are likely to be better than the labor force data. We use the rate of population growth as a proxy for the rate of growth of labor force. Balassa (1978) points out that aggregate output is more appropriate than output net of exports in such studies. We use the rate of growth of constant-price GDP as the proxy for rate of growth of aggregate output. GDP is preferred over GNP, as this study examines a production relation and not a national income identity. In addition, investment income depends on the stock of net foreign assets (Lawrence, 1989). The constant-price exports of goods and services data is used to compute $\dot{X}$ The constant-price gross domestic investment and GDP are used to compute $\frac{I}{Y}$. We combine the annual times-series data for 69 countries over 1961-92 for panel data analysis. For cross-country estimations, growth rates of the variables during 1961-92 are obtained by fitting exponential trend equations, and the ratios are calculated by taling simple averages of the basic variables. The sample includes low- and middle- income countries and excludes major oil exporting countries. Thus, we prevent any kind of direct selection bias in the sample. The variables are LDOT, IOY, ZDOT, and XDOT for rate of change of population, constant-price gross domestic investment-income ratio, constant-price ratio of change in export and output, and rate of change of constant-price exports, respectively.

III. Econometric Formulation

In this section we elaborate on several econometric tools that are used in this study. Issues pertaining to panel data estimation are discussed, and we present the econometric framework used for empirical estimation. Estimation techniques which use the temporal and cross-country nature of panel data are discussed. The panel data analysis is also extended to examine the presence of parametric differences.

A. Models for Panel Data

Panel data, when compared to time-series and cross-country data, provide more data points and thus greater degrees of freedom, reducing the collinearity among the explanatory variables and enhancing the efficiency of estimated regression parameters. Panel data provide the flexibility to examine and control the effects of missing or unobserved variables (Hsiao, 1986). In addition, panel data inherit the heteroscedastic and autoregressive nature of cross-country and time-series data, respectively.

To accommodate the temporal cross-country nature of the data set, we relax some of the assumptions of the classical linear regression model such as $Var[\varepsilon_{it}] = \sigma^2$ and $Cov[\varepsilon_{it}, \varepsilon_{js}] = 0$, if $t \neq s$ or $I \neq j$, while assuming presence of no parametric differences among countries and over the time horizon. We obtain nine models by crossing three contemporaneous covariances with the three autocorrelation specifications[5]. We examine four models, out of the nine models estimated, based on the setting of the model and some econometric issues explained in the following paragraphs. One of the motives behind examining four estimation procedures is to observe whether the estimated coefficients gain efficiency by relaxing some of the assumptions of classical regression model. At the outset, it would be appropriate to state that the asymptotic properties of the estimation procedures are based in terms of $N \rightarrow \infty$ and $T \rightarrow \infty$, where N and T refer to the numbers of countries and time periods, respectively.

First, we estimate the model maintaining all the assumptions of the classical regression model. Since the magnitude of the error terms may vary across countries, we test for heteroscedasticity of the error using the Lagrange Multiplier (LM) test. If the test statistic indicates the presence of heteroscedasticity, we relax the assumption of homoscedasticity and obtain a

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[5] LIMDEP Version 6.0 is used for empirical estimation.

countrywise heteroscedastic and nonautocorrelated model. The two-step feasible generalized least square (FGLS) procedure is used for estimation. The model specification is tested using the Wald test.

It is probable that some macroeconomic variables, institutional, and technological characteristics affect countries in varying degrees. We may find that due to increasing ties and exchange among countries, an economic boom or recession in one country may have some effect in other countries. Therefore, it would be appropriate to allow for contemporaneous correlation of the disturbances among countries, and we estimate a model with countrywise heteroscedasticity with cross-country correlation using the FGLS estimation method. The presence of cross-country correlated errors is tested using the LM test statistic.

The pooled regression models that we discussed so far are estimated on the assumption that the error-terms are nonautoregressive. For the time-series data, the error-terms may be autocorrelated, so the assumption of nonautocorrelation must be relaxed. We estimate the model using the Prais-Winsten transformation in conjunction with the FGLS and compute the common autocorrelation coefficient. As we have long time-series for each country, we may find it more appropriate to use countrywise specification of autocorrelation. We estimate a model which allows for countrywise heteroscedasticity, cross-country correlation, and country-specific autocorrelation.

B. Parametric Differences

Most cross-country analyses of the relationship between export-expansion and economic growth overlook the possibilities of parametric differences. Some differences in the institutional and technological characteristics of individual economies are expected. The use of cross-section data in some of the previous studies have imposed a common structure on the neoclassical production function model and invariably ignored the issue of parametric differences among nations. One of the advantages of panel data analysis is that it allows for the analysis of differences across countries.

In panel data analysis, the role of the omitted variables can be treated either as a fixed constant over time for each country or an individual specific effect like a random variable. However, it is not easy to decide what would be the most appropriate treatment of error-terms necessary to explain the differences in behavior of countries. Hsiao (1986) states that if the effects of omitted variables can be appropriately summarized by a random variable and the individual effects represent the ignorance of the investigator, it does not seem reasonable to treat one source of ignorance as fixed and the other source of ignorance as random. It is up to the investigator to decide whether to make inference with respect to the population characteristics or only with respect to the effects that are in the sample (Hsiao, 1986). In this study, we estimate models to assess individual effects both as fixed to countries as well as to random observations.

1. Fixed and Random Effects Models

The analyses of parametric differences are carried out by testing for random and fixed effects. Models are used to study the interspacial differences in technological, institutional, and other characteristics of countries. A time-series-cross-section model can be specified as:

$$(5) \qquad Y_{it} = \beta_i X_{it} + \gamma_i \mu_i + \varepsilon_{it}$$

where μ_i is the individual effect. There are two different treatments of the individual effect. In the fixed effect or least square dummy variable model, μ_i is considered as a fixed but unknown constant differing among countries. To test whether the constant term statistically differs among cross-sectional units, we include country specific dummy variables. Thus, we carry out a least square regression with *N-1* dummy variables and examine their statistical significance.

The fixed effect or least square dummy variable (LSDV) model is found to be an appropriate method when it is reasoned that the differences among countries can be viewed as parametric shifts of the regression function. In an alternative specification known as the random effects or variance components model (VCM), we assume that μ_i is drawn from an *iid* distribution, $\mu_i \sim N(0, \sigma^2_\mu)$ and is not correlated both with the ε_i and with the explanatory variables. We have the following specification for the VCM model:

(6) $Y_{it} = X_{it}\beta + \eta_{it},$

where $\eta_{it} = \mu_i + \varepsilon_{it}$. μ_i is hypothesized to be the random disturbance characterizing the *i*th cross-sectional unit and is constant through time. We assume that $E[\mu_i] = 0$, $Var[u_i] = \sigma^2_\mu$ and $Cov[\varepsilon_{it}, \mu_i] = 0$. The efficient estimator for the random effect model is a generalized regression model, and a two-step FGLS estimation procedure is used in this paper.

Three specification tests have been performed to determine the presence of parametric differences. These tests are the conventional F-test, the Breusch and Pagan's LM test, and the Hausman test. A simple *F* test is carried out to distinguish between fixed effect and the pooled regression model. A significant *F*-statistics indicates the presence of fixed effect. A significant Breusch and Pagan's LM statistic indicates the presence of random effect. A significant Hausman's chi-squared statistic shows the presence of fixed effect as opposed to random effect.

C. Cross-Section Regression Analysis

We prepare the cross-country data for each country for 1961-92 by taking simple averages of the variables. The cross-country regression analysis is carried out to examine the robustness of the empirical linkages between exports and growth, as well as to compare the results with previous studies such as Ram (1987), Feder (1982), and Balassa (1985). We estimate equations (3) and (4) using cross-country data set by ordinary least squares.

IV. Econometric Results

A. Cross-Country and Panel Data Analysis Results

Results of cross-section regression analysis based on the complete data set, and also on data set for low-, lower- and upper-middle income countries, are presented in Table 1. These results compare reasonably well with those of Ram (1987), Feder (1982), and Balassa (1985) which are also reported in Table 1. Empirical results using equations (3) and (4) indicate that there is a significant positive relationship between exports and economic growth for low-, lower- and upper-middle income countries. It should be noted that for upper-middle income countries the goodness of fit as measured by R^2 improves.

Table 1

CROSS-COUNTRY REGRESSION RESULTS

	Parameters					
Equation	LDOT	IOY	XDOT	ZDOT	R^2	N
3[!]	0.66*	0.05		0.56*	0.53	69
	(2.56)	(1.31)		(6.25)		
4[!]	0.55*	0.02	0.37*	0.25*	0.79	69
	(3.21)	(0.80)	(8.99)	(3.56)		
3[@]	0.53	0.02		0.75*	0.38	31
	(1.47)	(0.45)		(3.35)		
4[@]	0.36	0.01	0.29*	0.31	0.54	31
	(1.11)	(0.23)	(3.16)	(1.31)		
3[#]	1.75*	0.02		1.20*	0.56	22
	(3.42)	(0.39)		(3.40)		
4[#]	1.51*	0.05	0.38*	-0.11	0.78	22
	(4.04)	(1.34)	(4.17)	(-0.27)		
3[$]	1.01	-0.09		0.57*	0.60	16
	(1.49)	(-0.43)		(2.59)		
4[$]	0.35	0.06	0.48*	0.16*	0.96	16
	(1.53)	(0.87)	(10.23)	(1.99)		
Ram (1987)						
1960-72	0.515*	0.090*	0.180*		0.38	88
	(2.20)	(3.25)	(4.59)			
1973-82	0.457	0.134*	0.302*		0.44	88
	(1.51)	(3.95)	(6.17)			
Feder (1982)						
1960-72	0.745*	0.122*	0.208*		0.67	30
	(3.23)	(3.19)	(5.10)			
1973-82	1.027*	0.191*	0.158*		0.39	30
	(2.56)	(2.95)	(1.75)			
Balassa (1985)						
1960-72	1.143*	0.201*	0.151*		0.62	42
	(3.43)	(5.08)	(3.42)			
1973-82	0.774*	0.035	0.339*		0.51	42
	(2.10)	(0.82)	(5.49)			

Note: Time period for the cross-country data is 1961-1992.
N is the number of countries included in the data-set.
t-statistics are in the parenthesis.
* Significant at 5 percent.
[!] complete data set.
[@] low income countries.
[#] lower-middle income countries.
[$] upper-middle income countries.

Table 2

PANEL DATA ANALYSIS:
GROUPWISE HETEROSCEDASTICITY,
CROSS-SECTIONALLY CORRELATED,
WITHIN- AND BETWEEN-GROUP AUTOCORRELATED

	Parameters				
Equation	I	LDOT	IOY	ZDOT	XDOT
3[!]	0.002	0.38*	0.14*	0.23*	
	(0.45)	(2.96)	(9.43)	(14.46)	
4[!]	0.0007	0.37*	0.14*	0.15*	0.03*
	(0.16)	(2.95)	(10.11)	(6.44)	(3.95)
3[@]	0.02*	0.14	0.07*	0.25*	
	(2.60)	(0.70)	(3.54)	(9.90)	
4[@]	0.02*	0.11	0.08*	0.05*	0.10*
	(2.55)	(0.57)	(3.93)	(4.86)	(2.60)
3[#]	-0.02**	1.03*	0.17*	0.19*	
	(-1.83)	(2.73)	(6.05)	(5.74)	
4[#]	-0.02**	0.97*	0.17*	0.49*	0.01
	(-1.85)	(2.64)	(6.33)	(2.97)	(0.22)
3[$]	-0.013	0.63*	0.20*	0.23*	
	(-1.45)	(3.20)	(6.15)	(8.72)	
4[$]	-0.01	0.65*	0.20*	-0.002	0.24*
	(-1.45)	(3.34)	(6.13)	(-0.14)	(6.44)

t-statistics are in parenthesis.
I is the intercept.
* and ** significant at 5 and 10 percent.
[!] complete data set.
[@] low income countries.
[#] lower-middle income countries.
[$] upper-middle income countries.

We estimate equations (3) and (4) using panel data comprising 69 countries over the period 1961-1992. In our estimation, we have corrected for heteroscedasticity, first-order autocorrelation, and cross-country correlation. Table 2 presents the results after these corrections have been incorporated[6]. Results reinforce the conclusions of cross-country analysis that export variables have significant positive coefficients for the complete data set, as well as for other country groups. In addition, coefficients for rate of growth of labor and investment-output ratio are also positive and

[6] Complete empirical results of panel data analyses are presented in appendix 1.

significant in most cases.

Table 3

ESTIMATED FACTOR PRODUCTIVITY DIFFERENTIAL &
MARGINAL EXTERNALITIES OF EXPORTS
(EQUATION 4)

Data-Set & Estimation Procedures	Productivity Differential	Marginal Externalities	N
Cross-Country - Classical Regression	1.59* (4.29)	0.37* (8.99)	69[!]
Cross Country - Classical Regression	1.52 (1.25)	0.29* (3.16)	31[@]
Cross Country - Classical Regression	0.36 (0.48)	0.38* (4.16)	22[#]
Cross Country - Classical Regression	1.76* (3.40)	0.48* (10.23)	16[$]
Panel Data - Countrywise Heteroscedastic, Correlated & Group Autocorrelation	0.22* (7.99)	0.03* (3.95)	69[!]
Panel Data - Countrywise Heteroscedastic, Correlated & Group Autocorrelation	0.18* (4.07)	0.10* (2.60)	31[@]
Panel Data - Countrywise Heteroscedastic, Correlated & Group Autocorrelation	1.00* (1.96)	0.01 (0.22)	22[#]
Panel Data - Countrywise Heteroscedastic, Correlated & Group Autocorrelation	0.37* (6.02)	0.24* (6.44)	16[$]

* significant at 5 percent.
t-statistics are in parentheses.
N is the number of countries in the data set.
[!] Complete Data Set.
[@] Low Income Countries.
[#] Lower Middle Income Countries.
[$] Upper Middle Income Countries.

Equation (4) enables us to determine separately the effects of exports via productivity differential and marginal externalities[7]. Empirical estimates of these separate effects are presented

[7] The estimates of the standard-errors of productivity differential and marginal externalities can be obtained from the unrestricted results using the Taylor-series approximation given by the following expression:

$$Var(\hat{\delta}) = Var(\hat{\alpha}_4)\left[\frac{1}{(1-\hat{\alpha}_3-\hat{\alpha}_4)^2}\right]^2 + Var(\hat{\alpha}_3)\left[\frac{1}{(1-\hat{\alpha}_3-\hat{\alpha}_4)^2}\right]^2 + 2\left[\frac{1}{(1-\hat{\alpha}_3-\hat{\alpha}_4)^4}\right] Cov(\hat{\alpha}_3, \hat{\alpha}_4)$$

in Table 3. For cross-country data, the coefficient for productivity differential is significant and positive for the complete data set and upper-middle countries, but for low and lower-middle income countries the coefficient is positive. Estimations based on panel data, in general, show that the coefficient of the productivity differential is positive and significant. For the lower-middle income countries, coefficients of productivity differential is numerically the largest, whereas the low-income countries have the lowest. The coefficient for marginal externality effects for all estimations using cross-country and panel data are positive and significant, except for the panel data of upper-middle income countries. These results indicate the presence of marginal externality effects of exports and that the exporting sector experiences higher factor productivity. The empirical results in Table 3 also show the greater importance of the productivity differential - one of the mechanisms through which exports influence economic growth.

B. Fixed and Random Effects Model Estimation Results

We carry out fixed and random effects models for the complete data set and for data sets comprising of low, lower- and upper-middle income countries to uncover probable parametric differences.

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where δ is the productivity differential, $\alpha_3 = \theta$ = marginal externalities and $\alpha_4 = (\frac{\delta}{1+\delta} - \theta)$.

Table 4 gives the summary of results of fixed and random effects models estimated using the complete data set and data sets for low, lower- and upper-middle income countries[8]. The results point towards the presence of fixed effect for all data sets except for equation (3) for low income countries, indicating parametric differences among most countries. Such differences could be due to country-specific characteristics such as technological, institutional, and other socio-economical attributes. For the complete data-set, a few countries have significant and positive group coefficients, and some countries such as Guyana, Sudan and Zambia for equation (3), and Guyana for equation (4) have significant negative group coefficients. Among the low-income countries, for equation (4), some countries have positive and negative significant group coefficients. Some lower-middle income countries have negative and significant sign for group coefficients for both models. Among upper-middle income countries, Korea and Taiwan have positive and significant coefficients at different levels of significance, and Argentina, South Africa, Trinidad & Tobago, and Venezuela have significant but negative group coefficients.

[8] The complete results of the three specification tests performed to determine the presence of parametric differences are reported in Appendix 2.

Table 4

SUMMARY OF ONE WAY FIXED &
RANDOM EFFECTS MODELS ESTIMATION

Equation	Fixed v/s Random Effects	Countries with Significant t-statistic for individual effects
$3^!$	Fixed	Botswana*, Burundi*, Egypt*, *Guyana**, Hong Kong*, Israel**, Korea*, Malta*, Malaysia**, Pakistan*, Portugal**, *Sudan***, Taiwan*, Thailand*, Turkey**,Uganda*, *Zambia***
$4^!$	Fixed	Botswana*, Burundi*, Egypt*, *Guyana**, Hong Kong*, Israel**, Korea*, Malta*, Malaysia**, Pakistan*, Singapore**, Taiwan*, Thailand*, Uganda*
$3^@$	Random	
$4^@$	Fixed	Bangladesh*, Barbados**, Burundi*, Egypt*, Fiji**, Gambia*, Honduras*, India*, Indonesia*, Kenya*, Lesotho*, Malawi*, Malta*. Mali**, Pakistan*, Sri Lanka*, Swaziland*, Tanzania*, Uganda*
$3^\#$	Fixed	*Algeria*, Bolivia*, Cameroon**, Costa Rica**, Ecuador*, El Salvador**, Iran**, Jamaica*, Papua New Guinea*, Peru*, Philippines*, Senegal**
$4^\#$	Fixed	*Algeria*, Bolivia*, Cameroon**, Costa Rica**, Ecuador*, El Salvador**, Iran**, Jamaica*, Papua New Guinea*, Peru*, Philippines*, Senegal***
$3^\$$	Fixed	*Argentina***, Korea*, *South Africa**, Taiwan*, *Trinidad & Tobago***, *Venezuela**
$4^\$$	Fixed	*Argentina***, Korea**, *South Africa**, Taiwan*, *Trinidad & Tobago***, *Venezuela**

* and ** significant at 5 and 10 percent respectively.
Countries in italics have negative dummy intercepts.
! complete Data Set.
@ low income countries.
\# lower-middle income countries.
$ upper-middle income countries.

IV. Conclusion

The export-growth nexus has been studied extensively, and exports are found to influence economic growth positively. This study has two major objectives. First, we reexamine the export-growth relationship using panel data and study the sensitivity of the relationship by varying the level of aggregation in the data set. For example, the data set has been stratified into three groups such as, low-, lower- and upper-middle income countries. Second, we empirically verify the possible parametric differences among nations.

The presence of significant positive externalities of exports suggests that some government intervention is needed in the export sector. Such interventions should be geared towards supporting the exporting sector, as competitive markets may not optimally allocate resources to that sector. Significant productivity differential points towards greater efficiency of the export sector. This also indicates that resources are better utilized in the export sector than in the non-export sector.

This study indicates that there exists inter-country differences in the economic environment which can be attributed to country-specific characteristics. In presence of such differences, the role of exports on economic growth may differ from country to country. For example, a country with better technology, institutions, and favorable socio-economic conditions may experience a greater contribution of exports to economic growth than the country which is inferior in this respect. Significant negative dummy coefficients for some countries indicate that due to poor technology, inefficient institutions, and other unobservable characteristics, exports may not have strong and positive roles in economic growth.

There is a concern in the literature about the application of results based on aggregate data to specific countries. The regression results with complete data set and country groups suggest that there are considerable differences in the role of exports in economic growth. Analyses with the complete data set may provide a general tendency of the observed phenomenon. The advantage of studies based on desegregated data sets is that it provides a closer look at the role of exports in economic growth in low-, lower- and upper-middle income economies. The analyses of parametric differences using different country groups indicate that some countries may display substantial differences in country-specific characteristics on the aggregate level. However, some countries which may not exhibit such differences in an aggregate analysis may show substantial differences when data set is stratified. The results from complete data sets, and those of low, lower- and upper-middle income countries also prove that export-growth relationship is similar among countries of different classifications. However, the relative importance of exports in economic growth may differ among different country groups.

To summarize, this study reinforces empirically the conclusions of earlier studies that exports have a positive role in economic growth due to positive externality and higher productivity in the export sector. Results apply not only to the aggregate analysis but also to the different groups of countries such as, low, lower- and upper-middle income countries. The policy implication of this study is that to produce the optimum level of output in the exporting sector some sort of government support is needed. In addition, when deriving economic policies, the differences in economic environments of the countries should be considered. Country-specific characteristics may play an important role in understanding the role of the exporting sector in an economy.

List of Sample Countries

Algeria**, Argentina***, Bangladesh*, Barbados*, Benin*, Bolivia**, Botswana***, Brazil***, Burundi*, Central African Republic*, Cameroon**, Chile**, Colombia**, Costa Rica**, Dominican Republic**, Ecuador**, Egypt*, El Salvador**, Ethiopia*, Fiji*, Gambia*, Ghana*, Guatemala**, Guyana*, Honduras*, Hong Kong***, India*, Indonesia*, Iran**, Israel***, Jamaica**, Korea***, Kenya*, Lesotho*, Madagascar*, Malawi*, Malta*, Malaysia***, Mali*, Mauritius***, Mauritania*, Mexico***, Morocco**, Nigeria*, Pakistan*, Panama**, Papua New Guinea**, Paraguay**, Peru**, Philippines**, Portugal***, Rwanda*, Senegal**, Singapore***, South Africa***, Sri Lanka*, Sudan*, Swaziland*, Taiwan***, Tanzania*, Togo*, Trinidad & Tobago***, Thailand**, Tunisia**, Turkey**, Uganda*, Uruguay***, Venezuela***, Zambia*

* Low income countries.

** Lower-middle income countries.

*** Upper-middle income countries.

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Appendix 1

Table 1.1

PANEL DATA ANALYSIS
EQUATION 3

Estimation Procedures	I	LDOT	IOY	ZDOT
	Parameters			
Classical Regression	0.005	0.51*	0.099*	0.27*
LM Stat (762.45)*	(1.12)	(4.05)	(7.29)	(15.58)
Groupwise Heteroscedastic	-0.001	0.55*	0.13*	0.27*
Wald Stat (2448.40)*	(-0.38)	(5.26)	(10.75)	(15.96)
Groupwise Het. & Correlated	-0.003	0.53*	0.15*	0.24*
Common Autocorrelation	(-0.69)	(4.32)	(10.20)	(14.67)
Groupwise Het. & Correlated	0.002	0.38*	0.14*	0.23*
Group Autocorrelation	(0.45)	(2.96)	(9.43)	(14.46)

t-statistics are in the parenthesis.
* Significant at 5 percent.

Table 1.2

PANEL DATA ANALYSIS
EQUATION 4

Estimation Procedures	I	LDOT	IOY	ZDOT	XDOT
	Parameters				
Classical Regression	0.004	0.46*	0.11*	0.14*	0.06*
LM Stat (722.56)*	(0.85)	(3.62)	(7.95)	(5.55)	(6.97)
Groupwise Heteroscedastic	-0.002	0.50*	0.14*	0.16*	0.04*
Wald Stat (2390.52)*	(-0.5)	(4.76)	(11.22)	(6.41)	(5.93)
Groupwise Het. & Correlated	-0.004	0.51*	0.15*	0.17*	0.03*
Common Autocorrelation	(-0.77)	(4.22)	(10.56)	(6.79)	(3.90)
Groupwise Het. & Correlated	0.0007	0.37*	0.14*	0.15*	0.03*
Group Autocorrelation	(0.16)	(2.95)	(10.11)	(6.44)	(3.95)

t-statistics are in the parenthesis.
* Significant at 5 percent.

Table 1.3

PANEL DATA ANALYSIS[1]
EQUATION 3

	Parameters			
Model	I	LDOT	IOY	ZDOT
Classical Regression	0.02*	0.23	0.04**	0.28*
LM Stat (379.05)*	(2.89)	(1.16)	(1.88)	(10.13)
Groupwise Heteroscedasticity	0.01**	0.28	0.09*	0.29*
Wald Stat (1022.71)*	(1.88)	(1.72)	(4.72)	(11.03)
Groupwise Het. & Correlated	0.01	0.31	0.10*	0.27*
Common Autocorrelation	(1.44)	(1.73)	(4.76)	(10.44)
Groupwise Het. & Correlated	0.02*	0.14	0.07*	0.25*
Group Autocorrelation	(2.60)	(0.70)	(3.54)	(9.90)

[1]Low Income Countries.
t-statistics are in the parenthesis.
* and ** significant at 5 and 10 percent.

Table 1.4

PANEL DATA ANALYSIS[1]
EQUATION4

	Parameters				
Model	I	LDOT	IOY	XDOT	ZDOT
Classical Regression	0.02*	0.17	0.04*	0.07*	0.10*
LM Stat (360.70)*	(2.91)	(0.85)	(2.19)	(5.52)	(2.42)
Groupwise Heteroscedastic	0.01*	0.22	0.08*	0.05*	0.14*
Wald Stat (923.60)*	(2.06)	(1.34)	(4.54)	(4.77)	(3.46)
Groupwise Het. & Correlated	0.01	0.25	0.09*	0.04*	0.15*
Common Autocorrelation	(1.64)	(1.42)	(4.71)	(3.98)	(3.74)
Groupwise Het. & Correlated	0.02*	0.11	0.08*	0.05*	0.10*
Group Autocorrelation	(2.55)	(0.57)	(3.93)	(4.86)	(2.60)

[1]Low Income Countries.
t-statistics are in the parenthesis.
* and ** significant at 5 and 10percent.

Table 1.5

PANEL DATA ANALYSIS[1]
EQUATION 3

Model	Parameters			
	I	LDOT	IOY	ZDOT
Classical Regression	-0.01	1.06*	0.11*	0.30*
LM Stat (204.01)*	(-1.40)	(3.30)	(4.26)	(7.04)
Groupwise Heteroscedastic	-0.02	1.22*	0.15*	0.26*
Wald Stat (868.28)*	(-1.14)	(2.10)	(4.03)	(6.05)
Groupwise Het. & Correlated	-0.03*	1.12*	0.19*	0.21*
Common Autocorrelation	(-2.34)	(3.28)	(6.64)	(6.15)
Groupwise Het. & Correlated	-0.02**	1.03*	0.17*	0.19*
Group Autocorrelation	(-1.83)	(2.73)	(6.05)	(5.74)

[1]Lower Middle Income Countries.
t-statistics are in the parenthesis.
* and ** significant at 5 and 10 percent.

Table 1.6

PANEL DATA ANALYSIS[1]
EQUATION 4

Model	Parameters				
	I	LDOT	IOY	XDOT	ZDOT
Classical Regression	-0.01	0.94*	0.12*	0.09*	-0.008
LM Stat (188.76)*	(-1.36)	(2.96)	(4.65)	(4.14)	(-0.09)
Groupwise Heteroscedastic	-0.02*	1.16*	0.16*	0.08*	-0.02
Wald Stat (985.78)*	(-2.62)	(4.39)	(6.73)	(4.10)	(-0.29)
Groupwise Het. & Correlated	-0.03*	1.10*	0.19*	0.05*	0.03
Common Autocorrelation	(-2.43)	(3.35)	(6.76)	(2.91)	(0.47)
Groupwise Het. & Correlated	-0.02**	0.97*	0.17*	0.49*	0.01
Group Autocorrelation	(-1.85)	(2.64)	(6.33)	(2.97)	(0.22)

[1]Lower Middle Income Countries.
t-statistics are in the parenthesis.
*and ** significant at 5 and 10 percent.

Table 1.7

PANEL DATA ANALYSIS[1]
EQUATION 3

Model	Parameters			
	I	LDOT	IOY	ZDOT
Classical Regression	-0.01	0.82*	0.16*	0.22*
LM Stat (55.94)*	(-0.94)	(4.28)	(5.82)	(8.42)
Groupwise Heteroscedastic	-0.004	0.70*	0.15*	0.24*
Wald Stat (208.95)*	(-0.52)	(4.24)	(5.48)	(8.73)
Groupwise Het & Correlated	-0.004	0.43*	0.18*	0.23*
Common Autocorrelation	(-0.45)	(2.23)	(5.05)	(8.40)
Groupwise Het. & Correlated	-0.013	0.63*	0.20*	0.23*
Group Autocorrelation	(-1.45)	(3.20)	(6.15)	(8.72)

[1]Upper Middle Income Countries.
t-statistics are in the parenthesis.
* and ** significant at 5 and 10 percent.

Table 1.8

PANEL DATA ANALYSIS[1]
EQUATION 4

Model	Parameters				
	I	LDOT	IOY	XDOT	ZDOT
Classical Regression	-0.01	0.77*	0.17*	0.04*	0.16*
LM Stat (52.98)*	(-1.30)	(4.02)	(6.17)	(2.51)	(4.77)
Groupwise Heteroscedastic	-0.01	0.65*	0.16*	0.03*	0.18*
Wald Stat (202.86)*	(-0.71)	(3.97)	(5.77)	(2.38)	(5.00)
Groupwise Het. & Correlated	0.001	0.29	0.25*	0.05*	-0.03*
Common Autocorrelation	(0.13)	(1.61)	(7.52)	(3.20)	(-5.53)
Groupwise Het. & Correlated	-0.01	0.65*	0.20*	-0.002	0.24*
Group Autocorrelation	(-1.45)	(3.34)	(6.13)	(-0.14)	(6.44)

[1]Upper Middle Income Countries.
Test statistics in parenthesis.
* and ** significant at 5 and 10 percent.

Appendix 2

Table 2.1

Fixed Effect Model
Equation 3

Variable	Coefficient	t-statistic	R^2	F-Stat
LDOT	0.578*	2.841	0.21	3.498#
IOY	0.081*	4.720		
ZDOT	0.248*	13.728		
Country	Coefficient	t-statistic		
Algeria	-0.008	-0.674		
Argentina	-0.002	-0.174		
Bangladesh				

Appendix 2

Table 2.1

Fixed Effect Model
Equation 3

Variable	Coefficient	t-statistic	R^2	F-Stat
LDOT	0.578*	2.841	0.21	3.498#
IOY	0.081*	4.720		
ZDOT	0.248*	13.728		
Country	**Coefficient**	**t-statistic**		
Algeria	-0.008	-0.674		
Argentina	-0.002	-0.174		
Bangladesh	0.009	0.889		
Barbados	0.006	0.593		
Benin	-0.003	-0.252		
Bolivia	-0.003	-0.287		
Botswana	0.039*	3.161		
Brazil	0.018***	1.661		
Burundi	0.029*	2.779		
Central African Republic	-0.010	-0.953		
Cameroon	0.003	0.237		
Chile	0.009	0.834		
Colombia	0.015***	1.382		
Costa Rica	0.005	0.472		
Dominican Republic	0.009	0.801		
Ecuador	-0.004	-0.313		
Egypt	0.022*	2.022		
El Salvador	0.002	0.232		
Ethiopia	0.000	0.010		
Fiji	0.002	0.232		
Gambia	0.008	0.704		
Ghana	-0.006	-0.529		
Guatemala	0.009	0.857		
Guyana	-0.027*	-2.593		
Honduras	0.003	0.292		
Hong Kong	0.023*	2.108		
India	0.011	1.050		
Indonesia	0.019	0.173		
Iran	0.007	0.553		
Israel	0.019**	1.664		
Jamaica	-0.013	-1.254		
Korea	0.045*	4.200		
Kenya	0.011	0.921		
Lesotho	0.017***	1.476		
Madagascar	-0.012	-1.141		
Malawi	0.005	0.440		
Malta	0.025*	2.444		
Malaysia	0.021**	1.795		
Mali	0.002	0.172		
Mauritius	0.013	1.247		
Mauritania	-0.012	-1.043		

Mexico	0.016***	1.408
Morocco	0.011	0.993
Nigeria	-0.005	-0.411
Pakistan	0.026*	2.283
Panama	0.013	1.134
Papua New Guinea	-0.000	-0.005
Paraguay	0.013	1.114
Peru	-0.011	-0.936
Philippines	-0.000	-0.005
Portugal	0.018**	1.752
Rwanda	0.002	0.146
Senegal	-0.003	-0.267
Singapore	0.011	0.911
South Africa	-0.006	-0.522
Sri Lanka	0.015***	1.451
Sudan	-0.019**	-1.798
Swaziland	0.012	0.991
Taiwan	0.066*	5.997
Tanzania	0.004	0.301
Togo	-0.009	-0.791
Trinidad & Tobago	-0.003	-0.251
Thailand	0.034*	3.037
Tunisia	0.015***	1.352
Turkey	0.018**	1.693
Uganda	0.030*	2.603
Uruguay	-0.003	-0.343
Venezuela	-0.007	-0.604
Zambia	-0.021**	-1.752

Random Effect Model

Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	0.531*	3.338	0.13	96.86$	7.91%
IOY	0.091*	5.961			
ZDOT	0.259*	14.648			
Constant	0.006	1.200			

*, ** and *** significant at 5, 10 and 20 percent, respectively.
Presence of Fixed Effect: $ Presence of Random Effect; Presence of Fixed Effect.

Table 2.2

Fixed Effect Model
Equation 4

Variable	Coefficient	t-statistic	R^2	F-Stat
LDOT	0.487*	2.409	0.22	3.34#
IOY	0.085*	4.956		
ZDOT	0.119*	4.363		
XDOT	0.054*	6.161		
Country	Coefficient	t-statistic		
Algeria	-0.007	-0.615		
Argentina	-0.003	-0.292		
Bangladesh	0.009	0.855		
Barbados	0.007	0.691		
Benin	-0.003	-0.262		
Bolivia	-0.002	-0.203		
Botswana	0.044*	3.575		
Brazil	0.016***	1.437		
Burundi	0.028*	2.708		
Central African Republic	-0.009	-0.792		
Cameroon	0.004	0.347		
Chile	0.008	0.795		
Colombia	0.014***	1.332		
Costa Rica	0.006	0.559		
Dominican Republic	0.010	0.925		
Ecuador	-0.003	-0.258		
Egypt	0.022*	1.995		
El Salvador	0.004	0.368		
Ethiopia	0.001	0.130		
Fiji	0.004	0.412		
Gambia	0.011	0.945		
Ghana	-0.005	-0.441		
Guatemala	0.009	0.899		
Guyana	-0.024*	-2.326		
Honduras	0.005	0.413		
Hong Kong	0.032*	2.872		
India	0.009	0.885		
Indonesia	0.016***	1.511		
Iran	0.007	0.574		
Israel	0.019**	1.667		
Jamaica	-0.012	-1.183		
Korea	0.041*	3.817		
Kenya	0.013	1.070		
Lesotho	0.015***	1.315		
Madagascar	-0.011	-1.065		
Malawi	0.006	0.536		
Malta	0.028*	2.728		
Malaysia	0.023*	2.068		
Mali	0.001	0.097		
Mauritius	0.015***	1.423		
Mauritania	-0.010	-0.929		
Mexico	0.014***	1.307		

Morocco	0.011	1.041
Nigeria	-0.005	-0.452
Pakistan	0.024*	2.159
Panama	0.014	1.259
Papua New Guinea	0.000	0.005
Paraguay	0.013	1.128
Peru	-0.009	-0.814
Philippines	-0.001	-0.058
Portugal	0.016***	1.571
Rwanda	0.003	0.243
Senegal	-0.001	-0.067
Singapore	0.023**	1.893
South Africa	-0.005	-0.419
Sri Lanka	0.015***	1.498
Sudan	-0.016***	-1.488
Swaziland	0.017***	1.409
Taiwan	0.064*	5.932
Tanzania	0.004	0.370
Togo	-0.004	-0.341
Trinidad & Tobago	-0.001	-0.127
Thailand	0.033*	2.957
Tunisia	0.014***	1.354
Turkey	0.014	1.271
Uganda	0.031*	2.792
Uruguay	-0.004	-0.458
Venezuela	-0.006	-0.482
Zambia	-0.017***	-1.493

Random Effect Model

Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	0.454*	3.304	0.15	79.22[$]	62.42[%]
IOY	0.103*	7.309			
ZDOT	0.137*	5.320			
XDOT	0.058*	6.797			
Constant	0.005	1.031			

*, ** and *** significant at 5, 10 and 20 percent, respectively.

Presence of Fixed Effect; $ Presence of Random Effect; % Presence of Fixed Effect

Table 2.3

Fixed Effect Model
Low Income Country
Equation 3

Variable	Coefficient	t-statistic	R^2	F-Stat	
LDOT	-0.009	-0.025	0.16	3.36#	
IOY	0.022	0.849			
ZDOT	0.279*	9.912			
Country	Coefficient	t-statistic			
Bangladesh	0.030*	2.232			
Barbados	0.019**	1.711			
Benin	0.022***	1.468			
Burundi	0.048*	3.687			
Central African Republic	0.012*	0.886			
Egypt	0.048*	3.418			
Ethiopia	0.023***	1.626			
Fiji	0.026**	1.947			
Gambia	0.034*	2.183			
Ghana	0.017	1.187			
Guyana	-0.006	-0.502			
Honduras	0.033*	2.069			
India	0.036*	2.650			
Indonesia	0.043*	3.168			
Kenya	0.045*	2.604			
Lesotho	0.049*	3.239			
Madagascar	0.009	0.640			
Malawi	0.034*	2.201			
Malta	0.042*	3.378			
Mali	0.026**	1.902			
Mauritania	0.018	1.187			
Nigeria	0.021***	1.446			
Pakistan	0.054*	3.504			
Rwanda	0.026**	1.738			
Sri Lanka	0.037*	2.903			
Sudan	0.005	0.323			
Swaziland	0.043*	2.654			
Tanzania	0.034*	2.188			
Togo	0.021***	1.317			
Uganda	0.053*	3.494			
Zambia	0.011	0.701			
		Random Effect Model			
Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	0.15254	0.588	0.09	18.53	1.20
IOY	0.02996	1.315			
ZDOT	0.28035	10.093			
Constant	0.02399	2.828			

*, ** and *** significant at 5, 10 and 20 percent, respectively.
Presence of Fixed Effect; $ Presence of Random Effect, % Presence of Random Effect

Table 2.4

Fixed Effect Model
Low Income Country
Equation 4

Variable	Coefficient	t-statistic	R^2	F-Stat
LDOT	0.004	0.013	0.18	$3.08^{\#}$
IOY	0.221	0.868		
XDOT	0.660*	4.830		
ZDOT	0.113*	2.566		
Country	Coefficient 0.004	t-statistic 0.013	0.18	3.08
Bangladesh	0.027*	2.027		
Barbados	0.021**	1.892		
Benin	0.020***	1.287		
Burundi	0.044*	3.471		
Central African Republic	0.012	0.904		
Egypt	0.046*	3.284		
Ethiopia	0.022***	1.549		
Fiji	0.027*	2.041		
Gambia	0.034*	2.231		
Ghana	0.015	1.087		
Guyana	-0.003	-0.213		
Honduras	0.032*	2.003		
India	0.032*	2.369		
Indonesia	0.039*	2.872		
Kenya	0.044*	2.555		
Lesotho	0.045*	3.009		
Madagascar	0.007	0.524		
Malawi	0.033*	2.128		
Malta	0.047*	3.788		
Mali	0.023**	1.703		
Mauritania	0.018	1.225		
Nigeria	0.019	1.255		
Pakistan	0.049*	3.219		
Rwanda	0.025***	1.629		
Sri Lanka	0.036*	2.869		
Sudan	0.006	0.422		
Swaziland	0.047*	2.919		
Tanzania	0.033*	2.095		
Togo	0.025***	1.585		
Uganda	0.052*	3.456		
Zambia	0.012	0.765		

Random Effect Model

Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	0.13057	0.552	0.13	$12.25^{\$}$	$8.92^{\%}$
IOY	0.03667	1.687			
XDOT	0.07038	5.266			
ZDOT	0.10757	2.515			
Constant	0.02267	2.887			

*, ** and *** significant at 5, 10 and 20 percent, respectively.
Presence of Fixed Effect; $ Presence of random Effect; % Presence of Fixed Effect

Table 2.5

Fixed Effect Model
Lower Middle Income Country
Equation 3

Variable	Coefficient	t-statistic	R^2	LM-Stat
LDOT	1.3090	2.805	0.15	4.71#
IOY	0.15651	4.538		
ZDOT	0.28594	6.788		
Country	Coefficient	t-statistic		
Algeria	-0.055*	-2.843		
Bolivia	-0.036*	-2.286		
Cameroon	-0.030**	-1.897		
Chile	-0.017***	-1.319		
Colombia	-0.017	-1.096		
Costa Rica	-0.034**	-1.919		
Dominican Republic	-0.026***	-1.582		
Ecuador	-0.040*	-2.344		
El Salvador	-0.026**	-1.793		
Guatemala	-0.022***	-1.358		
Iran	-0.034**	-1.826		
Jamaica	-0.040*	-3.095		
Morocco	-0.023***	-1.444		
Panama	-0.023***	-1.428		
Papua New Guinea	-0.036*	-2.250		
Paraguay	-0.025***	-1.429		
Peru	-0.049*	-2.866		
Philippines	-0.038*	-2.222		
Senegal	-0.035*	-2.107		
Thailand	-0.004	-0.240		
Tunisia	-0.021***	-1.335		
Turkey	-0.015	-0.945		

Random Effect Model

Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	1.1092	3.150	0.11	3.36$	6.64%
IOY	0.1227	4.335			
ZDOT	0.2927	6.992			
Constant	-0.0173	-1.592			

*, ** and *** significant at 5, 10 and 20 percent, respectively.
Presence of Fixed Effect; $ Absence of Random Effect; % Presence of Fixed Effect

Table 2.6

Fixed Effect Model
Low Middle Income Country
Equation 4

Variable	Coefficient	t-statistic	R^2	F-Stat
LDOT	1.173*	2.525	0.17	4.27#
IOY	0.166*	4.828		
XDOT	0.077*	3.496		
ZDOT	0.020	0.235		

Country	Coefficient	t-statistic
Algeria	-0.054*	-2.794
Bolivia	-0.034*	-2.193
Cameroon	-0.028**	-1.772
Chile	-0.017***	-1.296
Colombia	-0.017	-1.143
Costa Rica	-0.032**	-1.782
Dominican Republic	-0.024***	-1.469
Ecuador	-0.038*	-2.245
El Salvador	-0.024**	-1.645
Guatemala	-0.021***	-1.297
Iran	-0.032**	-1.747
Jamaica	-0.038*	-2.970
Morocco	-0.022***	-1.398
Panama	-0.020	-1.260
Papua New Guinea	-0.034*	-2.162
Paraguay	-0.024***	-1.390
Peru	-0.047*	-2.787
Philippines	-0.037*	-2.244
Senegal	-0.031**	-1.895
Thailand	-0.004	-0.259
Tunisia	-0.020	-1.271
Turkey	-0.020***	-1.315

Random Effect Model

Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	0.960*	2.917	0.13	1.34$	11.09%
IOY	0.125*	4.671			
XDOT	0.086*	4.071			
ZDOT	-0.005	-0.054			
Constant	-0.015***	-1.431			

*, ** and *** significant at 5, 10 and 20 percent, respectively.
Presence of Fixed Effect; $ Absence of Random Effect; % Presence of Fixed Effect

Table 2.7

Fixed Effect Model
Upper Middle Income Country
Equation 3

Variable	Coefficient	t-statistic	R^2	F-Stat
LDOT	0.751*	2.887	0.36	1197.98#
IOY	0.154*	4.988		
ZDOT	0.182*	6.792		
Country	**Coefficient**	**t-statistic**		
Argentina	-0.019**	-1.780		
Botswana	0.020***	1.355		
Brazil	-0.001	-0.050		
Hong Kong	0.008	0.589		
Israel	-0.001	-0.112		
Korea	0.025*	2.022		
Malaysia	0.000	0.019		
Mauritius	-0.002	-0.210		
Mexico	-0.004	-0.290		
Portugal	-0.001	-0.112		
Singapore	-0.012	-0.758		
South Africa	-0.028*	-2.139		
Taiwan	0.048*	3.826		
Trinidad & Tobago	-0.021**	-1.833		
Uruguay	-0.016***	-1.642		
Venezuela	-0.030*	-2.155		

Random Effect Model

Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	0.77635	3.241	0.23	132.18$	3.04%
IOY	0.15776	5.259			
ZDOT	0.18958	7.201			
Constant	-0.00383	-0.376			

*, ** and *** significant at 5, 10 and 20 percent, respectively.
Presence of Fixed Effect; $ Presence of Random Effect; % Presence of Fixed Effect

Table 2.8

Fixed Effect Model
Upper Middle Income Country
Equation 4

Variable	Coefficient	t-statistic	R^2	F-Stat
LDOT	0.715*	2.720	0.36	1760.51#
IOY	0.156*	5.034		
XDOT	0.015	0.970		
ZDOT	0.157*	4.293		
Country	**Coefficient**	**t-statistic**		
Argentina	-0.020**	-1.815		
Botswana	0.020***	1.381		
Brazil	-0.001	-0.110		
Hong Kong	0.009	0.677		
Israel	-0.002	-0.127		
Korea	0.024**	1.869		
Malaysia	0.001	0.046		
Mauritius	-0.002	-0.214		
Mexico	-0.004	-0.315		
Portugal	-0.002	-0.192		
Singapore	-0.010	-0.629		
South African	-0.027*	-2.113		
Taiwan	0.047*	3.738		
Trinidad & Tobago	-0.021**	-1.824		
Uruguay	-0.016***	-1.691		
Venezuela	-0.030*	-2.128		

Random Effect Model

Variable	Coefficient	t-statistic	R^2	LM-Stat	Hausman Test Stat
LDOT	0.736*	3.012	0.24	103.38$	11.16%
IOY	0.160*	5.296			
XDOT	0.019	1.180			
ZDOT	0.160*	4.451			
Constant	-0.004	-0.383			

*, ** and *** significant at 5, 10 and 20 percent, respectively.
Presence of Fixed Effect; $ Presence of Random Effect; % Presence of Fixed Effect