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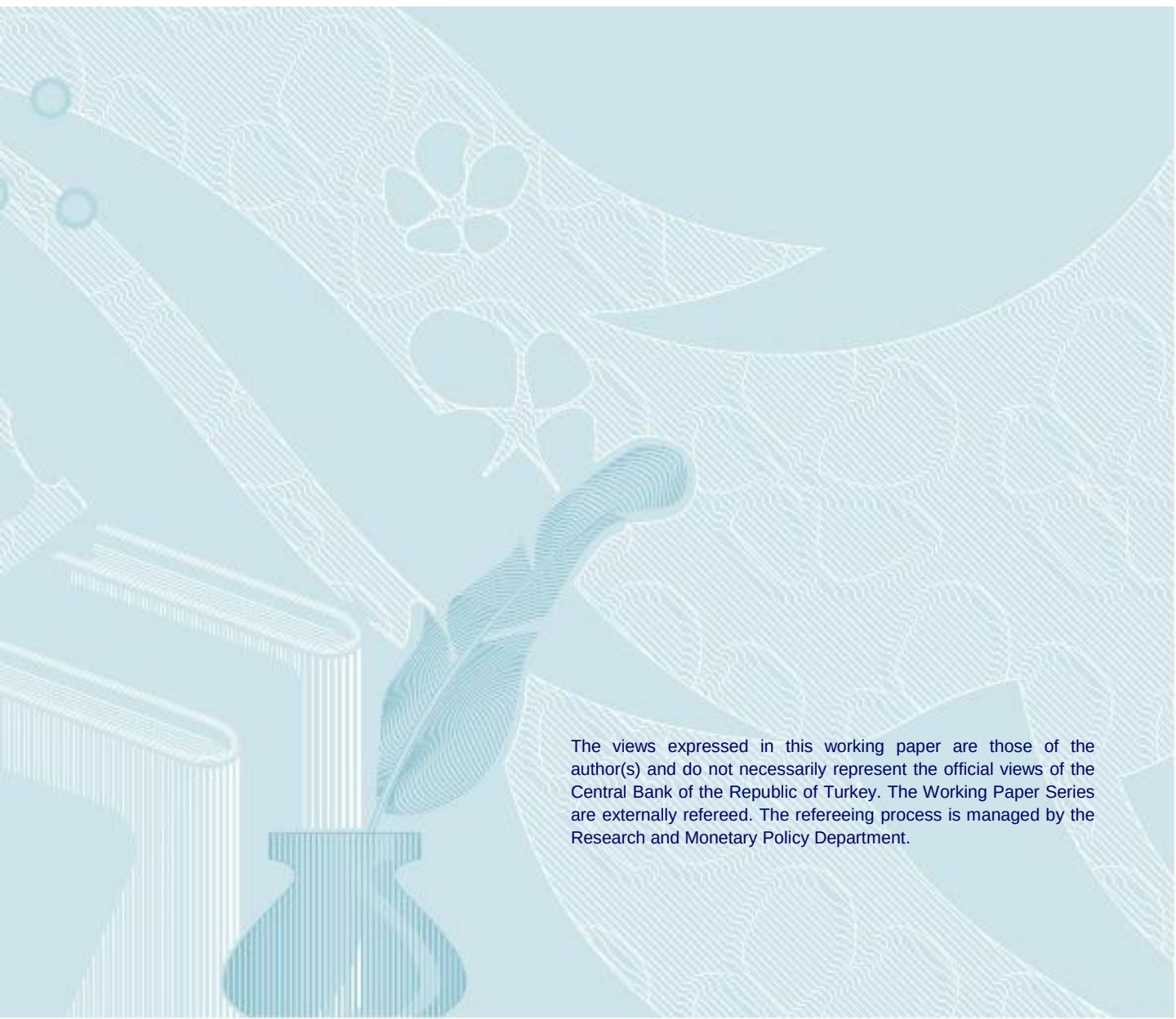

Openness to International Trade and Economic Growth: A Cross-Country Empirical Investigation

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Abstract

This paper examines the long-run relationship between trade openness and economic growth across countries over the period 1960-2000. Two strategies are followed in empirical investigation. First, we extend the augmented neo-classical growth model with an openness variable and estimate it by using a battery of openness measures suggested in the literature. We also construct three composite trade policy indexes consisting of weighted averages of tariff rates, non-tariff barriers and black market premium for foreign exchange rate. Second, we implement Bayesian model averaging technique to deal with the model uncertainty, a fundamental problem which has been plaguing the previous works on the topic. Our findings show that there is no robust link between trade openness and long-run economic growth.

J.E.L. Classification : F43, O47, C11, C21, C52.

Key words: Economic Growth, Trade Openness, Cross-Country Growth Regression, Model Uncertainty, Bayesian Model Averaging.

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1 Introduction

The global integration through international trade has accelerated in the last few decades due to the extensive trade liberalisation in the majority of developing countries since the beginning of the 1980s. During the 1980-2010 period, the world output has doubled while the volume of world trade has more than tripled. Does this mean that openness to international trade boosts economic growth in the long run? This is the question that we intend to answer in this paper.

Although the relationship between trade openness and economic growth is one of the oldest issues in economics, the existing theory does not provide a conclusive answer.[1] Therefore, the openness-growth nexus is basically an empirical question and has been extensively investigated by empirical cross-country work dating back to the 1970s and the 1980s.[2] This issue especially attracted renewed interest since the early 1990s, with almost all studies finding a strong and statistically significant positive relationship between trade openness and economic growth.[3]

However, the cross-country growth literature is still far from settled since the findings of this literature have been subject to an important criticism in terms of robustness. In particular, Edwards (1993), Harrison and Hanson (1999) and Rodrik and Rodríguez (2000) argue that the cross-country studies suffer from lack of robust and convincing evidence on the topic due to two important drawbacks: first, the empirical studies fail to provide an openness measure based purely on trade policy; second, they employ very

[1]The traditional Ricardian-Heckscher-Ohlin trade theory points out that openness to international trade brings only a one-time increase in output, yet does not suggest any decisive implications for long-run growth. The neoclassical growth model concludes that the long-run growth rate of per capita output is determined by the exogenous technological progress. Only the newer endogenous growth theories pay attention to implications of trade openness on growth in the long run since openness facilitates the transmission of technology by providing communication with foreign counterparts; encourages firms to invent new and distinct ideas and technologies; and may lead to a rise in the level of R&D activities by directing domestic resources towards more unskilled labour intensive sectors and/or by enlarging market size of R&D sector (see Rivera-Batiz and Romer (1991) and Grossman and Helpman (1991, Chapters 6 and 9)). However, these models do not necessarily predict that openness leads to economic growth in all circumstances and for all countries. In other words, whether openness causes economic growth in the long run depends on country-specific conditions.

[2]Balassa (1978), Tyler (1981) and Feder (1982) are few examples amongst others.

[3]Examples include Dollar (1992), Edwards (1992, 1998), Lee (1993), Sachs and Warner (1995), Harrison (1996), Vamvakidis (1999), Frankel and Romer (1999), Wacziarg (2001), Greenaway et al. (2002), Yanikkaya (2003), Dollar and Kraay (2003), Lee et al. (2004), Alcalá and Ciccone (2004), Rodrik et al. (2004), Aksoy and Salinas (2006), Foster (2008), Kneller et al. (2008), Wacziarg and Welch (2008), Chang et al. (2009), Kim (2011).

simple growth models, implying that the strong results in favour of openness may arise from model misspecification.

An outstanding but generally neglected feature of the empirical literature is that the substantial part of existing studies focuses solely on the period of 1970-1990. Although data availability is an important reason for this, investigating the openness-growth link over the 1970-1990 period is troublesome. The first problem is that a time period of 20 years is not long enough to fully reflect long-run growth dynamics. Second and more importantly, the sample period from 1970 to 1990 is inappropriate as most of the developing countries followed protectionist trade polices not only during the 1970s but also during the 1960s, and their trade policy measures did not change substantially over the period 1960-1980. However, most of them experienced relatively higher growth performance in the 1960s. Therefore the empirical evidence based on the sample period 1970-1990 is highly likely to be biased since it does not include the information about growth of the 1960s.

In this paper, we revisit the empirical evidence on the relationship between trade openness and long-run economic growth within the sample period 1960-2000. We do so by extending the augmented neoclassical growth model developed by Mankiw, Romer and Weil (1992) with a measure of openness.

A myriad of openness measures have been suggested in the empirical work. This clearly gives rise to "proxy uncertainty" in the sense that there is no complete consensus over alternative proxy variables for openness in the literature. Indeed, most openness measures tend to measure only one aspect of trade policy and as noted by Pritchett (1996) the correlations among them are weak in many cases. This paper addresses the problem of proxy uncertainty and employs many openness variables instead of relying on a few ones. In other words, we attempt to show which one fits the data better.

Among these openness measures, trade volume (conventionally expressed as the ratio of exports plus imports to GDP) has been commonly used in the literature although it is the most problematic measure of openness, at least conceptually.[4] The reason is that we define openness as removing or reducing policy barriers to international trade rather than trade intensity. It is obvious that a country's trade volume is affected not only by trade policy but also by other factors such as country size, distance to trade partners, transportation costs, world demand and so on. Implications of this are twofold: first, it is very likely that employing trade volume as a proxy for trade policy openness

[4]In the previous version of this study, we also empirically investigate the relationship between trade volume and economic growth using several trade ratios over the 1960-2000 period. We conclude that ratio of trade volume to GDP is positively and significantly correlated with economic growth. However, this result is mainly driven by a few outlying countries. See, Ulaşan (2012) for a more detailed discussion.

leads to misleading results on openness-growth connection; second, direct trade policy measures such as tariffs and non-tariff barriers are ideal measures to capture a country's degree of openness to trade.

However, the main problem with direct trade policy measures is that a single policy measure reflects only one dimension of trade policy stance and hence does not pick up differences in trade-policy-induced barriers across countries. Therefore, testing openness-growth connection by using a single policy variable may be misleading and a composite measure directly addressing and encompassing every aspect of trade policy is necessary. This means that we need reasonable weights to combine different policy instruments into a composite indicator. We attempt to construct such a measure in this paper. We compute three composite trade policy indexes consisting of weighted averages of tariff rates, non-tariff barriers and black market premium for foreign exchange rate. Weights are estimated using the models in which both nominal and real trade volumes as a share of GDP are regressed on the initial level of income, country size and trade policy instruments.

Another fundamental problem in the literature on the relationship between openness and growth is that most studies employ very simple growth models and ignore other potentially important growth theories as mentioned earlier. This approach clearly suffers from model uncertainty problem and hence may lead to misleading results. Actually, model uncertainty arises from the open-ended nature of growth theories, that is, the validity of one growth theory does not imply the falsity of others as pointed out by Brock and Durlauf (2001). Therefore, this problem is inherent in all cross-country work. Despite this fact, the empirical literature on the connection between growth and openness rarely paid attention to model uncertainty.

In order to deal with the problem of model uncertainty, we apply Bayesian model averaging technique on a large cross-country growth data set. By integrating model uncertainty into subsequent statistical inference, this method serves as a useful robustness check on the determinants of cross-country growth differences. We systematically classified 16 important growth variables under 7 growth theories as well as augmented neo-classical growth variables and openness measures to implement this approach. Our classification on growth theories are useful in two respects: First, it helps us to address "theory uncertainty" and "proxy uncertainty" separately. These two are the most important layers of model uncertainty as indicated by Brock et al. (2003). Second, it allows us to define a hierarchical prior structure as a more appropriate prior specification over possible growth models.

The contributions of this paper are multiple: First, in contrast to previous studies which mainly focus on the period 1970-1990, this paper analyses the openness-growth link over a much longer time period. In other words the

sample period is sufficiently long in order to account for both trade policy stance and growth dynamics in the long run. Second, we employ a battery of openness measures suggested in the literature. Providing a wider picture, this enables us to better evaluate both existing openness variables and the openness-growth connection. Third, we construct three openness indexes arguably better capturing trade policy stance than existing openness measures. Finally, we carry out a sensitivity analysis in the form of Bayesian model averaging. Dealing with the problem of model uncertainty in a statistically coherent manner, this method facilitates assessing the robustness of trade openness as a growth determinant.

The cross-country empirical investigation in this paper shows that there is not a robust link between trade openness and long-run economic growth. The evidence in this paper indicates that sound and stable macroeconomic management related to fiscal and monetary policies and the quality of economic institutions are positively and robustly correlated with economic growth in the long run.

The structure of this paper is as follows. Section 2 provides the basic framework for the empirical cross-country investigation of the openness-growth connection. Section 3 presents OLS estimates based on the cross-country data over the period 1960-2000. Section 4 applies Bayesian model averaging technique to cross-country growth data to take into account model uncertainty. Finally, Section 5 summarises the results and concludes.

2 Economic Growth and Openness to International Trade: Baseline Model

We adopt the empirical framework of the augmented neo-classical growth model suggested by Mankiw et al. (1992) to investigate openness-growth link. In other words, we extend this model by adding a proxy variable for openness as follows:

$$\begin{aligned}\log y_i(t) - \log y_i(0) = \gamma_0 + \gamma_1 \log y_i(0) + \gamma_2 \log(n_i + g + \delta) \\ + \gamma_3 \log s_{i,K} + \gamma_4 \log s_{i,H} + \gamma_4 OP_i + \varepsilon_i \qquad (1)\end{aligned}$$

where, y_i and $(n_i + g + \delta)$ denote the level of GDP per worker and the sum of rates of population growth, technological progress and depreciation in country i, respectively. The terms $s_{i,K}$ and $s_{i,H}$ represent the rates of accumulation of both physical and human capital for country i, respectively.

Finally, the term OP indicates country i's degree of openness.

Following Mankiw et al. (1992), we assume that the sum of rates of depreciation and technological progress is constant across countries and equal to 0.05. We measured $s_{i,K}$ by the ratio of real investment to real GDP and $s_{i,H}$ by the secondary school gross enrolment rate.[5] Data are compiled from standard sources: GDP per capita and investment rates are taken from the Penn World Tables Version 6.1 (Heston, Summers and Aten, 2002); population, labour force and gross secondary school enrolment rates come from the World Bank World Development Indicators (2002, 2006). Using labour force as the total population between ages 15 and 64, GDP per capita is converted to GDP per worker. All of these variables are averaged over the period 1960-2000 except the initial level of income. The variables and their sources are detailed in the Appendix.

In summary, we estimate the following cross-country growth regression in this paper:

$$\begin{aligned} \log y_{i,2000} - \log y_{i,1960} = \gamma_0 &+ \gamma_1 \log y_{i,1960} + \gamma_2 \log(n_i + g + \delta) \\ &+ \gamma_3 \log(Investment\ rate_i) \\ &+ \gamma_4 \log(School\ enrolment\ rate_i) \\ &+ \gamma_5 Openness_i + \varepsilon_i \end{aligned} \tag{2}$$

Once we specify the cross-country growth regression expressed in equation (2), the problem of simultaneity arises immediately: Does openness leads to economic growth or vice versa? A country may abandon protectionist or inward-looking trade polices after specialising in sectors with the dynamic comparative advantage in terms of rapid productivity growth and large technological spillovers. In this case, causality occurs from economic growth to trade openness. The openness variable in equation (2) is, therefore, likely to be correlated with the error term, ε_i. This means that the OLS estimate of γ_5 will be biased and the direction of causality between growth and openness will remain unclear.

The standard way for overcoming simultaneity problem is finding or constructing an instrumental variable (IV) which is correlated with the openness variable but uncorrelated with ε_i. If one can find a valid IV and estimate the

[5]Using school enrolment rates as a proxy for the saving rate of human capital is problematic in the literature and leads researchers to employ average years of schooling as more reliable variables for human capital (see, for instance Bils and Klenow (2000), amongst others). We, however, employ secondary school enrolment rate in order to follow theoretical framework suggested by Mankiw et al. (1992) more strictly as years of schooling are a stock rather than a flow variable for human capital. In addition, school enrolment rates are available for a larger sample of countries.

cross-country growth regression in equation (2) by two stage least squares (2SLS), then the IV estimate of γ_5 will reflect the true effect of openness on growth. However, finding a proper IV, which is not a direct growth determinant and/or not correlated with other omitted growth determinants is extremely difficult in the cross-country growth works.[6] The reason is that there is a wide range of different theories to explain growth such as economic and political institutions, trade openness, geography, culture and so on. As indicated previously, the prominent aspect of growth theories is that they are open-ended in the sense that the inclusion of one growth theory does not preclude the validity of others.

It is worth recalling that the 2SLS estimate will be again biased if IV is not valid and in this case the OLS estimate would be more preferable. In some studies, especially those employing panel data models, the lagged values of endogenous variables are used as instruments. However, lagged values of endogenous variables do not guarantee that they are directly uncorrelated with growth and hence they are proper instruments since many growth variables, such as measures of educational attainment affect growth with a substantial delay.[7]

It might be, therefore, possible to conclude that the cross-country growth regressions can never reveal the direction of causality. Despite this fact, the cross-country works still provide useful information between growth and a variable of interest. Even if we can not establish the casuality between growth and openness, a statistically significant partial association can be used to reject alternative hypotheses which fail to provide statistically significant correlation and one can provide plausible causal statement as argued by Mankiw (1995) and Wacziarg (2002). For instance, if we conclude that OLS estimate of γ_5 is positive and statistically significant and fail to conclude the statistically significant negative association between openness and growth, then it is not reasonable to reach an inference such that openness is harmful for economic growth. Similarly, Warner (2003) argues that it is very difficult to attribute a positive coefficient estimate on openness variable to reverse casuality from growth to trade polices. The reason is that there are no specific cases in which countries opened to international trade, grew slowly

[6]Mankiw (1995, p.303) points out "[W]hen looking for instruments, it is easy to fall prey to temptation." Durlauf, Johnson and Temple (2005, p.638) argue that "[t]he belief that it is easy to identify valid instrumental variables in the growth context is deeply mistaken."

[7]It is obvious that the lags of openness are subject to instrument invalidity. As argued by Lee et al. (2004), investment and hence capital accumulation today affect not only growth today but also growth in the future. Since capital accumulation requires imported goods, then the degree of openness today influences future growth.

and then closed again because of poor economic performance.

3 OLS Estimates

In this section we present and discuss the findings of our empirical investigation under three categories of openness measures: Direct trade policy measures, deviation measures and subjective measures. Before evaluating the regression results, we want to emphasise two points about the regressions. First, in each regression we check the normality assumption applying median and inter quartile range comparison suggested by Hamilton (1992) which is originally based on Hoaglin, Iglewicz and Tukey (1986) on regression residuals and conclude that residuals are normally distributed. Therefore, we may assume that actual errors are normally distributed (at least approximately).

Second, in each regression we also check the constant error variance assumption by employing the Breusch-Pagan test for heteroscedasticity and then carry out regression analysis employing t-statistics based on the usual standard errors unless we reject the homoscedasticity assumption. We report t-statistics based on the heteroscedasticity consistent (White-robust) standard errors only for the regressions in which the assumption of homoscedastic error variance is rejected.[8]

3.1 Direct Trade Policy Measures

We start our investigation on the openness-growth connection by employing direct trade policy measures, namely tariff rates, non-tariff barriers on imports and black market premium for exchange rate. It is obvious that the first two measures directly affect a country's trade volume and reducing or removing them clearly indicates a more open trade regime. Yet, the use of

[8]The common practice in cross-country growth literature for dealing heteroscedasticity is reporting regression results with the heteroscedasticity consistent (White-robust) standard errors since these errors work well regardless of heteroscedasticity in the actual errors. However, heteroscedasticity consistent errors are consistent but not unbiased. More clearly they are justified only asymptotically. In small samples, heteroscedasticity consistent standard errors may have distributions that are not close to those of usual standard errors which means that they may be larger or smaller than the usual ones. As pointed out by Wooldridge (2003) heteroscedasticity consistent standard errors are generally found to be larger than the usual standard errors. This can affect the subsequent statistical inference such that one can conclude that a variable is statistically insignificant according to t-test based on the heteroscedasticity consistent standard errors even if that variable is significant (at least marginally) in the case of usual t-test. Therefore, there is no reason to use heteroscedasticity consistent standard errors as long as the homoscedastic error variance assumption holds and the errors are normally distributed.

the black market premium as a measure of trade barriers is debatable in the literature. Authors such as Sachs and Warner (1995) and Warner (2003) argue that a high black market premium causes increases in the price of imports relative to domestic prices and thus plays the same role with tariff and non-tariff barriers. Others, such as Rodrik and Rodríguez (2000) claim that a high black market premium generally shows macroeconomic imbalances rather than trade policy barriers.

Undoubtedly, directly addressing trade policy both tariff rates and non-tariff barriers are ideal measures in order to capture a country's degree of openness to international trade. Yet, unfortunately we do not have good data for these measures across countries and over time. The most common data for these measures in the literature come from the data set by Barro and Lee (1994). In this data set, tariff rate and non-tariff coverage ratios are weighted averages by the product shares in a country's overall imports. However, both variables cover the only imports of intermediate inputs and capital goods over the 1983-1985 period. In addition, they have a problem of downward bias since both measures are weighted by their own-import value. Finally, it is not likely that all non-tariff barriers can be measured and they accurately reflect the intensity of non-tariff barriers.

Employing these two measures as an openness variable, we estimate our baseline model. The estimation results are reported in Table 1. In columns 1 and 2 of Table 1, we only include tariff rate and non-tariff barriers, respectively. Both measures enter the regressions with negative but insignificant coefficient estimates. In column 3, we allow both tariff rate and non-tariff barriers together. As can be seen, tariff rate and non-tariff barriers are neither individually nor jointly significant. In the fourth column, we replace tariff rate with the collected import duties as a ratio to imports over the 1970-1998 period and find a positive but insignificant coefficient estimate. It is well-known fact that the ratio of collective import duties to a country's overall imports is a problematic measure in order to reflect a country's tariff structure due to the fact that a country with very high tariff rates may appear open by this measure. In column 5, we include unweighted average tariff rate over the 1990-2000 period that is provided by Wacziarg and Welch (2008). The difference between this measure and tariff rate of Barro and Lee (1994) is that the former is simply averages of ad valorem tariff rates across commodities subjected to imports. The estimated coefficient of unweighed tariff rates is negative but again statistically insignificant.

We include average black market premium over the 1960-2000 period in column 7 and find that the black market premium is negatively and significantly associated with economic growth. In columns 8 and 9, we replace average black market premium with two dummy variables, respectively. The

first dummy variable takes the value of 1 if the average black market premium exceeds 20 % in the 1960s or the 1970s or the 1980s or the 1990s while the second one is equal to 1 if the average black market premium is higher than 20 % over the 1960-2000 period. Our aim in constructing for these dummies is to check the nexus between growth and a larger level of black market premium. Following Sachs and Warner (1995), we assume 20 % as a threshold level. As shown in the table, in each case the dummy variables are negatively correlated with growth and strongly significant. In column 10, we include tariff rate, non-tariff barriers and average black market premium jointly. The result is essentially same. Both tariff rates and non-tariff measures are not significant but black market premium is. In the last column, the regression is exactly the same as the regression in column 10, the only difference is that we replace average black market premium with the dummy variable for black market premium. As seen, the result is unchanged.

Table 1: Economic Growth and Direct Trade Measures: OLS Estimates[†]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log GDP per worker 1960	-0.485	-0.476	-0.497	-0.446	-0.479	-0.484	-0.499	-0.506	-0.493	-0.505
	(5.82)	(5.74)	(5.78)	(5.29)	(6.14)	(7.30)	(7.24)	(7.59)	(6.88)	(7.46)
$\log(n_i + g + \delta)$	-1.291	-1.274	-1.229	-1.109	-1.061	-1.092	-0.996	-1.043	-1.269	-1.194
	(2.85)	(2.77)	(2.65)	(2.60)	(2.80)	(3.09)	(2.74)	(2.98)	(3.54)	(3.39)
log of Investment rate	0.428	0.433	0.420	0.443	0.400	0.327	0.323	0.329	0.319	0.336
	(4.20)	(4.24)	(4.07)	(4.02)	(4.14)	(3.53)	(3.42)	(3.61)	(2.49)	(2.77)
log of School enrolment	0.423	0.426	0.440	0.445	0.448	0.475	0.495	0.483	0.441	0.436
	(4.08)	(4.12)	(4.21)	(4.14)	(4.79)	(5.57)	(5.63)	(5.71)	(4.85)	(5.06)
owti[a]	-0.327	-	-0.290	-	-	-	-	-	-0.309	-0.096
	(1.12)		(0.93)						(1.07)	(0.33)
owqi[b]	-	-0.116	-0.050	-	-	-	-	-	0.088	0.019
		(0.60)	(0.24)						(0.48)	(0.10)
Import Duties[c]	-	-	-	0.377	-	-	-	-	-	-
				(0.44)						
uwti[d]	-	-	-	-	-0.477	-	-	-	-	-
					(0.90)					
log (1+BMP)[e]	-	-	-	-	-	-0.233	-	-	-0.224	-
						(2.84)			(2.26)	
BMP dummy[f]	-	-	-	-	-	-	-0.199	-	-	-
							(2.32)			
BMP dummy[g]	-	-	-	-	-	-	-	-0.263	-	-0.275
								(3.22)		(3.01)
Constant	2.556	2.495	2.821	2.654	3.109	2.937	3.357	3.301	2.523	2.874
	(1.96)	(1.91)	(2.08)	(1.88)	(2.56)	(2.78)	(3.00)	(3.11)	(2.14)	(2.51)
Number of observations	87	85	85	93	101	101	101	101	83	83
Breusch-Pagan test[h] (p-value)	0.82	0.70	0.83	0.59	0.81	0.30	0.47	0.39	0.12	0.11
F-test[i]	-	-	0.61	-	-	-	-	-	2.09	3.51

Continued on Next Page...

Table 1 – *Continued*

Adjusted R^2	0.60	0.60	0.60	0.56	0.61	0.64	0.64	0.65	0.62	0.63

Note: t-statistics are in parenthesis. In the regressions where the heteroscedasticity test is failed to pass at 15 % level t-statistics based on heteroscedastic-consistent (White-robust) standard errors are reported.

† Dependent variable is the log difference of real GDP per worker between 1960 and 2000.

[a] Own-import weighted tariff rates on intermediate inputs and capital goods.

[b] Own-import weighted non-tariff frequency on intermediate inputs and capital goods.

[c] Collected import duties as ratio of imports over 1970-1998 period.

[d] Unweighted average tariff rate over the 1990-99 period.

[e] Logarithm of one plus average value of black market premium over the 1960-1999 period.

[f] Dummy variable is equal to 1 if the average black market premium exceeds 20 % in either the 1960s or the 1970s or the 1980s or the 1990s.

[g] Dummy variable is equal to 1 if the average black market premium exceeds 20 % over the 1960-2000 period.

[h] The null hypothesis is that the errors are homoscedastic.

[i] F-test statistic for the joint significance of openness variables.

As a result, our empirical investigation between growth and direct trade policy measures indicates that the significant association with economic growth is established only for the black market premium. However, Warner (2003) points out that the time period should be 1970-1990 for testing the impact of trade protection through tariff rates. The reason is that the majority of developing countries have liberalised their trade regimes during the late 1980s and the early 1990s. In other words, the large cross-country variation in tariff rates in the earlier period was eliminated after the 1980s. In addition, he indicates that India is a clear outlying observation. Therefore, according to Warner (2003), one can find a negative and significant correlation between growth and tariff rate if he omits India from the sample and estimates the growth regression over the 1970-1990 period.

In order to test Warner's claim we estimate our baseline model over the period 1970-1990 for the same sample without India. The regression result is given in the first column of Table 2 and shows a negative but statistically insignificant coefficient estimate of the tariff rate. In addition to India, we identify three more countries namely Burkina Faso, Guyana, and Tanzania as outliers applying the Hadi methodology on the data set over the 1970-1990 period.[9] In the second column of Table 2, we drop these countries as well as India from the regression and conclude that tariff rate is again negative but not significant. Therefore, our findings indicate that Warner's claim is not valid over the 1970-1990 period.

However, it may be more reasonable to investigate growth-tariff connection over the period 1960-2000. As we argue in the introduction, most of the developing countries followed protectionist trade polices not only during the 1970s but also during the 1960s and experienced relatively higher growth performance in the 1960s. This means that the time period suggested by Warner (2003) might be biased since it does not include the growth information of 1960s. Therefore, in column 3, we estimate our baseline growth model with the tariff rate whilst dropping India over the 1960-2000 period and conclude that coefficient of tariff rate is negative and significant at the 11 % significance level. In addition if we also omit Tanzania, the other outlier over the sample period, from the regression in column 4, we find that tariff rate is negative and significant at 9 % significance level. It is, therefore, possible to conclude that tariff rate is negatively associated with economic growth over the 1960-2000 period at the marginally significant level once we take into account outlying countries.

In summary, our cross-country empirical investigation indicates that among the direct trade policy measures only tariff rate and black market premium

[9]See Hadi (1992) for details of his outlier identification method.

Table 2: Economic Growth and Tariffs: OLS Estimates under Different Time Periods and without Outliers[†]

	1970-1990		1960-2000	
	(1)	(2)	(3)	(4)
log of Initial GDP per worker	-0.289	-0.357	-0.488	-0.494
	(4.64)	(6.33)	(5.87)	(5.95)
$\log(n_i + g + \delta)$	-0.494	-0.818	-1.151	-1.209
	(1.57)	(2.69)	(2.47)	(2.59)
log of Investment rate	0.302	0.364	0.424	0.493
	(4.57)	(5.40)	(4.17)	(4.30)
log of School enrolment	0.193	0.174	0.420	0.355
	(2.92)	(2.51)	(4.07)	(3.10)
owti[a]	-0.360	-0.444	-0.725	-0.762
	(1.12)	(1.48)	(1.64)	(1.73)
Constant	2.280	2.140	3.006	2.990
	(2.45)	(2.46)	(2.22)	(2.21)
Number of observations	86	83	86	85
Breusch-Pagan test[b] (p-value)	0.36	0.21	0.86	0.80
Adjusted R^2	0.41	0.54	0.60	0.61

Note: t-statistics are in parenthesis. In the regressions where the heteroscedasticity test is failed to pass at 15 % level t-statistics based on heteroscedastic-consistent (White-robust) standard errors are reported.

[†] Dependent variable is the log difference of real GDP per worker between 1960 and 2000.

[a] Own-import weighted tariff rates on intermediate inputs and capital goods.

[b] The null hypothesis is that the errors are homoscedastic.

are negatively correlated with economic growth. However, we conclude that this correlation is marginally significant in the tariff case while strongly significant for the black market premium.

3.1.1 Black Market Premium for Foreign Exchange Rate: A Proxy for Trade Policy or for Macroeconomic Imbalances?

As mentioned above, whether the significant association between black market premium and economic growth reflects the relationship between growth and restrictive trade policies, or the connection between growth and other poor macroeconomic polices rather than trade polices is debatable. Now, we consider this point further.

Our data for black market premium come from Global Development Network (2005). Unfortunately, we lack data on the black market premium for several countries in the 1960s. In addition, for many countries data are missing during the mid 1990s. In order to increase the number of observa-

tions, we take the averages of black market premium for the 18 countries over the 1970-2000 period instead of 1960-2000 period. Of course, this approach implicitly assumes that for these countries the black market premium in the 1970s reflects the black market premium in the 1960s. Indeed, this assumption is not very realistic since we do not observe a certain pattern on the black market premium during the 1960s and the 1970s for the countries whose data are available in both decades. Among the 103 countries we identify, 43 of them experience a higher level of black market premium in the 1970s compared to the 1960s. Most of these countries are located in Africa and Latin America. On the other hand only 39 countries mostly located in the Middle East, North Africa, East Europe, Asia and Pacific have a lower level of black market premium in the 1970s with respect to the 1960s. 21 developed countries have zero black market premium in both decades.

Table 3: Black Market Premium (%): Summary Statistics

	Number of Observations	Mean value	Standard Deviation	Minimum value	Maximum value
The Largest Sample					
BMP 1960-2000	121	259.701	2114.377	-0.442	23235.250
BMP in 1960s	103	48.685	228.780	-0.090	2276.400
BMP in 1970s	121	36.319	72.469	-6.960	451.790
BMP in 1980s	121	129.106	600.604	-1.410	6406.610
BMP in 1990s	121	1205.328	12627.680	-0.350	138935.900
The 2^{nd} Largest Sample					
BMP 1960-2000	103	297.5641	2291.072	-0.442	23235.250
BMP in 1960s	103	48.68505	228.7795	-0.090	2276.400
BMP in 1970s	103	39.39447	77.2462	-1.290	451.790
BMP in 1980s	103	139.4033	648.8455	-1.410	6406.610
BMP in 1990s	103	1411.573	13686.08	-0.350	138935.900
The Regression Sample					
BMP 1960-2000	101	66.520	199.778	-0.442	1796.679
BMP in 1960s	90	47.521	241.983	-0.090	2276.400
BMP in 1970s	101	32.399	64.711	-6.960	451.790
BMP in 1980s	101	137.674	654.984	-1.410	6406.610
BMP in 1990s	101	30.501	124.572	-0.350	1199.310
The Smallest Sample					
BMP 1960-2000	90	67.668	209.826	-0.442	1796.679
BMP in 1960s	90	47.521	241.983	-0.090	2276.400
BMP in 1970s	90	33.895	67.323	-0.870	451.790
BMP in 1980s	90	142.192	692.166	-1.410	6406.610
BMP in 1990s	90	32.662	131.741	-0.350	1199.310

Table 3 provides summary statistics of black market premium for each

decade. As can be seen, for the first and largest sample in Table 3, both the mean and standard deviation of black market premium is higher in the 1960s compared to the 1970s. In order to provide a better comparison we also report the summary statistics of black market premium for 103 countries whose data are available in each decade (the second largest sample). Again both the mean and standard deviation of the black market premium is higher in the 1960s compared to the 1970s. Therefore, it is likely that we underestimate average black market premium over the 1960-2000 period by using the 1970-2000 averages for the countries whose data are missing during the 1960s. However, since we conclude that a negative and highly significant association between black market premium and economic growth over the 1960-2000 period, this bias in the data makes our result stronger.

The other important point is that the mean of the black market premium is substantially higher in the 1990s compared to the other decades in the largest sample. At the first sight, this might be thought to be surprising because most of the developing countries have liberalised their capital accounts since the late 1980s and one would expect very low black market premium for these countries during the 1990s. However, this is mainly a result of a small number of countries with the extreme values of black market premium in this decade such as Iran, Iraq, Afghanistan, Liberia, Syria and Libya. As shown in Table 3, not only is the mean value of black market premium substantial but also its standard deviation is very high during the 1990s.

Of course, from our point summary statistics of regression sample are of great concern rather than those of the largest samples. When we consider only the regression sample, both mean and standard deviation of black market premium in the 1980s are considerably higher than other decades. In addition, the statistics of black market premium based on the smallest sample consisting of the countries whose data are available in each decade support this fact. This implies that the negative and statistically significant association between black market premium and economic growth over the 1960-2000 period may be as a result of both the high level and variation of the black market premium during the 1980s.

Therefore, in Table 4 we estimate our baseline model with the averages of black market premium in each decade. In column 1, we allow average black market premium in each decade to vary continuously and conclude that none of them are statistically significant despite a negative sign. In addition, they are jointly insignificant. It is worth noting that the t-statistics of black market premium in the 1980s is relatively higher. In columns 2-5, we insert average black market premium in each decade separately and find that the only average black market premium in the 1980s is negatively and significantly correlated with growth. It is, therefore, possible to conclude

Table 4: Economic Growth and Black Market Premium: OLS Estimates[†]

	(1)	(2)	(3)	(4)	(5)
log GDP per worker 1960	-0.514	-0.507	-0.483	-0.456	-0.475
	(7.14)	(6.39)	(8.00)	(6.99)	(6.92)
$\log(n_i + g + \delta)$	-1.032	-1.180	-1.222	-1.008	-1.070
	(2.94)	(3.05)	(3.64)	(2.85)	(2.91)
log of Investment rate	0.294	0.324	0.341	0.336	0.362
	(2.69)	(3.17)	(3.14)	(3.68)	(3.84)
log of School enrolment	0.511	0.506	0.452	0.453	0.470
	(5.93)	(5.11)	(6.05)	(5.36)	(5.34)
log (1+BMP) in 1960s	-0.113	-0.132	-	-	-
	(0.76)	(1.16)			
log (1+BMP) in 1970s	-0.068	-	-0.244	-	-
	(0.26)		(1.16)		
log (1+BMP) in 1980s	-0.130	-	-	-0.186	-
	(1.35)			(3.07)	
log(1+BMP) in 19990s	-0.034	-	-	-	-0.181
	(0.28)				(1.52)
Constant	3.318	2.855	2.560	2.925	2.941
	(2.84)	(2.53)	(2.50)	(2.79)	(2.64)
Number of observations	90	90	101	101	101
Breusch-Pagan test[a] (p-value)	0.08	0.53	0.11	0.21	0.91
F-test[b]	1.81	-	-	-	-
Adjusted R^2	0.62	0.61	0.63	0.65	0.62

Note: t-statistics are in parenthesis. In the regressions where the heteroscedasticity test is failed to pass at 15 % level t-statistics based on heteroscedastic-consistent (White-robust) standard errors are reported.

[†] Dependent variable is the log difference of real GDP per worker between 1960 and 2000.

[a] The null hypothesis is that the errors are homoscedastic.

[b] F-test statistic for the joint significance of log of average black market premium in the decades.

that the significant and negative correlation between black market premium and economic growth over the 1960-2000 period mainly depends on the high level and high variation in the black market premium during the 1980s in which many developing countries launched the liberalisation programs after the debt crises in the late 1970s and the early 1980s. Hence, it is more likely that negative and significant connection between black market premium and

Table 5: Economic Growth and Black Market Premium Dummy: OLS Estimates†

	(1)	(2)	(3)	(4)	(5)
log GDP per worker 1960	-0.560	-0.511	-0.517	-0.476	-0.545
	(6.24)	(6.43)	(7.63)	(8.46)	(7.96)
$\log(n_i + g + \delta)$	-1.117	-1.139	-1.181	-1.001	-1.266
	(3.64)	(2.97)	(3.39)	(3.18)	(3.67)
log of Investment rate	0.321	0.318	0.340	0.334	0.380
	(2.70)	(3.10)	(3.75)	(3.21)	(4.25)
log of School enrolment	0.488	0.520	0.476	0.452	0.445
	(5.32)	(5.11)	(5.64)	(5.97)	(5.36)
BMP dummy in 1960s[a]	-0.026	-0.137	-	-	-
	(0.21)	(1.26)			
BMP dummy in 1970s[a]	-0.150	-	-0.261	-	-
	(1.34)		(3.17)		
BMP dummy in 1980s[a]	-0.103	-	-	-0.275	-
	(0.85)			(3.38)	
BMP dummy in 1990s[a]	-0.173	-	-	-	-0.385
	(1.01)				(3.65)
Constant	3.555	3.007	3.022	3.138	3.052
	(3.11)	(2.62)	(2.88)	(3.06)	(2.96)
Number of observations	90	90	101	101	101
Breusch-Pagan test[b] (p-value)	0.09	0.58	0.18	0.12	0.50
F-test[c]	3.09	-	-	-	-
Adjusted R^2	0.65	0.61	0.65	0.66	0.66

Note: t-statistics are in parenthesis. In the regressions where the heteroscedasticity test is failed to pass at 15 % level t-statistics based on heteroscedastic-consistent (White-robust) standard errors are reported.

† Dependent variable is the log difference of real GDP per worker between 1960 and 2000.

[a] Dummy variable is equal to 1 if the average black market premium exceeds 20 %.

[b] The null hypothesis is that the errors are homoscedastic.

[c] F-test statistic for the joint significance of the black market premium dummies.

economic growth over the period 1960-2000 reflects the adverse relation between macroeconomic imbalances and growth.

In Table 5, we exactly replicate the cross country growth regressions in Table 4. The only difference is that in Table 5 we use a dummy variable which takes the value of 1 if the average value of black market premium

exceeds 20 %. As seen in the table, the dummy variables are continuously and separately negative and significant, except the dummy in the 1960s. This implies that a higher level of black market premium is particularly harmful for economic growth.

In conclusion, our findings about the relationship between economic growth and direct trade policy measures are not in favour of more liberal trade policies. We find evidence for the adverse growth-tariff connection, but the tariff rate is only marginally significant. More to the point this finding implies that imposition of tariffs on intermediate inputs and capital goods is harmful for growth rather than the negative impact of all kind of tariffs on economic growth as our tariff variable includes only imports of intermediates and capital goods. On the other hand our finding concerning the statistically significant association between black market premium and economic growth may indicate the negative relationship between growth and macroeconomic imbalances rather than the trade restrictive effect of black market premium.

3.2 Deviation Measures

Cross-country growth regressions including only single trade policy measures have low-power for testing openness-growth connection. The reason is that each trade policy measure takes into account only one aspect of trade policy and hence tells one part of the story as pointed out by Leamer (1988). This means that a single trade-policy indicator does not pick up differences in trade-policy-induced barriers among countries. Therefore, we need a single general measure encompassing all aspects of trade policy for testing the protectionism in general. As noted by Warner (2003, p.4) "[T]he right regression for testing the impact of protectionism would seem to entail some aggregation of the policy instruments."

One way in order to overcome this problem is employing deviation measures. These measures basically show the difference between predicted and actual trade and hence can be used as an indicator of the overall level of trade protectionism. Deviation measures are essentially based on the following rationale: According to the traditional small country model, international trade is determined by the factor endowments, international prices, technology, preferences, natural trade barriers and trade policy instruments (Leamer (1988)). Therefore, differences among the countries in the level of trade can be considered as trade policy barriers if the countries are substantially identical in terms of factor endowment, technology, preferences, and natural barriers or their effects are controlled for. This implies that if one constructs a model which sufficiently explains trade flows across countries, then residuals obtained from that model can be considered as an overall mea-

sure of trade barriers subject to only trade policy. Of course this approach implicitly assumes that trade policy barriers are the only important omitted variables and they are uncorrelated with the other determinants of trade.

In the literature many deviation measures as an indicator of openness to international trade have been suggested. In this respect, outward orientation index by Syrquin and Chenery (1989) and predicted trade shares by Frankel and Romer (1999) are the most well-known measures. The problem with these variables is, however, that they measure openness over a short time period or for one year. More clearly, the outward orientation index of Syrquin and Chenery (1989) covers 1965-1980 period while the Frankel-Romer predicted trade shares are constructed for only 1985. This means that employing these openness measures in a cross-country growth regression over the 1960-2000 sample period is not plausible. Therefore, we prefer to use estimated residuals from a simple trade model as follows:

$$\begin{aligned}((X+M)/GDP_i) = \alpha_0 &+ \alpha_1 \log(Initial\ per\ worker\ GDP_i) \\ &+ \alpha_2 \log(Area_i) + \alpha_3 \log(Average\ labour\ force_i) + \varepsilon_i\end{aligned} \tag{3}$$

The model in equation (3) includes the dependent variable which is the exports plus imports as a share of GDP and hence already takes into account the size of country. The data for this variable are obtained from Penn World Tables, and often referred as "current openness" since trade shares are measured in current prices. We employ the real GDP per worker as a proxy for factor endowments of country. In order to avoid the possible endogeneity problem we use the 1960 value of per worker GDP. The other explanatory variables are the land area and average labour force. Both variables are expressed in logarithms and represent the country size. As pointed out by Frankel and Romer (1999) country size is an important determinant of international trade due to the fact that there are more opportunities for within country trade in the larger countries.

The specification in equation (3) is of course very simple in many aspects. First, the dependent variable is the average total trade as a ratio of GDP rather than the sum of bilateral trades across countries. Obviously estimating total trade as a sum of bilateral trades by employing a model including some gravity variables such as distance between two countries, common border dummy as well as other determinants would be better. However, unfortunately we lack data on bilateral trades across countries over the period 1960-2000. Second, this specification assumes that the only important omitted variables are trade policy barriers. A better specification therefore would be to include trade policy barriers such as tariffs and non-tariff bar-

riers on imports (we will consider this point later). Finally we assume that preferences and technology are constant among countries. Even though these are important shortcomings for the model in (3), we believe that the estimated residuals from this model can be used as a more reliable indicator for openness compared to simple actual trade ratios. Obviously, a large value of residual implies that the country is more open to international trade once the initial factor endowments and country's size are controlled.

Table 6: Exports plus Imports as a Share of GDP: OLS Estimates

Dependent variable†	Current Openness		Real Openness	
	(1)	(2)	(3)	(4)
log GDP per worker 1960	0.061	0.050	0.150	0.150
	(2.08)	(1.59)	(5.23)	(4.70)
log Area	-0.110	-0.106	-0.094	-0.094
	(2.57)	(2.40)	(2.62)	(2.54)
log Average Labour Force	-0.049	-0.054	0.003	0.003
	(1.52)	(1.56)	(0.11)	(0.09)
Landlocked country dummy	-	-0.072	-	-0.005
		(0.91)		(0.09)
Constant	2.218	2.354	0.222	0.231
	(5.73)	(5.59)	(0.72)	(0.67)
Number of observations	111	111	111	111
Breusch-Pagan test[a] (p-value)	0.00	0.00	0.00	0.00
Adjusted R^2	0.45	0.45	0.40	0.40

Note: t-statistics based on heteroscedastic-consistent (White-robust) standard errors are in parenthesis.

† 1960-2000 averages.

[a] The null hypothesis is that the errors are homoscedastic.

Employing the current openness as a dependent variable we estimate this model by OLS over the 1960-2000 period. Column 1 of Table 6 presents the resulting OLS estimate. In column 2, we also include a dummy variable for landlocked countries in order to control for natural trade barriers.[10] However, inserting the landlocked country dummy neither changes the basic results

[10]While constructing this dummy variable, we keep the landlocked countries in Europe such as Austria, Luxembourg, Switzerland and Hungary since these countries have borders with major trade centres and thus becoming landlocked may not create an important disadvantage in terms of international trade.

nor improves the fit of the model.[11] Therefore, we prefer to employ residuals which come from the first regression as an openness variable and label it as *RESID_Current Openness*. In columns 3 and 4, we replicate the regressions in the first two columns. The only difference is that in columns 3 and 4, we use real openness of Penn World Tables as the dependent variable. Real openness is defined as the ratio of exports plus imports relative to GDP in constant prices.[12] As can be seen, the regression results in columns 3 and 4 are different from those in columns 1 and 2 in some aspects: First, when the dependent variable is real openness the coefficient estimate of initial income is considerably larger and highly significant. Second, average labour force is not only significant but also very close to zero. Third, the R^2 values of the regressions in columns 3 and 4 is smaller and hence it is possible to conclude that these regressions are less precise. On the other hand, as in the case of current openness, including a landlocked country dummy does not improve the goodness of fit of the regression in column 3. Therefore, we again use the estimated residuals in column 3 as an openness measure and label it as *RESID_Real Openness*.

Table 7 reports the estimation results by employing these two deviation measures in the framework of our baseline cross-country growth model. Notice that our approach here is in essence a two-step/generated-regressor substitution procedure since we employ predicted residuals obtained from an auxiliary model in equation (3) as an openness measure. Although this approach produces consistent parameter estimates in the second step, it is well-known fact that the standard errors and related test statistics estimated in the second step are incorrect (because the second step regression employs predicted values of error term rather than its actual values). Murphy and Topel (1985) suggest a method for calculating second-step standard errors. However, Murphy-Topel estimator is not very attractive in our case since this method requires the same sample of observations in both step. We prefer bootstrap simulation method as a more pragmatic and better alternative to correct second-stage estimated standard errors since our sample in the first stage is larger. In short, we report z-statistics obtained from the bootstrap estimates of standard errors for statistical significance test. As seen in the table, we conclude that both variables are positively, but insignificantly associated with growth.

[11] We also insert two more variables into the regression: foreign direct investment to GDP ratio and distance from major trading centres. Akin to the lanclocked country dummy, the inclusion of these variables does not improve the model. The regression results are available from the author upon request.

[12] Alcalá and Ciccone (2004) argue that real openness is a better measure of openness compared to current openness in the presence of trade-driven productivity.

Table 7: Economic Growth and Deviation Measures: OLS Estimates†

	(1)	(2)
log GDP per worker 1960	-0.415	-0.418
	(6.69)	(6.87)
$\log(n_i + g + \delta)$	-1.198	-1.118
	(2.94)	(3.04)
log of Investment rate	0.359	0.349
	(3.06)	(2.78)
log of School enrolment	0.429	0.446
	(5.51)	(5.69)
RESID_Current Openness	0.268	-
	(1.13)	
RESID_Real Openness	-	0.323
		(1.33)
Constant	2.038	2.268
	(1.77)	(2.19)
Number of observations	105	105
Adjusted R^2	0.61	0.62

Note: z-statistics based on bootstrap estimates of standard errors with 1000 replications are in parenthesis.

† Dependent variable is the log difference of real GDP per worker between 1960 and 2000.

3.3 Subjective Measures

In the third and last step, we consider some subjective measures for openness. These measures are in some sense similar to the deviation measures such that both categories try to capture all aspects of trade policy. The main difference is that openness indicators in this category are partly or completely based on the subjective judgment.

We start with the real exchange rate distortion index suggested by Dollar (1992) as an openness variable. Our data on this variable come from Global Development Network (2005) and cover the 1970-2000 period. This measure compares the domestic prices of tradable goods across countries. Assuming that the law of one price always holds, a higher level of distortion index indicates a more distorted trade regime. Our estimation results reported in column 1 of Table 8 show that the distortion index is significantly and negatively associated with growth. In column 2, we include the variability index which is simply a coefficient of variation of the real exchange rate

distortion index over the 1970-2000 period and conclude that the variability is negative and significant with a substantially larger coefficient estimate. However, in a difference to Dollar (1992), we find an insignificant coefficient estimate of the distortion index when both distortion and variability indexes are included in the regression together. As shown in column 3, the regression result shows that the distortion index is not statistically significant.

The assumption that law of one price is always held in the case of free trade has some practical flaws as argued by Rodrik and Rodríguez (2000), however. It is possible to consider the cross country differences in price levels as a result of monetary and exchange rate polices rather than trade restrictions. It is, therefore, more reasonable to attribute these findings to the importance of real exchange rate stability rather than the liberal trade polices for better growth performance.

In column 4, we include the dummy variable for openness suggested by Sachs and Warner (1995, SW henceforth). The SW dummy variable is a single openness measure covering all major kinds of trade restrictions, namely non-tariff barriers, average tariff rate, black market premium for exchange rate, a socialist country, and a state monopoly on major exports. SW define their dummy variable such that a value of zero indicates a closed economy while the value of one is for an open economy. However, differently from SW, we extend their openness dummy over the period 1960-2000 rather than 1970-1989 period. This means that we consider only 26 countries as always open during the 1960-2000 period while SW define 33 open countries between 1970 and 1989. More clearly we define the countries Taiwan, Jordan, Ireland, South Korea, Indonesia, Japan and Australia as closed over the 1960-2000 period since these countries opened their trade regimes during the 1960s according to the SW criteria. Notice that in our regressions Germany and Taiwan are always omitted because of missing data on these countries over the sample period. In spite of this difference, we conclude that the SW dummy variable is statistically significant and positive. Regression result in column 4 implies that in the long run GDP per worker in an open economy would have 2.6 times that in a closed economy once the other determinants are controlled.[13] [14] In addition, in column 5 we employ the SW dummy over

[13]The effect of openness dummy on the long run income level can be calculated as $\exp(-\gamma_5/\gamma_1)$ where γ_5 is the coefficient of openness dummy and γ_1 is the coefficient of the initial level of income. According to the regression result in Column 4, $\gamma_5 = 0.463$ and $\gamma_1 = -0.483$, hence the long run level of GDP per worker in an open country would be $2.6 = exp(-0.463/-0.483)$ times the GDP per worker in a closed economy.

[14]Moreover, we test the absolute convergence hypothesis for open economies over the 1960-2000 period. In order to facilitate comparison with SW, we employ annual growth rate and initial income according to GDP per capita rather than GDP per worker and

the period 1970-2000 period which is exactly identical to the original SW dummy variable. Now the coefficient estimate of the dummy is larger and indicates that GDP per worker in an open economy would be equal to 3.2 times the GDP per worker in a closed economy in the long run.

The SW dummy variable is, however, heavily criticised by Harrison and Hanson (1999) and Rodrik and Rodríguez (2000). The most important criticism is that the strength of the dummy is mainly the result of the criteria related to state monopolies on exports and the black market premium. According to Rodrik and Rodríguez (2000), the export monopolies component of the SW dummy acts like a sub-Saharan Africa dummy while the black market premium component reflects poor macroeconomic conditions and imbalances rather than restrictive trade polices. That is why, in column 6 we insert a sub-Saharan Africa dummy to the regression. The regression result indicates that the coefficient estimate of the SW dummy is now higher and highly significant. In column 7, we substitute the sub-Saharan African dummy with a composite regional dummy for both sub-Saharan Africa and Latin America. Now, the coefficient estimate of SW dummy is relatively smaller, but still statistically significant. In column 8, we introduce the black market premium dummy which takes the value of 1 if the average black market premium exceeds 20 % in any of the 1960s, 1970s, 1980s or 1990s as well as the composite regional dummy variable. The regression result shows that the coefficient estimate of SW dummy is not only smaller but also marginally significant at the 7 % level. In column 9, we substitute the black market premium dummy with logarithm of one plus average black market premium and conclude the same result. Therefore, it is possible to conclude that the SW dummy is sensitive to the black market premium for exchange rate, but not to dummy variable for sub-Saharan Africa.

We employ the fraction of open years according to SW liberalisation dates over the 1960-2000 period in column 10.[15] This variable is more reasonable

conclude the following cross-country growth regression for 24 countries which are always open during the 1960-2000 period (robust t-statistics are in parentheses).

$$[\log y_{i,2000} - \log y_{i,1960}]/40 = \underset{(6.14)}{15.349} - \underset{(5.00)}{1.397} \log y_{i,1960} \qquad \bar{R}^2 = 0.68$$

where y_i is the real GDP per capita. As can be seen, the coefficient estimate of initial income is very close to that estimated by SW (They report the coefficient estimate of initial GDP per capita as minus 1.368, see column 3 of Table 11 on page 48 in Sachs and Warner (1995)).

[15]For the period 1990-2000, we employ the liberalisation dates provided by Wacziarg and Welch (2008) updating the SW dummy and liberalsation status. In their systematic review, Wacziarg and Welch (2008) disagree with SW on the liberalization status or dates in the case of several countries. Some countries such as Panama and Cape Verde which

with respect to the SW dummy since the SW liberalisation dates are based on the intensive survey of the country cases as pointed out by Wacziarg (2001) and Wacziarg and Welch (2008). The regression result indicates that the fraction of open years is strongly and significantly correlated with economic growth over the period 1960-2000.

were not included in SW are classified in the study by Wacziarg and Welch (2008). There are five countries namely, Ivory Coast, the Dominican Republic, Mauritania, Niger and Trinidad and Tobago for which Wacziarg and Welch (2008) disagree with SW assignment of liberalization dates and four countries which remains closed as of 2001 according to Wacziarg and Welch (2008) while SW classifies them as open in the early 1990s. These countries are Belarus, Croatia, Estonia, and India. In this study, we follow the Wacziarg and Welch (2008) for the disagreement cases. See Sachs and Warner (1995) and Wacziarg and Welch (2008) and appendices therein for more information about the SW liberalisation dates.

Table 8: Economic Growth and Subjective Measures: OLS Estimates[†]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log GDP per worker 1960	-0.498	-0.520	-0.515	-0.483	-0.478	-0.500	-0.454	-0.469	-0.472	-0.496
	(6.91)	(7.63)	(7.42)	(7.10)	(7.44)	(7.37)	(6.72)	(6.57)	(7.81)	(7.43)
$\log(n_i + g + \delta)$	-1.245	-1.042	-1.041	-0.315	-0.310	-0.294	-0.258	-0.483	-0.506	-0.524
	(3.29)	(2.83)	(2.81)	(0.79)	(0.84)	(0.75)	(0.66)	(1.21)	(1.39)	(1.44)
log of Investment rate	0.536	0.526	0.524	0.335	0.316	0.313	0.302	0.278	0.261	0.317
	(5.49)	(5.65)	(5.58)	(3.71)	(3.65)	(3.48)	(3.38)	(2.98)	(2.36)	(3.57)
log of School enrolment	0.421	0.466	0.460	0.471	0.426	0.383	0.409	0.424	0.421	0.397
	(4.36)	(5.05)	(4.92)	(5.65)	(5.35)	(4.04)	(4.76)	(4.70)	(4.95)	(4.84)
Distortion Index by Dollar (1992)[a]	-0.256	-	-0.056	-	-	-	-	-	-	-
	(2.47)		(0.46)							
Variability Index by Dollar (1992)[b]	-	-0.468	-0.428	-	-	-	-	-	-	-
		(3.81)	(2.83)							
Openness Dummy (1960-2000)[c]	-	-	-	0.463	-	0.510	0.397	0.269	0.244	-
				(3.69)		(4.03)	(3.15)	(1.86)	(1.89)	
Openness Dummy (1970-2000)[c]	-	-	-	-	0.549	-	-	-	-	-
					(4.88)					
Sub-saharan Africa	-	-	-	-	-	-0.242	-	-	-	-
						(1.85)				
Latin America and Africa[d]	-	-	-	-	-	-	-0.234	-0.210	-0.234	-
							(2.30)	(2.06)	(2.44)	
BMP dummy[e]	-	-	-	-	-	-	-	-0.072	-	-
								(0.73)		
log (1+BMP)[f]	-	-	-	-	-	-	-	-	-0.195	-
									(2.42)	
Fraction of open years[g]	-	-	-	-	-	-	-	-	-	0.645
										(4.31)
Constant	3.240	3.828	3.831	4.839	4.675	4.971	4.765	4.302	4.269	4.097

Continued on Next Page...

Table 8 – *Continued*

	(2.94)	(3.57)	(3.56)	(4.18)	(4.43)	(4.34)	(4.21)	(3.66)	(3.51)	(3.90)
Number of observations	87	87	87	102	102	102	102	98	98	102
Breusch-Pagan test[h] (p-value)	0.68	0.82	0.72	0.77	0.37	0.68	0.55	0.26	0.15	0.91
Adjusted R^2	0.67	0.70	0.70	0.65	0.68	0.66	0.67	0.65	0.67	0.67

Note: t-statistics are in parenthesis. In the regressions where the heteroscedasticity test is failed to pass at 15 % level t-statistics based on heteroscedastic-consistent (White-robust) standard errors are reported.

† Dependent variable is the log difference of real GDP per worker between 1960 and 2000.

[a] Real exchange rate distortion index, 1970-2000 averages.

[b] Coefficient variation of real exchange rate distortion index over the 1970-2000 period.

[c] Dummy variable for open countries according to the Sachs and Warner (1995) criteria.

[d] Composite regional dummy variable for Latin America and Sub-saharan Africa.

[e] Dummy variable is equal to 1 if the average black market premium exceeds 20 % in either the1960s or the 1970s or the 1980s or the 1990s.

[f] Logarithm of one plus average value of black market premium over the 1960-1999 period.

[g] Fraction of open years according to librealization dates in Sachs and Warner (1995) and Wacziarg and Welch (2008)

[h] The null hypothesis is that the errors are homoscedastic.

Table 9: International Trade and Trade Policy Indexes: OLS Estimates

Dependent variable[†]	Current Openness		Real Openness	
	(1)	(2)	(3)	(4)
log GDP per worker 1960	0.019	0.041	0.091	0.100
	(0.47)	(1.25)	(2.61)	(3.29)
log Area	-0.124	-0.072	-0.103	-0.055
	(2.24)	(1.89)	(2.28)	(1.87)
log Average Labour Force	-0.021	-0.055	0.034	0.003
	(0.46)	(1.46)	(0.98)	(0.09)
owti[a]	-0.140	-0.063	-0.236	-0.193
	(0.72)	(0.42)	(1.19)	(1.20)
owqi[b]	-0.237	-0.162	-0.196	-0.115
	(2.06)	(1.75)	(2.01)	(1.49)
log (1+BMP)[c]	-	0.016	-	-0.038
		(0.36)		(1.11)
Constant	2.369	2.014	0.403	0.205
	(4.10)	(4.71)	(0.83)	(0.52)
Number of observations	85	83	85	83
Breusch-Pagan test[d] (p-value)	0.00	0.00	0.00	0.00
F-test[e]	2.19	1.11	2.60	1.76
Adjusted R^2	0.43	0.43	0.40	0.40

Note: t-statistics based on heteroscedastic-consistent (White-robust) standard errors are in parenthesis.

[†] 1960-2000 averages.

[a] Own-import weighted tariff rates on intermediate inputs and capital goods.

[b] Own-import weighted non-tariff frequency on intermediate inputs and capital goods.

[c] Logarithm of one plus average value of black market premium over the 1960-1999 period.

[d] The null hypothesis is that the errors are homoscedastic.

[e] F-test statistic for the joint significance of owti, owqi and log(1+BMP)

Finally, we construct a simple subjective openness measure. Recall that our simple model for international trade expressed in equation (3). As mentioned above, one of the weaknesses of this model is the assumption that the only important omitted variable is trade policy barriers. Now, we relax this assumption and introduce three trade policy instruments namely tariffs, non-tariff barriers and the black market premium. Our aim is to obtain approximate weights for these trade policy instruments in order to construct a composite trade policy indicator. Estimation results are given in Table 9. Regression results are not very precise compared to our previous estimations

in Table 6. First, introducing trade policy instruments does not improve the goodness of fit. Second, except for non-tariff barriers, all trade policy instruments are found to be statistically insignificant. One reason for the less precise results is that our data on tariffs and non-tariff barriers are not very satisfactory. Multicollinearity among the policy instruments may be another reason. However, in spite of the lack of precision, our results indicate that all trade policy instruments have the expected sign. The only exception is the regression in column 2 in which the sign of the black market premium is positive. Hence, except this regression, the coefficient estimates of trade policy instruments can be used as approximate weights.

In light of the regressions in Table 9, we define the following three trade policy indicators;

$$
\begin{aligned}
&Trade\ policy\ 1 = -0.14(owti) - 0.24(owqi) \\
&Trade\ policy\ 2 = -0.24(owti) - 0.20(owqi) \\
&Trade\ policy\ 3 = -0.19(owti) - 0.12(owqi) - 0.04\log(1 + BMP)
\end{aligned}
$$

where BMP is the average black market premium and owti and owqi denote the own-import weighted tariff rates and non-tariff frequency on intermediate inputs and capital goods, respectively. Notice that the higher level of trade policy index implies a more open country since weights are negative numbers. Thus, one would expect a positive coefficient estimate of the indexes if openness is positively correlated with economic growth. Employing these indexes we estimate our baseline model and conclude them all of them have the positive but insignificant coefficient estimates (Table 10). Notice that we again employ standard errors calculated from bootstrap simulation method for statistical significance test as generated trade policy indices are based on the coefficient estimates obtained from a first-stage regression model.

4 Sensitivity Analysis: Bayesian Model Averaging Estimates

Despite a wide range of growth theories and hence a large number of suggested proxy variables, most studies in the empirical cross-country growth literature include a small set of explanatory variables, as acknowledged by many authors.[16] The main problem with these studies is that their results

[16]See, for instance, Levine and Renelt (1992), Mankiw (1995), Sala-i-Martin (1997), Temple (2000), and Brock and Durlauf (2001) *inter alia*.

Table 10: Economic Growth and Composite Trade Policy Measures: OLS Estimates†

	(1)	(2)	(3)
log GDP per worker 1960	-0.484	-0.489	-0.489
	(6.55)	(6.53)	(6.73)
$\log(n_i + g + \delta)$	-1.237	-1.221	-1.298
	(2.88)	(2.77)	(3.26)
log of Investment rate	0.431	0.428	0.363
	(3.21)	(3.21)	(2.88)
log of School enrolment	0.432	0.436	0.439
	(4.51)	(4.49)	(4.89)
Trade policy 1	0.574	-	-
	(0.85)		
Trade policy 2	-	0.643	-
		(0.93)	
Trade policy 3	-	-	1.188
			(1.28)
Constant	2.682	2.783	2.464
	(2.12)	(2.13)	(2.02)
Number of observations	85	85	83
Adjusted R^2	0.60	0.60	0.60

Note: z-statistics based on bootstrap estimates of standard errors with 1000 replications are in parenthesis.

† Dependent variable is the log difference of real GDP per worker between 1960 and 2000.

are very sensitive to changes in the list of explanatory variables. This implies that identification of explanatory variables in a particular cross-country growth regression is a very important task and thus the problem of model uncertainty is immense.

The empirical literature on openness-growth nexus is particularly subject to this problem because many studies in this literature employ simple growth models and ignore other potentially important growth theories. It is, therefore, likely that the strong results in favour of openness may arise from model misspecifation and/or openness measures may be acting as a proxy for other macroeconomic policies or for other important factors such as institutions and geography, as indicated by Rodrik and Rodríguez (2000).

One promising solution to this issue is to integrate model uncertainty

into subsequent statistical inference using model averaging techniques. We employ model averaging technique in a Bayesian manner, called as Bayesian Model Averaging (BMA hereafter) because BMA incorporates the model uncertainty into statistical inference such that the true model is considered as an unobservable random variable.[17] In this regard, BMA is a method of estimating a variable of interest under each possible model and then taking weighted average of these estimates according to the posterior model probabilities.[18] Therefore, BMA takes into account all possible models instead of focusing on a selected one. This means that the main aim of BMA is to provide a better parameter estimate of the variable of interest rather than to find the best (or true) model.

4.1 Specifying Prior Probabilities

It is obvious that the Bayesian nature of this technique requires the specification of prior probabilities. That is, we need to assign appropriate priors to models and to parameters within each model, namely coefficients of regressors and variances for error term in order to compute the posterior probabilities of quantity of interest.

Regarding the model priors, the most common approach is employing uniform priors over the models, that is each model has equal prior probability. Even though assigning equal priors to models seems reasonable, this prior structure is problematic in the context of cross-country growth regression in two respects: first, uniform priors imply higher weights for larger models although there is no a priori reason to believe that the larger models are more likely to be true growth model than smaller models as argued by Sala-i-Martin et al. (2004); second and more importantly, under the uniform model priors, the model space encompassing all candidate models will be dominated by the growth theories presented by a large number of proxy variables. This means that growth theories represented by a larger number of variables take higher prior probabilities with respect to other growth theories measured by a smaller number of variables although, in principle, all potential growth

[17] This property is an important departure from classical (or frequentist) statistics since in the classical framework the true model (or data generating process) is assumed to be known and hence cannot be treated as a random variable. This also implies that building a model averaging technique based on a rigorous statistical theory is very difficult in the classical statistics. Nevertheles, various frequentist model averaging methods have appeared recently in the literature. See Moral-Benito (2013) for a nice summary of frequentist approach to model averaging.

[18] The reader can refer to Hoeting et al. (1999) and Koop (2003, chapter 11), among others for more information on BMA.

theories are equally likely to be included in true growth model.[19]

In order to deal with this problem, Brock, Durlauf and West (2003) suggest a tree structure addressing different aspect of model uncertainty in growth regression. Following this tree structure, we first assign uniform priors on alternative growth theories implying that a particular growth theory is assigned a prior probability of 0.5 and this prior is unaffected by inclusion or exclusion of other theories. In the second step, we equally distribute the prior probability of a particular theory (that is equal to 0.5) across proxy variables within that theory.

This hierarchical prior structure on models seems easier to justify in the case of linear cross-country growth regression. It is consistent with the open-ended nature of growth theories since the probability that each growth theory is included in the true model is equally likely. Moreover, it allows to distinguish the uncertainty over theories from the uncertainty on proxy variables. However, care must be taken with two points while applying this prior structure: first, one should avoid employing proxy variables which represent more than one theory; and second, the connection among theories should be minimised.

In light of this discussion and also following the existing growth literature, we consider 16 growth variables classified under 7 theories as well as the augmented neo-classical growth variables and openness measures in our BMA application as follows:

1. Economic Institutions: Following Hall and Jones (1999), we measure institutional quality by using a composite index based on the data set of International Country Risk Guide (ICRG) published by a private international consulting company, Political Risk Services. The institutional quality index is calculated as the equally weighted average of four political risk components of ICRG data for the years 1984-2000: i) investment profile as an average of three subcomponents namely, contract viability, profits repatriation and payment delays; ii) law and order; iii) corruption; and iv) bureaucratic quality. The higher value of index implies the greater institutional quality.

2. Political Structure: We employ an index on institutional democracy in order to address the impact of political structure on economic growth.

[19]For example, consider a case in which a particular growth theory is measured by n different proxy variables. This implies that $2^n - 1$ different combinations of these proxy variables produce the models including only the proxy variables of that theory. It is clear that the prior probability of that theory is $2^n - 1$ times as high as the prior probability of another growth theory measured by only one proxy if we define a uniform prior structure on the models.

The democracy index is taken from Polity IV Project (Marshall et al. (2005)) and is averaged over the period 1960-2000.

3. Geography: Akin to Sachs (2001), we use two variables, the proportions of country's land area in geographical tropics and in navigable waters to capture the effect of geography.

4. Cultural and Religious Affiliates: Culture is measured by two variables related to linguistic characteristic of a country: fraction of population speaking English and fraction of population speaking a major European language except English. These variables allow us to investigate the effects of Anglo-Saxon and continental Europe traditions on economic development. We measure religion by three variables, fractions of Catholics, Muslims, and Protestants in total population. Notice that the fraction of other religions is excluded from the analysis in order to prevent multicollinearity problem, and hence the effect of other religions is captured by the intercept term in the growth model.

5. Macroeconomic Policy: We emphasise fiscal and monetary policies as two essential aspects of macroeconomic policy and measure them by government consumption expenditures to GDP ratio and inflation rate, respectively. Inclusion of these variables is particularly important since an important criticism on the openness-growth literature is that openness measures are proxy for other macroeconomic policies rather than trade policy per se.

6. Population Heterogeneity: We consider this theory as another important growth determinant and measure it by two variables: ethnolinguistic fragmentation index (ELF) and a measure of ethnic tensions. The first index shows the probability that two randomly selected persons of a given country do not belong to the same ethnolinguistic group. Therefore, the higher value of index indicates the more heterogenous country in terms of ethnic and linguistic aspects.[20] The second variable measures the degree of tension within a country along racial, nationality, or language divisions and comes from ICRG. The lower value implies the greater degree of ethnic tensions.

7. Regional Differences: We include three dummy variables for sub-Saharan Africa, Latin America and the Caribbean, and East Asia and Pacific to explain different growth performances across these regions. Due to the

[20]This index has become a standard variable in the cross-country growth literature since the important studies by Mauro (1995) and Easterly and Levine (1997).

poor growth performance in Africa and Latin America over the 1960-2000 period one may expect negative coefficient estimates of dummy variables for these two regions whereas the opposite situation is true for East Asia and Pacific.

Related to choice of prior probabilities over model parameters, we substantially benefit from the study by Fernández, Ley and Steel (2001). Employing theoretical considerations and extensive simulations, Fernández, Ley and Steel (2001) suggest prior probabilities having little impact on the posterior inference. Therefore, following these authors closely we employ improper noninformative priors for the common parameters in all models, and Zelner's g-prior structure for the coefficients of additional explanatory variables.[21]

4.2 Results

In this section, we report the findings obtained from our BMA exercises. An important feature of our BMA application is that we keep all variables of augmented neoclassical growth model in each possible model to reveal the effect of growth theories and their proxy variables on economic growth through productivity channel.[22] Therefore, in addition to intercept term, each possible model includes four common variables, namely initial level of income, sum of rates of population growth, technological change and depreciation, physical and human capital savings rates expressed in equations (1) and (2). Only different combinations of openness measures and other variables classified under the growth theories discussed above yield different models. More compactly, we can rewrite our baseline presentation of cross-country growth regression model in its generic form as follows:

$$\varrho_i = \gamma + \pi X_i + \psi Z_i + \upsilon_i \tag{4}$$

where ϱ_i is average real growth rate of GDP per worker over a particular time period, γ is the intercept, X_i is a set of explanatory variables suggested by the augmented neo-classical growth model, Z_i is a set of additional control variables offered by new growth theories and υ_i is the error term.

[21] Fernández et al. (2001) propose a g-prior such that $g = 1/max\{n, k^2\}$, n and k denote the number of observations and the number of potential explanatory variables, respectively. We set $g = 1/k^2$ as $k^2 > n$ in our BMA applications. See, Liang et al. (2008), Ley and Steel (2009), Eicher et al. (2011) and Moral-Benito (2013) for elaborate discussions on the specification of prior structure over the model parameters in BMA applications.

[22] Moreover, there is a common consensus on these variables in the literature and hence they are generally considered as fixed regressors in empirical cross-country growth studies.

In the framework of growth model expressed in equation (4), we carry out two main BMA exercises. The only difference between these two exercises stems from the proxy variables used for openness. Put differently, direct trade policy measures are employed in the first exercise while openness is measured by the deviation and subjective indexes in the second application of BMA.

In the first BMA exercise, we employ tariff rates (owti), non-tariff coverage ratio (owqi), collected import duties as a ratio of imports and average black market premium for exchange rate as openness indicators. That is why we have 20 potential growth variables representing 8 different theories in the first BMA exercise and different combinations of these variables produce $2^{20}(= 1,048,576)$ possible models. A complete data set covering 66 countries is used (see the Appendix for the list of countries).

Table 11 reports the posterior estimates of growth theories and their individual proxy variables. Notice that we do not report the posterior estimates of intercept term and of augmented neo-classical growth variables. The reason is that we include these variables as fixed regressors in all models, as mentioned earlier. That is, both prior and posterior probabilities of these variables are by definition equal to one.

The BMA results indicate that posterior inclusion probabilities of both trade openness and its individual proxies are found to be very low. It is worth reminding that we already assign uniform prior probabilities to growth theories. As noted previously, this implies that prior probability of a particular growth theory being included in the true growth model is 0,5. Therefore, it is definitely possible to conclude that theories with the posterior inclusion probabilities less than 0.5 are not robustly correlated with long-run economic growth. Hence, our first BMA exercise shows that trade openness is not a robust growth determinant.

Akin to openness, geography, cultural and religious affiliates, and population heterogeneity have also posterior inclusion probability lower than 0.5, implying that these theories are not fundamental to long-run economic growth. However, we conclude that four growth theories-economic institutions, political structure, macroeconomic policy, and regional differences, have posterior inclusion probabilities higher than 50 % . Except political structure, their posterior inclusion probabilities are very high and almost equal to one.

Considering the individual proxies of these theories, we conclude that posterior mean of the ICRG institutional quality index is positive, implying that quality of institutions has a stimulating effect on economic growth. The high level of posterior inclusion probability of macroeconomic policy emanates from both inflation rate and government consumption to GDP ratio.

Table 11: Posterior Estimates with Direct Trade Policy Measures

Growth Theories & Their Proxies	Posterior Inclusion Probability	Posterior Mean	Posterior Standard Error
Economic Institutions	*0.999*		
Institutional Quality Index of ICRG	0.999	0.304	0.063
Political Structure	*0.698*		
Democracy	0.698	-0.026	0.015
Geography	*0.155*		
Population in Tropics	0.137	-0.031	0.098
Land Area in Navigable Waters	0.032	0.003	0.128
Cultural and Religious Affiliates	*0.012*		
Fraction of English Speaking	0.002	0.000	0.136
Fraction of European Lang. Speaking	0.002	0.000	0.120
Fraction of Catholics	0.003	0.000	0.001
Fraction of Muslims	0.002	0.000	0.000
Fraction of Protestants	0.006	0.000	0.002
Population Heterogeneity	*0.066*		
Ethnolinguistic Fragmentation	0.048	-0.009	0.131
Ethnic Tension	0.020	0.001	0.030
Macroeconomic Policy	*0.992*		
Average Inflation	0.991	-0.097	0.024
Government Consumption	0.633	-1.260	0.848
Regional Differences	*0.999*		
East Asia & Pacific	0.116	0.018	0.118
sub-Saharan Africa	0.997	-0.649	0.118
Latin America & the Caribbean	0.061	0.001	0.131
Trade Openness	*0.091*		
owti	0.063	-0.029	0.198
owqi	0.009	0.000	0.134
log (1+ BMP)	0.032	-0.005	0.073
Import Duties	0.011	-0.004	0.665

Both variables have negative posterior means and considerably high posterior probabilities. These findings clearly indicate that inflation and government consumption are not good for economic growth. Concerning the regional differences, we find the only dummy for sub-Saharan Africa is robustly correlated with growth while dummies for East Asia and Latin America are not. The posterior coefficient estimate of African dummy is negative and

indicates poor growth performance of countries in sub-Saharan Africa with respect to the rest of the world between 1960 and 2000. Finally, the average democracy index is found to be negative with a posterior inclusion probability greater than 0.5. Even though its posterior mean is very low, this finding may imply that the greater democracy retards the economic growth over 1960-2000 period. Another possibility is the reverse causality between growth and democracy, i.e. the countries with poor growth performance tend to be less democratic.

In the second exercise we measure openness by deviation measures and subjective indicators. These are *RESID_Current Openness*, *RESID_Real Openness*, fraction of open years, the composite trade policy indexes and the real exchange rate distortion index. The remaining growth theories and their empirical proxies are exactly same as those in the first exercise. This means that our second BMA exercise includes 23 additional growth variables and the model space now comprises of $2^{23}(= 8,388,608)$ different models. The sample of the second BMA application encompasses 61 countries and is given in the Appendix.

Since the model space in the second exercise is large in order to account for all possible models, we employ Markov chain Monte Carlo model composition (MC^3 henceforth) algorithm developed by Madigan and York (1995).[23] MC^3 algorithm employs a subset of model space as a reliable approximation to model space rather than searching all possible models. The key point in the application of this algorithm is that one should iterate the Markov chain with enough number of draws to estimate the posterior quantities of interest with reasonable accuracy. Therefore, we simulated the MC^3 algorithm with 350,000 and 400, 000 draws, respectively and then compared the results. Since the posterior estimates are found to be extremely close to each other, we conclude that the Markov chain is converging to the true posterior distributions. This implies that we can use the results obtained from the simulation with 400,000 drawings of the MC^3 sampler as reliable posterior estimates.

The BMA estimates based on deviation and subjective openness measures are presented in Table 12. As can be seen, the posterior estimates are substantially similar to those obtained from our previous application. We again conclude that four growth theories-economic institutions, political structure, macroeconomic policy, and regional differences have the posterior inclusion

[23]In order to construct a Markov chain, we need a transition matrix showing the transition probabilities from one model to another. As a difference to Madigan and York (1995), in our transition matrix, the neighbourhood for a possible model is defined as the models including the same growth theories plus one more and one less theory with respect to that model.

Table 12: Posterior Estimates with Deviation and Subjective Openness Measures

Growth Theories & Their Proxies	Posterior Inclusion Probability	Posterior Mean	Posterior Standard Error
Economic Institutions	*0.957*		
Institutional Quality Index of ICRG	0.957	0.213	0.066
Political Structure	*0.757*		
Democracy	0.757	-0.029	0.014
Geography	*0.113*		
Population in Tropics	0.098	-0.025	0.102
Land Area in Navigable Waters	0.037	0.004	0.127
Cultural and Religious Affiliates	*0.012*		
Fraction of English Speaking	0.002	0.000	0.134
Fraction of European Lang. Speaking	0.003	0.000	0.112
Fraction of Catholics	0.003	0.000	0.001
Fraction of Muslims	0.002	0.000	0.001
Fraction of Protestants	0.005	0.000	0.002
Population Heterogeneity	*0.187*		
Ethnolinguistic Fragmentation	0.040	-0.006	0.134
Ethnic Tensions	0.156	0.004	0.030
Macroeconomic Policy	*0.997*		
Average Inflation	0.997	-0.114	0.023
Government Consumption	0.747	-0.496	0.866
Regional Differences	*0.965*		
East Asia & Pacific	0.190	0.037	0.114
sub-Saharan Africa	0.954	-0.515	0.115
Latin America & the Caribbean	0.134	0.013	0.110
Trade Openness	*0.004*		
RESID_Current Openness	0.000	0.000	0.231
RESID_Real Openness	0.000	0.000	0.276
Fraction of Open Years	0.001	0.000	0.179
Trade Policy 1	0.001	-0.001	2.104
Trade Policy 2	0.001	0.001	0.694
Trade Policy 3	0.002	0.003	0.917
Distortion Index by Dollar (1992)	0.000	0.000	0.079

probabilities greater than 0.5. Neither trade openness nor remaining theories are found to be robustly correlated with growth, similar to the first exercise.

Differently from the first BMA application, one point may be worth noting: trade openness has the lowest posterior inclusion probabilities among the growth theories. As seen in the table, posterior probability of openness is almost zero.

Finally, we carry out an additional exercise by introducing openness as a fixed variable in our BMA setting. In other words, in addition to an intercept term and augmented neo-classical growth variables, we also include an openness variable as a common regressor in all possible models. However, this does not mean that we are certain that openness has an impact on long-run economic growth and hence it should be considered as a true growth determinant. Our aim is only to determine whether openness is a robust growth variable by using its posterior t value which is equal to the ratio of posterior mean to corresponding posterior standard error. According to Brock and Durlauf (2001), a variable can be considered as a robust growth correlate if its coefficient estimate of posterior mean is twice at least its posterior standard error, that is the posterior t approach mimics the typical assessment of statistical significance level at 5 % in classical statistics.

Table 13: Posterior Estimates with Openness Measures as a Fixed Variable

	Posterior Mean	Posterior Standard Er.ror	Posterior t-statistic
Direct Trade Policy Measures			
owti	-0.463	0.198	-2.34
owqi	0.003	0.136	0.02
log (1+ BMP)	-0.149	0.077	-1.93
Import Duties	-0.871	0.859	-1.01
Deviation and Subjective Measures			
RESID_Current Openness	0.092	0.217	0.42
RESID_Real Openness	-0.024	0.210	-0.12
Fraction of Open Years	0.137	0.169	0.81
Trade Policy 1	0.431	0.527	0.82
Trade Policy 2	0.591	0.491	1.20
Trade Policy 3	0.915	0.603	1.52
Distortion Index by Dollar (1992)	-0.016	0.084	-0.19

Therefore, we introduce openness measures as a fixed variable one by one into our cross-country growth data and then apply BMA approach for each openness variable. Table 13 presents the results obtained from these BMA

applications. We report posterior estimates of the only openness variables to save space. As shown in the table, own-weighted tariff rate is the only one openness measure whose absolute value of posterior t-value is greater than 2. Posterior t-value of BMP is also found to be close to 2 in absolute terms, indicating that this variable is a robust growth correlate at 10 % significance level. However, except these two variables, the remaining measures of openness have very low levels of posterior t-statistics. These findings clearly imply that trade openness is not a robust growth determinant even one is convinced that openness must be in the growth regressions.

In summary, the results of our BMA exercises suggest that there is no robust data evidence for the inclusion of openness in the true growth model. Furthermore, this finding is robust to different empirical proxies of openness, and none of them is robustly correlated with long-run economic growth.

5 Summary and Concluding Remarks

In this paper, we revisit the empirical evidence on the relationship between trade openness and economic growth over the sample period 1960-2000. We do so by experimenting with a large number of openness measures in the framework of the augmented neo-classical growth model developed by Mankiw et al. (1992). In addition to these measures of openness, we construct three composite trade policy indexes. These indexes are in essence weighted averages of tariff rates, non-tariff barriers and black market premium for foreign exchange rate, and arguably better capture the trade policy stance with respect to any single trade policy measure. Two strategies were carried out in our empirical investigation.

First, we extended the augmented neo-classical growth model with an openness variable and estimated it as a single cross-sectional growth regression. The OLS results show that most measures of openness are positively and significantly correlated with growth. With regard to direct trade policy measures, our findings show weak evidence in favour of openness, however. We conclude that tariff rate on intermediate inputs and capital goods is negatively associated with growth at marginally significance level. Our empirical analysis also reveals that the statistically significant association between black market premium and growth indicates the negative relationship between growth and macroeconomic imbalances rather than its trade restrictive effect on growth. It is very likely that the same is true for real exchange rate distortion index, as already noted by Rodrik and Rodríguez (2000). We could not find any statistically significant relationship between non-tariff barriers and economic growth. Similarly, our estimates indicate

that there is no significant association between growth and our composite trade policy indexes.

We implemented Bayesian model averaging technique as a second strategy to address model uncertainty, a fundamental problem which has been plaguing the previous works. We classified a wide range of different growth theories and their proxies systematically and concluded that economic institutions, inflation rate, government consumption, the average democracy index and a dummy for sub-Saharan Africa were directly and robustly correlated with growth. Neither measures of trade openness nor the other growth variables were found to be robustly associated with growth.

In light of data evidence here, two conclusions can be drawn: First, trade openness does not ensure long-run economic growth by itself. Second, improving quality of economic institutions and following sound fiscal and monetary policies are key factors to promote economic growth in the long run. Economic reforms in these areas should take priority over the policies enhancing trade openness for better economic performance.

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6 Appendix: Descriptions and Sources of Variables used in Cross-Country Growth Analysis

6.A Augmented Neo-classical Growth Model

Real GDP per capita: 1996 international prices, chain series. **Source**: Global Development Network Growth Database (2005) which rely on Penn World Tables Version 6.1 (Heston, Summers and Aten (2002)).

Population: : Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. **Source**: The World Bank World Development Indicators (2002, 2006).

Labour force: Labour force or economically active population defined as the total population between ages 15 and 64. **Source**: The World Bank World Development Indicators (2002, 2006)

Share of labour force: Share of labour force in total population. The exact calculation is LF/TP.

Real GDP per worker: 1996 international prices, chain series. The exact calculation is $PWGDP = RGDPCH * (1/SLF)$.

Growth: Average growth rate of real GDP per worker over the 1960-2000 period. The exact calculation is $log(PWGDP2000/PWGDP1960)$, where PWGDP1960 and PWGDP2000 is the real GDP per worker in 1960 and 2000, respectively.

Initial income: Real GDP per worker in 1960.

Population growth (n): Average rate of population growth between 1960 and 2000. The exact calculation is $(1/40) * log(TP2000/TP1960)$, where TP1960 and TP2000 are the total population in 1960 and 2000, respectively.

(g+δ): Sum of exogenous rates of technological process and depreciation over the 1960-2000 period and assumed to be equal to 0.05.

(n+g+δ): Sum of rates of population growth, technical process and depreciation over the 1960-2000 period.

Investment rate: Average of Investment share in GDP at constant prices over the 1960-2000 period. **Source**: Penn World Tables Version 6.1 (Heston, Summers and Aten (2002)) and the World Bank World Development Indicators (2002, 2006).

School enrolment rate: Average gross rate of secondary school enrolment over the 1960-2000 period. **Source**: The World Bank World Development Indicators (2002, 2006).

6.B Trade Policy

Current Openness of Penn World: Average share of exports plus imports of goods and services in GDP in current prices over the 1960-2000 period. **Source**: Penn World Tables Version 6.1 (Heston, Summers and Aten (2002)).

Real Openness of Penn World: Average share of imports plus exports in US dollar in GDP in PPP US dollar over the 1960-2000 period. The Exact calculation is $ROPEN = (PGDP/100) * COPEN$, where $PGDP$ is the Penn World variable of price level of GDP, unit: US dollar=100 in current prices, and $COPEN$ is the current openness variable of Penn World. **Source**: Penn World Tables Version 6.1 (Heston, Summers and Aten (2002)).

Tariff rate (OWTI): Own-import weighted tariff rates on intermediate inputs and capital goods over the 1983-1985 period. **Source:** Barro and Lee (1994),

Non-tariff Barriers (OWQI): Own-import weighted non-tariff frequency on intermediate inputs and capital goods over the 1983-1985 period. **Source:** Barro and Lee (1994).

Import Duties (M_DUTY): Collected import duties as a fraction of imports over the 1970-1998 period. **Source:** The World Bank World Development Indicators (2002).

Tariff rate (UWATR): Unweighted average tariff rates on all commodities over the period 1990-1999 period. **Source:** Wacziarg and Welch (2008)

Black Market Premium (BMP): Average of black market premium for foreign exchange rate over the period 1960-1999. The black market premium is calculated as $(Parallel\ Exchange\ rate/Official\ Exchange\ rate) - 1$. **Source:** Global Development Network Growth Database (2005).

log (1+BMP): Logarithm of one plus average of black market premium over the period 1960-1999.

Black Market Premium Dummy 1 (BMP_Dummy1): The dummy variable is equal to 1 if the average black market premium exceeds 20 % in the 1960s or the 1970s or the 1980s or the 1990s.

Black Market Premium Dummy 2 (BMP_Dummy2): The dummy variable is equal to 1 if the average black market premium exceeds 20 % over the 1960-2000 period.

Real Exchange Rate Distortion index (RERD): The real exchange rate distortion index over the period 1970-2000. **Source:** Dollar (1992) and Global Development Network Growth Database (2005).

Exchange Rate Variability Index (RERV): Coefficient of variation of the real exchange rate distortion index over the 1970-2000 period.

Sachs-Warner Openness Dummy (SW-Dummy): The Sachs-Warner openness dummy over the period 1960-2000. **Source:** Sachs and Warner (1995) and Wacziarg and Welch (2008).

Sachs-Warner Open Years (SW-Years): Fraction of open years on the basis of Sachs-Warner and Wacziarg-Welch liberalisation dates over the 1960-2000 period. **Source:** Sachs and Warner (1995) and Wacziarg and Welch (2008).

Landlocked Country : A dummy variable for landlocked countries, except those in Europe (Andorra, Austria, Belarus, Czech Republic, Hungary, Luxembourg, Liechtenstein, Moldova and Switzerland). **Source:** Gallup et al. (1999) and author's calculation.

6.C Other Growth Determinants employed in BMA Exercises

Institutional Quality Index of ICRG: A measure of economic institutions based on four political risk components of International Country Risk Guide (ICRG) published by Political Risk Services Group: 1) Investment Profile as a average of three subcomponents namely, contract viability, profits repatriation and payment delays; 2) law and order; 3) corruption; 4) bureaucratic quality. The index is calculated as the equal weighting average of these four categories for the years 1984-2000

(annual observations are calculated as the averages of the monthly indexes). The higher points indicates the greater institutional quality. **Source:** Political Risk Services Group.

Democracy: Institutionalised democracy measure of the Polity IV project. The democracy index is constructed from three essential elements: i) the competitiveness of political participation; ii) the openness and competitiveness of executive recruitment and iii) the constraints on the chief executive. The index ranges between 0 and 10 and higher points indicate greater institutionalised democracy in a given country. Average is taken over the period 1960-2000. **Source**: Marshall et al. (2005).

Land Area in Tropics: The proportion of the country's land area in the geographical tropics. **Source**: Center for International Development at Harvard University.

Land Area in Navigable Waters: The proportion of the country's land area within 100 km of ice-free coast or navigable river. **Source**: Center for International Development at Harvard University.

Fraction Speaking English: The fraction of population speaking English as a first language. **Source**: Dollar and Kraay (2003).

Fraction Speaking European Language: The fraction of population that is able to speak one of the major languages of Western Europe, namely, French, German, Portuguese, or Spanish, as a first language. **Source**: Dollar and Kraay (2003) and author's calculation.

Fraction of Catholics: The share of the population that adheres to the Roman Catholic religion in a given country. **Source**: La Porta et al. (1999).

Fraction of Muslims: The share of the population that belongs to Islamic religion in a given country. **Source**: La Porta et al. (1999).

Fraction of Protestants: The share of the population that belongs to Protestantism in a given country. **Source**: La Porta et al. (1999).

Ethno-linguistic Fragmentation Index: The index shows the probability that two randomly selected persons do not belong to the same ethno-linguistic group in a given country and ranges between 0 and 1. The lower value of the index implies the more homogenous population. **Source:** Easterly and Levine (1997).

Ethnic Tensions: This variable is one of the political risk components of International Country Risk Guide and measures the degree of tension within a country attributable to racial, nationality, or language divisions. Average is taken over the 1984-2000 period (annual observations are calculated as the averages of the monthly indexes). The variable ranges between 0 and 6 and the lower value indicates the higher degree of ethnic tensions. **Source:** Political Risk Services Group.

Inflation Rate: Average inflation rate based on consumer price index over the 1960-2000 period. **Source:** The World Bank World Development Indicators (2002, 2006) based on International Monetary Fund, International Financial Statistics and data files.

Government Consumption: The ratio of general government final consumption expenditure in GDP. **Source**: The World Bank World Development Indicators (2002, 2006) based on World Bank national accounts data, and OECD National Accounts data files.

Sub-Saharan African dummy: A dummy variable takes the value of 1 for the countries in sub-Saharan Africa. **Source**: Global Development Network Growth Database (2005).

Latin American dummy: A dummy variable takes the value of 1 for the countries in Latin America and Caribbean. **Source**: Global Development Network Growth Database (2005).

East Asian dummy: A dummy variable takes the value of 1 for the countries in East Asia and Pacific. **Source**: Global Development Network Growth Database (2005).

Table 14: Summary Statistics of Openness Measures

	♯ of Obs.	Mean	Std. Dev.	Min.	Max.
Direct Trade					
Policy Measures					
OWTI	104	0.1688	0.1630	0	1.319
OWQI	102	0.1858	0.2372	0	0.888
M_DUTY	117	0.1229	0.0888	0	0.4645
UWATR	121	0.1496	0.0932	0.003	0.547
log (1+BMP)	121	0.3776	0.6716	-0.004	5.453
BMP_Dummy1	121	0.5455	0.5000	0	1
BMP_Dummy2	121	0.4463	0.4992	0	1
Deviation Measures					
RESID_COPEN	111	0.0000	0.3071	-0.5700	1.9100
RESID_ROPEN	111	0.0000	0.2706	-0.5495	1.5548
Subjective Measures					
RERD	94	1.1461	0.3925	0.5927	3.5802
RERV	94	0.2917	0.3220	0	2.7937
SW-Dummy	114	0.2281	0.4214	0	1
SW-Years	114	0.4322	0.3832	0	1
POLICY1	102	-0.0684	0.0695	-0.3978	-0.0002
POLICY2	102	-0.0780	0.0729	-0.4942	-0.0002
POLICY3	92	-0.0724	0.0617	-0.3666	0.0001

Table 15: List of Countries in BMA Exercises

Algeria**	Guyana*	Peru
Argentina	Haiti	Philippines
Austria	India	Portugal
Belgium	Indonesia	Republic of Congo
Bolivia	Iran	Republic of Korea
Brazil*	Ireland	Senegal
Burkina Faso*	Italy	Sierra Leone
Cameroon	Jamaica	Spain
Canada	Japan	Sri Lanka
Chile	Jordan	Sweden
Colombia	Kenya	Switzerland
Costa Rica	Madagascar	Syria
Cyprus	Malawi*	Thailand
Dem. Rep. of Congo	Malaysia	Trinidad &Tobago
Denmark	Mexico	Tunisia*
Ecuador	Morocco	Turkey
Egypt	Netherlands	United Kingdom
El Salvador**	Nicaragua	United States
Finland	Nigeria	Uruguay
France	Norway	Venezuela
Ghana	Pakistan	Zambia*
Greece	Papua New Guinea	Zimbabwe
Guatemala*	Paraguay	

Note: * indicates the countries included in only the sample of the first BMA exercise; ** indicates the countries employed in only the second BMA application.

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