ELSEVIER

Journal of Development Economics 72 (2003) 57–89

JOURNAL OF Development ECONOMICS

www.elsevier.com/locate/econbase

Trade openness and economic growth: a cross-country empirical investigation

Halit Yanikkaya*

College of Business and Administrative Sciences, Celal Bayar University, Uncubozkoy Kampusu, Manisa 45030, Turkey

Received 1 May 2002; accepted 1 October 2002

Abstract

This paper demonstrates that trade liberalization does not have a simple and straightforward relationship with growth using a large number of openness measures for a cross section of countries over the last three decades. We use two groups of trade openness measures. The regression results for numerous trade intensity ratios are mostly consistent with the existing literature. However, contrary to the conventional view on the growth effects of trade barriers, our estimation results show that trade barriers are positively and, in most specifications, significantly associated with growth, especially for developing countries and they are consistent with the findings of theoretical growth and development literature.

JEL classification: F0; O4
Keywords: Growth; Openness; Trade barriers; Trade volumes

1. Introduction

Do open economies grow faster than closed economies? Almost all empirical growth studies have provided an affirmative answer to this question. The reason for this strong bias in favor of trade liberalization is partly based on the conclusions of a wide range of empirical studies, which claimed that outward-oriented economies consistently have higher growth rates than inward-oriented countries. It is also partly due to the tragic failures of import-substitution strategies, especially in the 1980s and overstated expect-

* Tel. +90-236-233-0657; fax: +90-236-233-2729.
E-mail address: halit.yanikkaya@bayar.edu.tr (H. Yanikkaya).

0304-3878/03/$ - see front matter
doi:10.1016/S0304-3878(03)00068-3

ations from trade liberalization. This is probably best described by Rodrik (1999, p. 25) that "(j)ust as the advantages of import-substitution policies were overstated in an earlier era, today the benefits of openness are oversold routinely in the policy-relevant literature and in the publications of the World Bank and the IMF." It is, however, very difficult to understand this unconditional optimism in favor of trade liberalization among the economics profession and in policy circles. Although there is a near consensus about the positive association between trade flows and growth, the theoretical growth literature, which studied the growth effects of trade restrictions reported that these effects are very complicated in the most general case and the results are mixed as to how trade policies play a special role in economic growth. Furthermore, the fact that empirical studies describe openness very differently makes the classification of countries according to their level of openness a formidable task. Hence, it is not a surprise that use of different measures obtains very diverse openness rankings among countries.

Accordingly, this study examines the growth effects of a large number of measures of trade openness. Using the same specification for various openness measures where each variable measures a different aspect of openness, we try to accomplish two things. First, we believe that our results provide a more complete picture of the relationship between openness and growth as compared to empirical studies that used a subset of openness measures. Second, it enables us to compare regression results across individual measures and across groups.

We divide our trade openness measures into two broad categories: measures of trade volumes and measures of trade restrictions. On the one hand, our estimation results for various measures of trade volumes indicate that there is a positive and significant association between trade openness and growth. They are also consistent with the conclusions of empirical and theoretical growth studies. On the other hand, our estimation results for trade barriers contradict the conventional view on the growth effects of trade restrictions, which suggests an adverse association between trade barriers and growth. Using various new measures of trade restrictions along with commonly used average tariff rates, our estimation results from the most specifications show a positive and significant relationship between trade barriers and growth. Equally important, these results are essentially driven by developing countries and thus, consistent with the predictions of the theoretical growth literature that under certain conditions, developing countries can actually benefit from trade restrictions.

The outline of this paper is as follows. The next section reviews the theoretical and empirical literature on trade openness. Section 3 describes a standard growth equation and the data sources and definitions. Section 4 separately reports the estimation results for various measures of trade flows and restrictions on these flows. In this section, we further address the potential problems of the cross-country growth framework. Section 5 concludes the paper.

2. Literature review

The relationship between trade openness and growth is a highly debated topic in the growth and development literature. Yet, this issue is far from being resolved. Theoretical

growth studies suggest at best a very complex and ambiguous relationship between trade restrictions and growth. The endogenous growth literature has been diverse enough to provide a different array of models in which trade restrictions can decrease or increase the worldwide rate of growth (see Romer, 1990; Grossman and Helpman, 1990; Rivera-Batiz and Romer, 1991a,b; Matsuyama, 1992). Note that if trading partners are asymmetric countries in the sense that they have considerably different technologies and endowments, even if economic integration raises the worldwide growth rate, it may adversely affect individual countries (see Grossman and Helpman, 1991a,b; Lucas, 1988; Rivera-Batiz and Xie, 1993; Young 1991).

It is worthwhile to note that the theoretical growth literature has given more attention to the relationship between trade policies and growth rather than the relationship between trade volumes and growth. Therefore, the conclusion about the relationship between trade barriers and growth cannot be directly applied to the effects of changes in trade volumes on growth. Even though these two concepts, trade volumes and trade restrictions, are very closely related, their relationship with growth may differ considerably. This is because there are several other very important factors that affect a country's external sector, such as geographical factors, country size, and income.[1] In other words, one should be as clear as possible about which openness measure he uses and what are the exact mechanisms through which it affects the growth. We shall discuss each openness measure used in this study later in the section.

In the theory of international trade, the static gains from trade and losses from trade restrictions have been examined thoroughly. Yet, trade theory provides little guideline as to the effects of international trade on growth and technical progress. On the contrary, the new trade theory makes it clear that the gains from trade can arise from several fundamental sources: differences in comparative advantage and economy-wide increasing returns.

The phenomenal differences among the growth rates of the East Asian, the Latin American, and Sub-Saharan African countries over the last several decades have stimulated a renewed interest in the effects of trade policies on growth. During most of the 20th century, import substitution industrialization (ISI) strategies dominated most developing countries' development strategies. While developing countries in Latin America that followed ISI strategies experienced relatively lower growth rates, East Asian countries, that employed export-promotion policies, consistently outperformed other countries. This probably explains why a growing body of empirical and theoretical research has shifted towards examining the relationship between trade liberalization and the economic performance of countries since the late 1970s.

However, the most serious problem facing researchers today is the lack of a clear definition of what is meant by "trade liberalization" or "openness". Over time, the definition of openness has evolved considerably from one extreme to another. Even today it is not unambiguous as to what describes "openness". On the one hand, Krueger (1978) discussed how trade liberalization can be achieved by employing policies that lower the biases against the export sector. It is even more striking that according to her definition one

[1] See Rodriguez and Rodrik (2001) for a more complete discussion of this subject.

country can have an open economy by employing a favorable exchange rate policy towards its export sector and at the same time can use trade barriers to protect its importing sector. This is best described in Krueger (1978, p. 89) that "(a) regime could be fully liberalized and yet employ exceedingly high tariffs in order to encourage import substitution." On the other hand, Harrison (1996 p. 420) stated that

> (t)he concept of openness, applied to trade policy, could be synonymous with the idea of neutrality. Neutrality means that incentives are neutral between saving a unit of foreign exchange through import substitution and earning a unit of foreign exchange through exports. Clearly, a highly export oriented economy may not be neutral in this sense, particularly if it shifts incentives in favor of export production through instruments such as export subsidies. It is also possible for a regime to be neutral on average, and yet intervene in specific sectors. A good measure of trade policy would capture differences between neutral, inward oriented, and export-promoting regimes.

Recently, the meaning of "openness" has become similar to the notion of "free trade", that is a trade system where all trade distortions are eliminated. Therefore, it is crucial to understand this definition problem because various openness measures have different theoretical implications for growth and different linkages with growth. However, empirical studies are not usually clear on this issue as Edwards (1993, p. 1365) stated,

> the literature on the subject has not always been successful in dealing with precise definitions of trade regimes, nor has it been able to handle successfully the difficult issue of measuring the type of trade orientation followed by a particular country.

A large number of empirical studies have made use of a variety of cross-country growth regressions to test endogenous growth theory and the importance of trade policies.[2] Probably due to the difficulty in measuring openness, different researchers have used many different measures to examine the effects of trade openness on economic growth. An ideal measure of a country's openness would be an index that includes all the barriers that distort international trade such as average tariff rates and indices of non-tariff barriers. Anderson and Neary (1992) have developed a "trade restrictiveness index", which in principle incorporates the effects of both tariffs and non-tariff barriers. However, it is not available for a large sample of countries. Thus, some studies have used the available data to measure trade openness and some other researchers have constructed indices that measure the openness of a country including Leamer (1988), Dollar (1992), and Sachs and Warner (1995). We divide the existing openness measures into five categories and review each category separately in the rest of the section.

First, the most basic measure of openness is the simple trade shares, which is exports plus imports divided by GDP. A large number of studies used trade shares in GDP and

[2] See Edwards (1993) and Rodriguez and Rodrik (2001) for an extensive review of the empirical literature on the growth effects of openness. See also Levine and Renelt (1992) and Temple (1999) for a complete review of the empirical growth literature.

found, as reviewed in Harrison (1996), a positive and strong relationship with growth. Furthermore, controlling for the endogeneity of trade with the geographic variables, Frankel and Romer (1999) and Irwin and Tervio (2002) recently reported that comparing the IV estimates of cross-country regressions of income on trade and other factors with the OLS estimates indicated that the OLS estimates understate the effects of trade on income. Rodriguez and Rodrik (2001) and Irwin and Tervio (2002), however, showed that significant and higher IV estimates of trade shares are not robust the inclusion of geographical variables such as latitude and tropical climate. More importantly, Rodrik et al. (2002) reported that neither geographical variables nor trade shares hold their significances when entered growth regressions with institutional quality variables measured by the rule of law and property rights.[3]

In addition, export shares and import shares in GDP are also used and enter positively in cross-country growth regressions. Our results for these variables are consistent with these existing studies. Hence, we believe that the inclusion of export and import shares in the growth regressions has been an important step towards understanding of the relationship between international trade and growth proposed by the new growth and new trade theories. Because, as discussed in Edwards (1993), one of the distinct characteristics of earlier literature is that it put too much emphasis on exports. From the standpoint of international trade theory, this view is hard to defend because, according to theory of comparative advantage, international trade leads to a more efficient use of a country's resources through the import of goods and services that otherwise are too costly to produce within the country. Thus, it is probably safe to conclude that imports are as important as exports for economic performance. As a matter of fact, these two should be considered complementary to each other rather than alternatives.[4]

New growth theory has provided important insights into an understanding of the relationship between trade and growth. For example, if growth is driven by R&D activities, then trade provides access for a country to the advances of technological knowledge of its trade partners. Further, trade allows producers to access bigger markets and encourages the development of R&D through increasing returns to innovation. Especially, trade provides developing countries with access to investment and intermediate goods that are vital to their development processes. Finally, if the engine of growth is the introduction of new products, then trade plays an important role in growth by providing access to new products and inputs. Therefore, we may well argue that developing countries can receive more benefit from trade with developed countries, which are technologically innovative countries, than from trade with developing countries, which are non-innovating countries. For this purpose, we use trade with OECD countries, which are generally technologically innovative countries, and trade with non-OECD countries to test this hypothesis. Our results do not provide support for this hypothesis since they both enter the growth regressions positively and significantly.

[3] See also Rodrik's (2000) comments on Frankel and Rose (2000) on the same issue.

[4] At another extreme, Rodrik (1999, p. 24) claimed that "(t)he benefits of openness lie on the import side, rather than the export side." In Chapter 2 of his book, he supported his view by focusing on the four types of imports: ideas, goods and services, capital, and institutions.

Nevertheless, one may argue that not all OECD countries are technologically innovative. Thus, to test the above hypothesis properly we use U.S. bilateral trade with a large number of countries. Without argument, the United States is one of the most highly innovative countries in the world. Under the assumption that trade is one of the most important sources for the diffusion of the new technologies across countries, we expect that the higher the discrepancy between the level of development of two countries, the more likely that trade benefits the less developed country through technology diffusion. Thus, U.S. bilateral trade is more likely to benefit the developing countries. Our results provide very strong evidence in favor of the hypothesis that countries that have more trade with the United States are likely to grow faster and this phenomenon is especially important for developing countries.

Moreover, we also use population densities in growth regressions to measure the trade openness of countries. They are constructed as the ratio of total population to total area so that higher ratios imply more open economies. Densities have been used in the literature as a measure of openness due to the belief that countries with higher densities are more likely to be open and have more international contacts (see Sachs and Warner 1995, 1997a,b). Consistent with earlier studies, our estimation results indicate that countries with higher densities tend to grow faster than those with lower densities.

The second category includes measures of trade barriers that include average tariff rates, export taxes, total taxes on international trade, and indices of non-tariff barriers (NTBs). Needless to say, none of these measures of trade restrictions is free from measurement errors. More importantly, if we focus on collected tariffs, defined as the ratio of tariff revenues to import values, although these rates may be misleading because they tend to underestimate the actual tariff rates, tariffs are one of the most direct indicators of trade restrictions. For example, Pritchett and Sethi (1994) documented the wide divergence between collected rates and official tariff rates. They then argued that one natural implication of this is that the interpretation of protection provided by tariffs is considerably difficult. Furthermore, they claimed that to use collected rates as the ''effective'' tariffs might even be more appropriate depending on the factors that cause the divergence between these two rates. However, one should keep in mind that collected rates are far from being ideal for capturing trade policy due to the little systematic relation between the official rates and the collected rates.

A number of studies have looked at the relationship between average tariff rates and growth in the last several decades. They reported mixed empirical results. For example, Lee (1993), Harrison (1996), and Edwards (1998) found a significant and negative relationship between tariff rates and growth. However, Edwards (1992), Sala-i-Martin (1997), and Clemens and Williamson (2001) concluded that this relationship is weak. An important shortcoming of these studies is that the majority of the empirical literature ignored the fact that there is no conclusive theoretical evidence on the growth effects of trade restrictions. As a result, most of these studies hypothesized and tested that trade restrictions are always detrimental for growth regardless of the countries' development level and size. In their critique of Edwards' (1998) paper, Rodriguez and Rodrik (2001) also pointed out this problem. When they tried to replicate his results using average tariffs from the World Bank, Rodriguez and Rodrik actually found that average tariff rates had a positive and significant relationship with total factor productivity (TFP) growth for the

1980–1990 period. The limitation of their result, however, is that their sample size was small, with only 43 countries, and the time period considered was short. When they extended their sample size to 66 countries, import duties became insignificant with a positive coefficient. Rodrik (2001) also reported the graphical evidence for the 1990s indicating a positive relationship between import tariffs and economic growth. For 80 countries over the period of 1970–1997, we examine the relationship between import duties and growth. Our results contradict the conventional view on the issue and confirm that trade barriers in the form of tariffs can actually be beneficial for economic growth. Note that although there exists a near consensus in the literature about the negative growth effects of trade barriers for the Post-War era, a number of studies (such as O'Rourke, 2000; Clemens and Williamson, 2001; Irwin, 2002b) reported the positive correlation between tariffs and growth for the late 19th and the early 20th century.[5] Clemens and Williamson (2001) argued that decline in trading partners' protection levels along with changes in partner growth and effective distance to partners after 1950 was the primary factor explaining for the reversal of the direction of the relationship between growth and tariffs after the World War II.

The growth effects of other forms of taxes on trade are largely ignored in the growth literature. Thus, in this study export taxes and total taxes on international trade are also used to measure trade restrictiveness of countries. Our estimation results for these variables with the exception of fixed effect estimates that show a significant and positive association between trade barriers and growth are similar to those for average tariffs. Moreover, due to data limitations, empirical studies tend to ignore the effects of NTBs on growth even though NTBs have been increasingly employed for the last several decades. However, Edwards (1992, 1998) used NTBs as a measure of trade restrictions and reported an insignificant relationship with growth. He concluded that NTBs are poor indicators of trade orientation because broad coverage of NTBs does not necessarily mean a higher distortion level.

The third category includes bilateral payments arrangements (BPAs) as a measure of the trade orientation of countries. A BPA is an agreement that describes the general method of settlement of trade balances between two countries. BPAs were first negotiated in the 1930s and were particularly common in the 1940s and 1950s. Although there has been a decreasing trend in the number of active agreements since then, they still exist today. After the Second World War, BPAs were used by most countries to finance trade with the non-dollar world because most countries had difficulties finding hard currency. Several studies such as Trued and Mikesell (1955), Triffin (1976), and Auguste (1997) argued that BPAs could be considered important steps towards more liberal trading and payments regimes since in the early years of the post-war era, there were severe restrictions on international trade and payments. For example, Triffin (1976, p. 144)

[5] However, in a series of papers, Irwin (2002a,b) argued that this positive correlation between tariffs and growth does not say anything about the direction the causation so these results should be interpreted with caution. Because several individual country experiences in the late 19th century are not consistent with the hypothesis of import substitution. And also most land-abundant countries used high tariffs to raise government revenue so their tariffs have a different structure than protective tariffs because land-abundant countries were more likely to levy high tariffs for public finance and political economy reasons.

stated that "paradoxical it may seem, the bilateral payments agreements served the essential function, through their mutual credit provisions, of avoiding or at least postponing the danger of a strict bilateral balancing of exports and imports on a barter basis." Therefore, it is obvious that in the past BPAs provided solutions to the hard currency problem faced by most countries.

Nevertheless, long after the restoration of convertibility of major Western European currencies, bilateral payments arrangements were still used by many countries. This very fact, however, cannot be explained by the need for hard currencies. Since these convertible European currencies have been heavily used in world trade, most countries' dependency on the dollar to finance their trade has been greatly reduced. Thus, it is probably safe to conclude that most countries have been using BPAs to expand or maintain export markets by discriminatory trade policies. Trued and Mikesell (1955) provided examples of these discriminatory practices.[6]

Auguste (1997) examined the effects of BPAs on economic welfare within the context of customs union theory. He argued that under the assumption of the existence of exchange rate misalignment and currency inconvertibility, BPAs can actually be welfare improving, even though BPAs discriminate against non-member countries. This positive effect is a result of the trade creation effect of the BPAs. Since both countries are assumed to face a foreign exchange constraint on bilateral trade on the margin, a BPA permits both countries to trade with each other. Also, as stated in Auguste (1997, p. 27) "(s)ince bilateral trade is financed via central bank clearing accounts, BPAs also reduce the need to hold transactions balances of foreign exchange to finance imports from partner countries." However, it is obvious from customs union theory that the BPAs can also exert a negative effect on economic welfare by distorting the direction of trade. Although the extension of swing credits enables countries to run a deficit up to a specific margin, permanent bilateral imbalances are highly unlikely. Thus, BPAs along with overvalued real exchange rates, as described in Auguste (1997, p. 27)

> encourages private agents to divert sources of imports to partner countries in deficit under the bilateral arrangements, since an effective means of payment would be more readily available than for imports from partners in surplus or from countries demanding hard settlements.

Therefore, the net effect of BPAs depends upon the relative size of the trade creation and diversion effects. Although the net effect of a BPA is usually ambiguous, Auguste showed that a BPA will not cause net trade diversion for partner countries' trade in the aggregate. Because both countries are having foreign exchange problems, savings of foreign exchange reserves from a BPA enable countries to import from third countries. Another channel by which BPAs can improve growth is that they may lead to more

[6] For example in the early 1950s, India and Pakistan had separate bilateral agreements with Egypt and France, respectively, even though both were in the sterling area. Also, Cuba and Colombia had negotiated separate bilateral agreements with several Western European countries even though both were members of the dollar area.

effective use of international reserves that may cause higher investment and physical capital accumulation.

Although we are not aware of any study that used BPAs to explain international growth differences, Mehrotra (1990) provided some empirical insights that support the idea discussed above. After reviewing a number of case studies on the effects of India's BPAs with centrally planned economies (CPEs) through the late 1960s and 1970s, he concluded that these BPAs raised India's export volume and improved its terms of trade. He also claimed that during the 1970s and 1980s, India's exports to the CPEs had an additional character to trade with market economies so that these agreements might have caused little or no trade diversion from hard currency markets. Similarly, our results imply a positive relationship between BPAs and growth. Thus, they provide some evidence for the idea that trade barriers may be beneficial for countries. Moreover, we also use a binary variable that measures restrictions on payments for current account transactions in the growth regressions. Negative but insignificant coefficients for this variable provide little support for the view that trade barriers are detrimental for growth.

The fourth category of measures uses the exchange rate. The most commonly used measure in this category is the black market premium that shows the success of the rationing function of prices in the foreign exchange market. In the growth literature, the black market premium is frequently used to show the severity of trade restrictions. Most of these of studies reported a significant and negative relationship between the black market premium and growth, see Harrison (1996), Edwards (1998), and Sala-i-Martin (1997). However, Levine and Renelt (1992) and Rodriguez and Rodrik (2001) argued that due to the high correlation between the black market premium and a number of "bad" policies and outcomes such as high inflation, severe external debt problems, a high degree of corruption, a less reliable bureaucracy, and ineffective law enforcement, it is difficult to use this variable as an indicator of any one policy. Thus, both studies concluded that it might be misleading to use the black market premium as a measure of the severity of trade barriers. Hence, we are reluctant to use the black market premium as a measure of trade restrictions. However, for the sake of argument, including it in regressions, our results show that it has a considerable impact on the statistical significance of government consumption, inflation, war dummies and measures of democracy and the rule of law. Hence, these results imply that the black market premium measures a combination of bad policies rather than being a measure of trade policy or for that matter any single policy. Another measure that uses exchange rates is movements in the real exchange rate. Although it is hard to estimate the equilibrium real exchange rate level, a real depreciation can be used to infer trade liberalization. Ceteris paribus, trade liberalization is expected to lower this variable (see Levine and Renelt, 1992; Andriamananjara and Nash, 1997).

Finally, we consider indices of trade orientation (such as Leamer's, 1988 openness index, Dollar's, 1992 price distortion and variability index, and Sachs and Warner's, 1995 openness index) that are constructed by some authors to test the effects of trade openness on growth. The basic claim of these studies is that outward-oriented economies have consistently outperformed inward-oriented economies. The need for these indices is partly due to the fact that most trade openness measures are uncorrelated or weakly

correlated with each other and no single measure of openness is superior to the others. And also, as Rodriguez and Rodrik (2001) suggested, partly it is an attempt to deal with the measurement error problem that is very common in this literature. These indices received a great deal of attention from the economics profession and multinational institutions. Rodriguez and Rodrik examined the recent empirical literature, including Dollar (1992), Sachs and Warner (1995),[7] Harrison (1996), Edwards (1998), and Frankel and Romer (1999) that investigated the effects of trade policies on growth and concluded that the empirical literature is mostly "uninformative" on the growth effects of trade policies.[8] They (p. 4) also stated that

> (t)here is a significant gap between the message that the consumers of this literature derived and the "facts" that the literature has actually demonstrated. The gap emerges from a number of factors. In many cases, the indicators of "openness" used by researchers are problematic as measures of trade barriers or are highly correlated with other sources of poor economic performance. In other cases, the empirical strategies used to ascertain the link between trade policy and growth have serious shortcomings, the removal of which results in significantly weaker findings.

Consequently, the emerging conclusion from these studies is that these indices have crucial shortcomings in measuring the trade orientation of countries. Hence, the relationship between a number of openness measures and growth is not as robust as previously suggested. Thus, we will not rely on these indices to measure the effects of trade policies. Rather, this study uses averages of import and export taxes, total taxes on international trade, bilateral payments arrangements, current account restrictions, and various measures of trade intensity ratios to measure the trade openness of countries. Although these measures have their own problems, as discussed above, they are much more direct measures of trade policies.

3. Model and data

We use the following empirical framework to investigate long-run growth. In general form, this model can be characterized as

$$\gamma_{yt} = F(y_t, k_t, h_t; Z_{(t)}), \tag{1}$$

where γ_{yt} is a country's per capita growth rate in period t, y_t is initial GDP per capita, k_t is the physical capital stock per person, h_t is initial human capital per person. We use telephone mainlines per worker and life expectancy rates as rough proxies for the stock of physical and human capital, respectively. Although the initial GDP per capita level is employed to assess the issue of conditional convergence, it is possible to interpret it as a proxy for the stock of capital for a country. The variable Z represents a vector of control

[7] See also Harrison and Hanson (1999) for a critique of the Sachs and Warner openness index.

[8] For the detailed critics of individual papers, see the paper itself.

and environmental variables that are primarily determined by decisions of governments or individuals. These variables include a large number of trade openness measures, war deaths and type of regime. Note that we also use two geographical factors, a variable that measures whether a country is in a tropical climate and a variable that measures whether a country has access to international waterways.

While GDP growth (GRWB) is calculated using the national accounts data from the World Development Indicators 1999 CDROM (WDI, 1999), initial GDP per capita levels (GDPSH) are from the Penn World Table 5.6.[9] Data for telephone mainlines (TELPW) come from Easterly and Lu[10] and life expectancy figures (LIFE) are taken from WDI (1999). Data on political regime type (REGIME), used to measure the level of democracy in a country, also come from Easterly and Yu. Data on war deaths (WAR) are taken from Easterly (1999). Data on tropical climate (TROPIC) and physical access to international waters (WATER) are taken from the Sachs and Warner data set published on the Center for International Development Web site.

We use two types of trade openness measures in the regressions to explore the relationship between trade liberalization and growth. Unless indicated otherwise, annual data on all openness measures are taken from the WDI (1999). The first group is calculated using trade volumes. The most basic measure of trade intensity is the so-called ''trade openness'' (OPEN) that is the ratio of exports plus imports to GDP. This paper also employs import penetration ratios (MGDP) and exports shares in GDP (XGDP) to measure openness of a country. Next, to assess whether the growth effects of trade with developed and with developing countries are different from one another, two more measures of trade intensity ratios—trade with OECD countries (TOECD) and trade with non-OECD countries (TNOECD)—are also used in the empirical estimates. The last two measures are taken from Easterly and Yu. Further, we make use of the so-called ''U.S. trade openness'' (USBTRD), which is defined as the ratio of each country's total bilateral trade with the US to its GDP. U.S. bilateral exports (USBEXP) and imports (USBIMP) (computed as USBTRD) are also used. Note that bilateral trade numbers are weighted by the capital to capital distance to control for the impact of geographical proximity on bilateral trade. Data on U.S. bilateral trade are compiled by the Direction of Trade Statistics and are available beginning in 1972. Finally, population densities (DENSITY), constructed as the ratio of total population to total area, enter the growth regressions as measures of trade openness.

The other group of trade openness measures is based on trade restrictions. First, we use total import duties (TARIFF) to measure the severity of trade restrictions. Import duties as a percentage of the value of imports are the sum of all levies collected on goods at the point of entry into the country and are used as a measure of the average import tariff rate. Second, we use total export duties (XTAX) and taxes on international trade (TAXTRD) as measures of trade policies. Export duties as a percentage of the value of exports are comprised of all levies collected on goods at the point of export. Similarly, taxes on trade

[9] See Nuxoll (1994) and Summers and Heston (1991) on the discussion of why researchers should use the Summers and Heston data for initial income levels but the World Bank data for growth rates.

[10] They maintain a database called ''Global Development Network Growth Database'' on the World Bank Web site.

as a percentage of current revenues include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes.

Third, bilateral payments arrangements (BPAs) are used to measure the trade restrictiveness of countries, as discussed above. We use two measures of BPAs: BPAs among IMF members (BPAIMF) and arrangements of IMF members with non-IMF members (BPA). Finally, we also use a measure of trade barriers (CURRENT), which are defined as restrictions that exist on payments with respect to current transactions in the form of quantitative limits or undue delay on other than restrictions imposed for security reasons and official action directly affecting the availability or cost of exchange. Tabular data on BPA, BPAIMF, and CURRENT are taken from the IMF's Annual Reports on Exchange Restrictions (ARER) and are available starting in 1967. As discussed above, there is ambiguity about the sign of the coefficient of the trade restriction variables.

The cross-country regressions apply to a panel of over 100 developed and developing countries observed from 1970 to 1997. Socialist (or formerly socialist) and the oil exporting countries are excluded from the sample due to data considerations or the bulk of GDP of oil producers represents the extraction of natural resources (see Mankiw et al., 1992; Barro, 1997). Moreover, the number of countries is limited by the availability of data. The system is a three-equation system. The dependent variables are the average growth rates of real per capita GDP over three periods: 1970–1979, 1980–1989, and 1990–1997.

4. Empirical results

4.1. Correlation across openness measures

The simple correlations between different measures of openness used in this study are reported in Table 1. While the first three columns consist of trade intensity indicators, the last five columns include measures of trade restrictions. The results show that there is generally a statistically significant correlation among the openness measures. More importantly, all of the correlation coefficients have the correct signs except for the correlation coefficients of TAXTRD with OPEN and USBTRD, which have incorrect signs but are insignificant.

As expected, trade intensity ratios, which are OPEN, USBTRD, and DENSITY, are correlated significantly and positively with each other. Further, there are positive correlations between measures of trade barriers, which are TARIFF, XTAX, TAXTRD, BPA, and CURRENT. Equally important, the correlation coefficients between these two groups are mostly negative. Although the relationships between openness measures within each group are generally statistically significant with the correct signs, the relationships between the indicators across the groups tend to be weak. For example, while almost all of the trade barriers are negatively and significantly correlated with OPEN, their relationships with the other two trade intensity ratios show weak correlation. Given the strong and positive relationship between trade intensity ratios and growth, the existence of a significant correlation between trade barriers and OPEN indicates that trade barriers are

Table 1
Pearson correlation coefficients for various openness indicators[a]

Variable	OPEN	USBTRD	DENSITY	TARIFF	XTAX	TAXTRD	BPA	CURRENT
OPEN (+)[b]	1.0	0.71	0.63	− 0.17	− 0.21	0.046	− 0.21	− 0.25
	0.0	0.0001	0.0001	0.0044	0.0005	0.4269	0.0001	0.0001
USBTRD (+)		1.0	0.67	− 0.12	− 0.062	0.038	− 0.15	− 0.19
		0.0	0.0001	0.0604	0.3176	0.5315	0.0084	0.0012
DENSITY (+)			1.0	− 0.16	− 0.066	− 0.11	− 0.060	− 0.14
			0.0	0.0066	0.2719	0.500	0.2803	0.0109
TARIFF (−)				1.0	0.25	0.64	0.13	0.41
				0.0	0.0001	0.0001	0.0253	0.0001
XTAX (−)					1.0	0.51	0.15	0.29
					0.0	0.0001	0.0143	0.0001
TAXTRD (−)						1.0	0.03	0.25
						0.0	0.6222	0.0001
BPA (−)							1.0	0.32
							0.0	0.0001
CURRENT (−)								1.0
								0.0

[a] The top figures show simple correlation coefficients for decade averages; the bottom figures indicate the *P*-level of the test.
[b] Indicates how an increase in a variable affects openness.

fairly effective for reducing trade. Thus, it is probably safe to conclude that trade barriers may have negative repercussions on growth through reducing the size of the external sector of a country.[11]

4.2. Trade volumes and growth

We begin the discussion with OPEN. Consistent with a number of empirical studies, as reviewed in Harrison (1996), our results support the hypothesis that countries with higher trade shares are likely to grow faster than other countries. Column 1 of Table 2 reports a significant and positive coefficient for OPEN. The coefficient on OPEN is 0.018, implying that a 10% increase in trade shares would increase the average growth rate of per capita GDP by 0.18% annually. One of the important criticisms of the significant coefficient is that it does not necessarily mean the direction of causation goes from higher trade shares to higher growth rates. Many studies have emphasized the likelihood of reverse causation between growth and OPEN because it is easy to think of a case in which fast growth may cause higher trade shares. To test whether the simultaneity is strong enough to drive this relationship, we use the averages of five previous years instead of contemporaneous values. Although, admittedly using the lagged values is not the perfect solution for this problem, it gives us some sense of understanding of the issue. Accordingly, column 2 reports a significant and positive coefficient, 0.014 (3.84), for lagged OPEN. Hence, our results provide substantial evidence to support the hypothesis that open economies

[11] We shall present the regression results of trade shares on various measures of trade barriers later in the section.

Table 2
Trade flows and per capita GDP growth: panel of three decades (1970–1997)

Variable	1	2	3	4	5	6	7	8	9	10	11
Log	− 4.38	− 4.56	− 4.03	− 5.13	− 4.70	− 4.38	4.43	4.42	− 4.81	− 4.96	− 3.73
(GDPSH)	(6.50)	(5.95)	(5.54)	(6.57)	(5.92)	(5.74)	(5.68)	(5.47)	(6.54)	(6.65)	(5.56)
Log	16.48	18.30	16.78	17.77	18.95	17.98	19.83	20.36	17.41	21.55	15.77
(LIFE)	(5.68)	(5.53)	(5.24)	(5.41)	(5.73)	(5.56)	(5.62)	(5.55)	(5.23)	(6.49)	(5.30)
TELPW	0.011	0.012	0.011	0.012	0.014	0.014	0.012	0.011	0.010	0.010	0.010
	(3.31)	(3.44)	(2.98)	(3.43)	(3.68)	(3.80)	(3.08)	(2.97)	(2.91)	(2.95)	(2.87)
TROPIC	− 1.97	− 1.85	− 1.88	− 2.34	− 1.71	− 1.67	− 1.83	− 1.61	− 2.65	− 1.96	− 1.70
	(4.80)	(4.02)	(4.42)	(5.29)	(3.69)	(3.76)	(3.94)	(3.34)	(5.82)	(4.39)	(4.10)
WATER	− 0.76	− 0.88	− 0.89	− 0.97	− 1.36	− 1.48	− 0.50	− 0.60	− 0.35	− 0.30	− 0.48
	(1.94)	(1.93)	(2.15)	(2.27)	(2.78)	(3.16)	(1.13)	(1.28)	(0.83)	(0.71)	(1.19)
WAR	− 0.0005	− 0.0009	− 0.0008	− 0.0009	− 0.0008	− 0.0009	− 0.0009	− 0.0009	− 0.0009	− 0.0001	− 0.0005
	(2.61)	(3.99)	(3.31)	(3.53)	(3.35)	(3.49)	(2.11)	(2.10)	(2.21)	(0.19)	(2.73)
REGIME	− 0.73	− 0.52	− 0.60	− 0.41	− 0.36	− 0.44	0.79	− 0.76	− 0.74	− 0.95	− 0.89
	(2.18)	(1.50)	(1.67)	(1.15)	(0.98)	(1.20)	(2.05)	(1.95)	(2.06)	(2.41)	(2.63)
OPEN	0.018	0.014*									
	(5.45)	(3.84)									
MGDP			0.029								
			(4.90)								

XGDP				0.039 (5.84)							
TOECD					0.016 (3.19)						
TNOECD						0.023 (3.36)					
USBEXP							0.0074 (3.25)				
USBIMP								0.0034 (1.41)			
USBTRD									0.020 (6.86)	0.015* (4.95)	
DENSITY											0.0009 (3.86)
R^2 for each	0.36, 0.39	0.30, 0.39	0.31, 0.40	0.33, 0.42	0.26, 0.42	0.24, 0.45	0.30, 0.43	0.28, 0.37	0.34, 0.51	0.21, 0.47	0.31, 0.38
Eq. (# of obs.)	0.25 (114)	0.33 (97)	0.35 (101)	0.38 (97)	0.33 (95)	0.36 (95)	0.17 (98)	0.17 (98)	0.28 (98)	0.37 (92)	0.22 (114)

[d] Only for developing countries. *t*-statistics are in parentheses.

The system has three equations, where the dependent variables are the per capita growth rate over each decade.

Each equation has a different constant term (not reported). Other coefficients are restricted to be the same for all periods.

* The column uses the 5-year lagged value of the variable.

measured using trade shares grow faster than closed economies. Another problem with this type of estimate, though much less pronounced than simultaneity, is the existence of outlier countries. Some scholars (see Edwards, 1992, 1998; Temple, 1999) suspect that countries with extremely high trade shares determine this relationship. To analyze this possibility, we drop five outliers, which are Guyana, Hong Kong, Luxembourg, Malta, and Singapore with an average trade share of 213.6% for the three decades. Estimating the same regressions as in columns 1 and 2 obtains similar results. As discussed in Edwards (1993), earlier empirical growth studies put too much emphasis on (the growth of) exports to classify countries according to trade openness, while they largely ignored import sectors and their growth effects. The significant and positive coefficients for both MGDP and XGDP in columns 3 and 4, 0.029 (4.90) and 0.039 (5.84), respectively, suggest that trade, import, and export shares are equally important explaining the growth differences across countries. Several studies such as Balassa and Balassa (1984), Levine and Renelt (1992), and Andriamananjara and Nash (1997), also found similar results.

One of the channels, suggested by new growth theory, by which trade enhances growth, is that a country can obtain advanced technology from its trading partners through trade. If this channel is more important than the other channels, countries may benefit more from trading with developed countries, which are technologically innovative, than by trade with developing countries, which are non-innovating. To test this hypothesis, we use the TOECD and TNOECD variables. Given that the majority of the advanced technology is produced in certain OECD countries, we would expect that the coefficient of TOECD to be bigger than that of TNOECD. The regression results in columns 5 and 6 show that both measures have significant and positive coefficients. The estimated coefficients for TOECD and TNOECD are 0.016 (3.19) and 0.023 (3.36), respectively. The size of the coefficient on TNOECD is slightly bigger than that of TOECD. Thus, these findings imply that access to new goods and technologies is not particularly crucial to growth as compared to access to markets resulting in exploitation of scale economies and comparative advantage. Thus, countries benefit from trading with developing countries as much as they benefit from trading with developed countries. Estimating the regressions reported in columns 5 and 6 for only developing countries produces somewhat similar coefficients, 0.016 (2.05) and 0.049 (2.72), for TOECD and TNOECD, respectively.[12] However, our results now imply that developing countries are likely to benefit more from trade with non-OECD countries.

Given that not all OECD countries are technologically innovative, testing this hypothesis using the last two measures may not be appropriate. As an alternative, we use data on U.S. bilateral trade with a large number of countries. Given the fact that the United States is one of the most highly innovative countries in the world, it is more appropriate to test this hypothesis using U.S. bilateral trade data. For this purpose, we use three measures of U.S. bilateral trade, USBEXP, USBIMP and USBTRD in columns 7, 8, and 9, respectively. The estimated results suggest that the countries that have more trade with the United States are likely to grow faster than the countries that have less trade with

[12] If we use TOECD without the United States, the estimated coefficient for the TOECD, 0.029 (3.95), is similar to those for the TOECD with the United States and USBTRD. Thus, trading with the US has no substantially different growth effect compared to the trading with other OECD countries.

the United States. The estimated coefficients for USBEXP, USBIMP, and USBTRD, 0.0074 (3.25), 0.0034 (1.41), and 0.020 (6.86), respectively, are all significant and positive.[13] Further, if we estimate the specification in column 9 only for developing countries, the estimated coefficient for USBTRD, 0.028 (5.03), implies that this phenomenon is more evident for the developing countries. Due to simultaneity concerns, in column 10, estimating averages of previous 5 years produces a significantly positive coefficient, 0.015 (4.95). Regarding outliers, if we drop the four countries (Hong Kong, Malaysia, Singapore, and Taiwan) with the largest volume of trade with the United States, then the estimated coefficient, 0.027 (4.54), for USBTRD, is significant and positive. Significant coefficients suggest that our results are robust to these problems.

A close look at the coefficients for USBEXP and USBIMP reveals that countries that import more US goods and services tend to grow faster. However, this is not readily obvious for the countries that export to the United States. Assuming that trade increases the diffusion of the technology and knowledge to other nations, US exports are a likely channel to convey this information. Thus, the effect of US exports on growth in the recipient countries is positive and significant, as expected. Further, significant coefficients for USBTRD and USBIMP suggest that exports to the United States are important for the growth of these countries. Thus, even if the mechanisms by which exports and imports promote growth are different, both are important in the growth process. Due to the substantially larger coefficient for USBTRD, it is probably safe to conclude that countries with a high level of trade with the United States grow faster not only because they import technologically advanced goods and investment goods, but also because they have access to a bigger market. Note that we are not aware of any study that uses any of the last five measures of openness within the context of cross-country growth regressions.

Finally, DENSITY is used to measure the trade openness of countries due to the common belief that countries with higher densities are more likely to be open and have more international contacts (see Sachs and Warner, 1995, 1997a,b). Moreover, when discussing 'external effects' of human capital, which is an important element in the growth of knowledge, Lucas (1988) argued that the role of the cities, supposedly more densely populated, is very similar to the role of 'external human capital' for economic growth. He (p. 38) described the external effects of human capital as "there are group interactions that are central to individual productivity and that involve groups larger than the immediate family and smaller than the human race as a whole." Column 11 reports a significantly positive coefficient for DENSITY, implying that countries with higher densities tend to grow faster. DENSITY can affect growth by at least two channels; more openness and higher human capital accumulation. To identify these channels, using OPEN and DENSITY in the same specification leads to insignificant coefficient for DENSITY. In addition, inclusion of DENSITY does not substantially change the size of the coefficient for LIFE. Hence, we conclude that DENSITY promotes growth through higher trade flows.

[13] The estimated coefficient for USBIMP is only significant at the 16% level. However, if we use five previous year averages, the estimated coefficients for USBEXP and USBIMP, 0.024 (5.40) and 0.023 (3.11), respectively, are statistically significant at the conventional levels.

4.3. Trade restrictions and growth

It is clear from the preceding section and also from existing empirical studies that trade volumes are positively and significantly correlated with growth. Consequently, one would expect that anything that poses a barrier to international trade is likely to be harmful to long run growth. In other words, barriers to trade in the forms of tariffs, export duties and taxes on international trade are expected to be correlated with growth negatively due to their potential trade-reducing effects. Moreover, a large number of studies reported a negative relationship between growth and average tariffs and also a number other forms of trade restrictions. Based on the existing empirical evidence, there is a near consensus that trade barriers are detrimental to growth, especially after the World War II. However, theoretical growth studies clearly indicated that there is no straightforward or unambiguous relationship between trade barriers and growth. On the contrary, they reported that countries can benefit from trade restrictions under certain conditions. In addition to new growth theory, the theory of strategic trade policy, the infant-industries arguments, and development economics provide a theoretical basis for the hypothesis that trade restrictions can promote growth in certain countries.

The regression results in Table 3 are consistent with the predictions of theoretical studies, rather than the conventional view on the issue. The first three columns of Table 3 actually report a significant and uncommonly positive relationship between TARIFF and growth. Column 1 reports a significant and positive coefficient, 0.053 (2.08), for TARIFF. Further, column 3 reports the regression result for TARIFF averaged over the previous 5 years. The estimated coefficient of lagged TARIFF, 0.042 (1.88), is also significant with the same sign. While the theoretical literature has discussed the possibility that trade barriers are likely to be beneficial to the growth of certain countries, it has emphasized that this is more likely to occur in developing countries. Accordingly, column 2 reports a significant and positive coefficient, 0.07 (2.15), for TARIFF for developing countries. Moreover, the estimated coefficient for developed countries is 0.22 (049). Using lagged values of TARIFF for developing countries also yields similar results (0.07 (2.39)). Thus, our results imply that developing countries with higher average tariffs grow faster than developing countries with lower tariffs. The coefficient on TARIFF, 0.07, implies that a 10% increase (approximately a one standard deviation) in tariffs would increase the average growth rate of per capita GDP by 0.7% annually. Next, we use several new measures of trade barriers. To the best of our knowledge, these measures have not been used to explain international growth differences before. First, we consider the growth effects of XTAX. The estimated coefficient, -0.044 (0.97), on contemporaneous XTAX in column 4 is insignificantly negative. However, if we use the previous 5-year averages of XTAX as in column 5, then the regression result shows a significantly positive effect on growth from lagged XTAX, 0.051 (2.03). Estimating the same regression in column 6 for developing countries also obtains a larger coefficient, 0.074 (2.42), implying that these results are driven by developing countries. Furthermore, both the contemporaneous and averages of five previous years of the taxes on international trade (TAXTRD) that include import and export duties along with the several other forms of taxes enter the regressions as measures of trade restrictions. The regression results in columns 7 and

Table 3
Trade restrictions and per capita GDP growth: panel of three decades (1970–1997)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
Log	−2.55	−0.73	−3.72	−3.98	−3.87	−2.59	−3.15	−3.04	−3.14	−4.37	−3.76	−2.97	−3.23
(GDPSH)	(3.27)	(0.73)	(4.65)	(5.05)	(4.77)	(2.43)	(4.05)	(3.91)	(4.58)	(5.63)	(4.91)	(3.30)	(3.32)
Log	14.66	14.42	17.13	17.25	17.35	15.72	15.53	13.35	13.93	17.76	15.04	13.29	10.70
(LIFE)	(3.78)	(3.22)	(3.05)	(4.39)	(4.57)	(3.64)	(4.07)	(3.68)	(4.57)	(5.08)	(4.71)	(3.86)	(3.00)
TELPW	0.011	0.008	0.013	0.011	0.010	0.015	0.011	0.012	0.008	0.012	0.008	0.010	0.018
	(2.98)	(0.92)	(3.05)	(3.12)	(2.80)	(1.89)	(3.03)	(3.06)	(2.18)	(3.09)	(1.99)	(1.38)	(2.25)
TROPIC	−1.19	−0.90	−1.52	−0.96	−1.67	−1.43	−1.44	−1.70	−1.63	−1.91	−1.84	−1.90	−1.84
	(2.53)	(1.70)	(3.38)	(2.02)	(3.60)	(2.75)	(2.97)	(3.69)	(3.82)	(4.12)	(4.29)	(3.94)	(3.47)
WATER	−0.25	0.17	0.26	−0.028	0.10	0.64	−0.40	−0.059	−0.37	−0.46	−0.51	−0.43	−1.11
	(0.50)	(0.27)	(0.53)	(0.06)	(0.21)	(1.08)	(0.82)	(0.12)	(0.84)	(0.99)	(1.10)	(0.86)	(2.25)
WAR	−0.010	−0.0014	−0.0014	−0.0010	−0.002	−0.0024	−0.0006	−0.0010	−0.0009	−0.0009	−0.0009	−0.0009	−0.0009
	(1.57)	(1.41)	(2.71)	(1.26)	(3.14)	(3.52)	(0.98)	(2.13)	(3.79)	(3.77)	(3.75)	(3.32)	(3.42)
REGIME	−0.92	−0.70	−0.91	−0.84	−0.87	−0.70	−0.88	−0.95	−0.86	−0.74	−0.81	−0.77	−0.51
	(2.07)	(1.33)	(2.17)	(1.70)	(2.07)	(1.44)	(2.06)	(2.33)	(2.55)	(2.18)	(2.39)	(2.02)	(1.41)
DENSITY	0.0014	0.0026	0.014	0.013	0.014	0.0017	0.0014	0.014	0.0010	0.0010	0.0009	0.002	0.006
	(3.82)	(1.96)	(3.98)	(3.64)	(3.84)	(1.51)	(3.61)	(3.77)	(3.89)	(4.03)	(3.71)	(1.89)	(2.47)
TARIFF	0.053	0.066[d]	0.042*										
	(2.08)	(2.15)	(1.88)										
XTAX				−0.044	0.051*	0.074[d,*]							
				(0.97)	(2.03)	(2.42)							
TAXTRD							0.026	0.023*					
							(1.90)	(1.87)					
BPA									0.71	0.31*			
									(1.76)	(0.91)			
CURRENT											−0.47	−0.96[d]	−0.22[d,*]
											(1.19)	(1.99)	(0.48)
R^2 for each	0.24,	0.28,	0.33,	0.31,	0.34,	0.37,	0.30,	0.27,	0.28,	0.29,	0.29,	0.31,	0.17,
	0.36	0.21	0.27	0.25	0.23	0.11	0.29	0.33	0.41	0.48	0.40	0.24	0.37
Eq. (# of obs.)	0.21	0.29	0.24	0.25	0.24	0.27	0.17	0.17	0.25	0.29	0.24	0.26	0.32
	(80)	(52)	(83)	(76)	(83)	(56)	(83)	(88)	(107)	(95)	(106)	(79)	(65)

See Table 2.

8 report the coefficients, 0.026 (1.90) and 0.023 (1.87), on the contemporaneous and lagged TAXTRD, respectively, which are both positive and statistically significant at the conventional levels.[14]

We then use two different measures of trade restrictions from the IMF's ARER: bilateral payments arrangements (BPAs) and restrictions on payments with respect to current account transactions (CURRENT). First, as discussed in Section 2, there is considerable evidence that many countries have employed BPAs to expand or maintain export markets through discriminatory trade policies. We use two measures of BPAs: arrangements among IMF members (BPAIMF) and arrangements of IMF members with non-IMF members (BPA). The regression result in column 9 reports a positive and significant coefficient, 0.71 (1.76) for BPA. This result indicates that there is a positive and significant relationship between bilateral payments arrangements and growth. One possible channel through which BPAs promotes growth is that BPAs may help countries use their international reserves effectively. Another channel through which BPAs affect growth is that they enhance the external sector of the recipient countries through trade creation under certain conditions. To see whether a BPA exerts an effect on growth through trade or through another channel, when we use OPEN instead of DENSITY in the specification as in column 9, the estimated coefficient for BPA is still significant, 1.01 (2.55), with the same sign. The larger coefficient for BPA can be due to the trade diversion effects of BPA dominating their trade creation effects. Thus, controlling for the trade levels of countries increases the size of the coefficient for BPA. Accordingly, BPAs are more likely to enhance growth through effective use of international reserves, which may lead to higher investment rates and physical capital accumulation. Estimating the same specifications with BPAIMF instead of BPA produces similar results.

However, using the BPA averages over five previous years obtains a positive but statistically insignificant coefficient, 0.31 (0.91), in column 10. Thus, this may suggest the presence of simultaneity that produces the positive and significant relationship. However, investigating the data does not support this view because there has been a downward trend in the number of countries employing BPAs for the last three decades. The average annual BPA are 0.32, 0.20, and 0.13 in the 1970s, 1980s, and 1990s, respectively. Moreover, since BPA along with the other variables published by ARER—namely BPAIMF, and CURRENT—is a binary variable, it has little variation across countries. Thus, countries with extremely high or low growth rates could drive these results. For this reason, we drop nine countries with remarkably high or low growth rates in one or more decades from the country sample,[15] and estimate the same specifications in columns 9 and 10. The regression results obtain similar coefficients, 0.67 (1.88) and 0.29 (0.93), for contemporaneous and lagged BPA. Once again these results suggest that our results are not determined by outliers.

[14] Since data for the last three measures of trade barriers is not available for the 1965–1969 period, if we estimate the two-equation system for the 1980s and 1990s, then the estimated coefficients on the lagged values of TARIFF, XTAX, and TAXTRD are 0.062 (2.60), 0.053 (1.69), and 0.028 (2.17), respectively.

[15] These are Botswana, China, Cyprus, Jordan, Malta, Romania, Sierra Leone, Singapore, and Zaire. Their annual average growth rates in one decade range from 13.6% to −9.3%.

Second, the estimated coefficient for CURRENT in column 11 is −0.47 (1.19), which is negative but statistically insignificant. This result implies a weak and inverse association with growth for all countries. Further, in column 12, estimating the same regression for developing countries produces a statistically significant and negative coefficient, −0.96 (1.99), for CURRENT. However, if we use CURRENT for the five previous years as in column 13, the estimated coefficient for lagged CURRENT for developing countries, −0.22 (0.48) is still negative but insignificant. Thus, the coefficient for lagged values indicates that the negative relationship might be the result of simultaneity running through poor growth performance to the erection of these restrictions. In other words, if a government faces balance of payments problems or foreign exchange crises, which are the likely cases in a recession, then it might employ these restrictions in an attempt to solve these problems. An investigation of the data also supports this view. For example, the annual average growth rates for the 1970s and 1980s for the developing countries were 2.43% and 0.54%, respectively. Consequently, this drastic drop in growth rates was accompanied by an increase in average CURRENT to 0.74 in the 1980s from 0.64 in the 1970s. Moreover, an increase in growth rates in the 1990s (1.04%) compared to the 1980s occurred with a decrease in average CURRENT in the 1990s (0.69) compared to the 1980s. Developed countries have followed roughly the same path. Thus, the significant coefficient for CURRENT is likely to be due to reverse causation, rather than restrictions on current account transactions lowering growth. Without the nine outlier countries, the estimated coefficients, −0.61 (1.73), −0.94 (2.10), and −0.28 (0.60), for CURRENT correspond to columns 11, 12, and 13, respectively. These results do not alter our conclusions.

There are several potential explanations for the existence of positive and strong relationship between trade barriers and growth. One of the possible explanations for this positive relationship is that if tariffs cause a reallocation of productive resources to the goods in which a country has comparative advantage from the goods in which a country has no advantage, then tariffs are likely to affect growth positively. Besides, if higher tariff rates cause a switch of resources towards to sectors that have relatively higher positive externalities for the whole economy, this also can generate positive growth effects. These results also provide support for the infant industry case for protection and for strategic trade policies.[16]

Moreover, combining these results with the raw data provides some important insights into the relationship between trade openness and growth. For instance, East Asian countries are far more open than the Sub-Saharan African and Latin American countries based on trade shares. The trade shares in GDP from 1970 through 1997 for East Asian, African, and Latin American countries are 93%, 63%, and 61%, respectively. However, average tariffs tell us a completely different story. For the same period, average tariff rates for East Asian, African, and Latin American countries are 11%, 18%, and 10%, respectively. In addition, tariff rates in East Asian countries are more than three times larger than those in the OECD countries. East Asian economies are actually as protective as Latin American economies that have supposedly followed import substitution policies

[16] For a complete discussion of strategic trade policies, see Krugman, 1986; Krugman and Smith, 1994.

for most of the period examined in this study. Although the extremely high trade shares in the East Asian economies can be considered to be the results of the export-oriented policies, higher average tariffs indicate that those economies have been subject to a similar level of government intervention as in Latin American countries. Accordingly, it is no surprise that higher trade shares in East Asian countries are accompanied with higher average tariffs. Based on these figures, we may well argue that the successes of East Asian economies over Latin American economies could probably be due to the fact that incentives for exporting sectors and import-competing sectors have been evenly distributed in East Asian economies but there have been a strong bias favoring import competing sectors in Latin American countries. Thus, based on the concept of openness as in Krueger (1978) and Harrison (1996), East Asian economies are much more open than Latin American economies not because East Asian economies have been subject to a lower level of government intervention than that of in Latin American economies but probably due to the neutral trade policies employed by East Asian governments. Consequently, we believe that the question that should be addressed is actually not that of open economies versus closed economies but rather what kind of government intervention or trade policy is better.

Our overall estimation results for trade barriers clearly indicate that there is no simple and straightforward relationship between trade restrictions and growth, as the existing literature claimed. Equally important, they strongly support the hypothesis that trade restrictions can be growth enhancing especially for developing countries. However, due to the measurement problems for average tariff rates and also that these tariff rates are not uniform rates that are levied on each and every sector of the economy but average tariff rates, it would certainly be a mistake to conclude that protecting the entire economy uniformly by using tariffs or NTBs will have positive consequences for growth even for developing countries. These results at best provide evidence for selective protection of industries or sectors. For example, it is highly probable that restricting imports of capital equipment raises the price of capital goods, and thereby reduces the level of real investment and eventually hurts growth.[17]

4.4. Trade volumes and trade barriers

Our estimation results for trade intensity ratios and trade barriers may seem inconsistent with one another because they seem to provide completely different and contradictory answers to the question concerning the growth effects of trade openness. To shed some lights on these seemingly contradictory results, we proceed in two ways. First, we reestimate the regressions for trade barriers in Table 3 using trade shares (OPEN) instead of population densities (DENSITY) and report the results in the first column of Table 4. As can be seen from Table 4, while now TAXTRD and CURRENT

[17] We also examine several measures of trade barriers used heavily in the previous studies. These are Leamer's intervention index, three measures of trade restrictions from Lee (1993), and Dollar's real exchange rate distortion index. Our results for these variables are consistent with the existing literature. Thus, they also challenge the view that there is strong and negative relationship between trade barriers and growth, as suggested by some previous studies.

Table 4
Trade volumes and trade restrictions

Eq. no.	Growth regressions				Trade regressions[a]		
	Variable	SUR		R^2 (# of obs. per eq.)	Variable	SUR	R^2 (# of obs. per eq.)
			OPEN				
3.1	TARIFF	0.054	0.020	0.36, 0.39	TARIFF	− 0.66	0.58, 0.50
		(2.22)	(5.99)	0.27 (80)		(3.36)	0.43 (94.7)
3.2	TARIFF[d]	0.070	0.026	0.43, 0.23	TARIFF[d]	− 0.51	0.60, 0.52
		(2.36)	(4.25)	0.28 (52)		(2.51)	0.31 (66.7)
3.3	TARIFF*	0.050	0.020	0.41, 0.25	TARIFF*	− 0.65	0.62, 0.47
		(2.22)	(5.74)	0.28 (83)		(2.38)	0.39 (76.7)
3.4	XTAX	− 0.033	0.019	0.41, 0.29	XTAX	− 1.07	0.57, 0.49
		(0.75)	(5.77)	0.30 (76)		(4.27)	0.42 (91.3)
3.5	XTAX*	0.069	0.020	0.42, 0.22	XTAX*	− 1.50	0.60, 0.48
		(2.70)	(5.76)	0.30 (83)		(4.69)	0.41 (76.7)
3.6	XTAX[d,*]	0.088	0.021	0.45, 0.08	XTAX[d,*]	− 1.02	0.69, 0.53
		(2.87)	(3.67)	0.31 (56)		(3.19)	0.32 (54)
3.7	TAXTRD	0.0053	0.020	0.37, 0.25	TAXTRD	− 0.32	0.57, 0.50
		(0.39)	(5.40)	0.28 (83)		(2.43)	0.41 (95.7)
3.8	TAXTRD*	0.014	0.018	0.35, 0.28	TAXTRD*	− 0.27	0.60, 0.49
		(1.16)	(5.07)	0.23 (88)		(1.94)	0.38 (95.3)
3.9	BPA	1.01	0.019	0.34, 0.43	BPA	− 4.01	0.55, 0.46
		(2.55)	(5.70)	0.29 (107)		(1.19)	0.37 (108.3)
3.10	BPA*	0.45	0.018	0.34, 0.48	BPA*	− 3.29	0.56, 0.46
		(1.31)	(5.32)	0.34 (95)		(1.04)	0.36 (106.3)
3.11	CURRENT	− 0.30	0.017	0.34, 0.39	CURRENT	− 11.81	0.58, 0.49
		(0.76)	(5.12)	0.27 (106)		(3.46)	0.39 (108.3)
3.12	CURRENT[d]	− 0.58	0.015	0.33, 0.23	CURRENT[d]	− 12.86	0.60, 0.52
		(1.24)	(2.81)	0.27 (79)		(3.50)	0.27 (84)
3.13	CURRENT[d,*]	0.13	0.012	0.22, 0.26	CURRENT[d,*]	− 15.66	0.62, 0.52
		(0.28)	(1.79)	0.33 (65)		(3.82)	0.30 (79)

Other regressors in trade regressions include log of initial values of per capita GDP, log values of area and total populations, and dummy variables for countries that are landlocked and (past) colonies.
See also notes to Table 2.

[a] Dependent variables are averages of trade shares over each decade from 1970 through 1997.

lose their significances, other variables have larger estimated coefficients. Hence, including trade shares in the regressions for trade barriers do not considerably affect their significance levels. Comparing the estimated coefficients for OPEN in Table 4 with that of OPEN in the first column of Table 2 indicates that the similar discussion also applies to the regressions results for trade shares. Second, we regress trade shares (OPEN) on the measures of trade barriers used throughout the study and on other variables (see Table 4 for the control variables). The SUR estimates for trade barriers in the trade regressions indicate that all the variables have statistically significant and negative coefficients with an exception of BPA. Thus, these results suggest that while trade barriers have adverse effects on growth through reducing trade, they positively affect growth through superior resource allocation and/or positive externalities. Our results imply that the latter dominates the former.

4.5. Sensitivity analysis

In this section, we carry out several robustness tests. First, the regressions results presented here may be subject to simultaneity problems. Thus, we test the sensitivity of our results for openness measures by taking into account endogeneity. There are two common proposed remedies for this problem. The first remedy is to use lagged values of the exogenous variables, which we have already applied to our results. Second, the endogeneity problem can also be addressed appropriately by using instrumental variables (IV) techniques. However, the major problem with this technique is that it is difficult to find good instruments that are correlated with the exogenous variables but are not correlated with the error terms. Thus, following the existing literature, we use either actual or 5-year lagged values of our regressors as instruments. Additionally, we employ constructed trade shares from Frankel and Romer (1999) for trade shares as instruments in growth regressions.[18] The IV estimation results for the all specifications are presented in Table 5. Note that the equation numbers in Tables 4–6 correspond to the specifications in Tables 2 and 3. Table 5 shows that for almost all of the variables the 3SLS estimates are bigger than the SUR estimates. Thus, the IV estimates actually strengthen our conclusions based on the SUR estimates. These estimates also indicate that the OLS estimates understate the effects of trade on growth. Thus, these results are consistent with the findings of Frankel and Romer (1999).

Next, we also replicate our results in Table 5 using 5-year averages instead of decadal averages and report them in Appendix B. There are some minor differences in these two tables but they are not strong enough to alter our overall conclusions. For example, comparing the IV estimates from these tables indicates that there are only three specifications (XTAX in two specifications, CURRENT) that become insignificant while keeping their original signs.

Finally, we employ econometric methods that control for fixed factors; first differences and fixed effects. First, we estimate first differences by a seemingly unrelated framework and present the results in Table 6. This setup includes two equations. In the first, the dependent variable is the growth rate of GDP from 1980 to 1989, less that from 1970 to 1979. In the second, the dependent variable is the growth rate from 1990 to 1997, less that from 1980 to 1989. Similarly, the independent variables are first differences of the variables that appear in Tables 2 and 3. Second, we have a panel data set for each indicator and growth rates, we then directly employ the method of fixed effects estimation by allowing both country and time effects.[19] As expected, the first

[18] Statistically insignificant F values for the tests of overidentifying restrictions for the IV estimates in Table 5 show that our instruments are valid for most of the specifications, except for (OPEN, OPEN*, POPLAND). However, Rodriguez and Rodrik (2001) argued that geographically constructed trade share may not be a valid instrument because geography may exert effects on income through various channels other than international trade.

[19] Note that in all specifications, highly statistically significant F values reject the null hypothesis that there are no fixed effects.

Table 5
Openness measures and per capita GDP growth: panel of three decades (1970–1997)

Eq.	Variable	OLS	SUR	3SLS	R^2 (# of obs.)
1.1	OPEN	0.017 (6.07)	0.018 (5.45)	0.048 (5.77)	0.27, 0.03 −0.04 (109)
1.2	OPEN*	0.015 (4.81)	0.014 (3.84)	0.033 (3.99)	0.27, 0.29, 0.29 (95)
1.3	MGDP	0.029 (5.73)	0.029 (4.90)	0.074 (5.35)	0.21, 0.13, 0.23 (98)
1.4	XGDP	0.037 (6.50)	0.039 (5.84)	0.10 (5.35)	0.18, 0.06, 0.06 (95)
1.5	TOECD	0.012 (2.82)	0.016 (3.19)	0.082 (5.42)	0.23, 0.23 −0.13 (91)
1.6	TNOECD	0.022 (3.52)	0.023 (3.36)	0.14 (5.14)	0.18, 0.02 −0.08 (91)
1.7	USBEXP	0.008 (3.53)	0.0074 (3.25)	0.050 (5.93)	0.32, 0.46 −2.4 (94)
1.8	USBIMP	0.004 (1.60)	0.0034 (1.41)	0.035 (4.26)	0.31, 0.47 −1.3 (94)
1.9	USBTRD	0.019 (7.50)	0.020 (6.86)	0.051 (6.35)	0.17, 0.001, 0.03 (94)
1.10	USBTRD*	0.016 (5.77)	0.015 (4.95)	0.031 (5.16)	0.15, 0.45, 0.26 (88)
1.11	DENSITY	0.0009 (4.31)	0.0009 (3.86)	0.004 (4.41)	−0.001, −0.23 −0.54 (109)
2.1	TARIFF	0.069 (2.93)	0.053 (2.08)	0.063 (2.00)	0.32, 0.27, 0.14 (71)
2.2	TARIFF[d]	0.076 (2.59)	0.066 (2.15)	0.073 (2.08)	0.36, 0.21, 0.36 (45)
2.3	TARIFF*	0.047 (2.08)	0.042 (1.88)	0.072 (3.10)	0.31, 0.33, 0.09 (81)
2.4	XTAX	−0.03 (0.73)	−0.044 (0.97)	−0.038 (0.75)	0.31, 0.20, 0.10 (71)
2.5	XTAX*	0.046 (1.76)	0.051 (2.03)	0.060 (2.38)	0.32, 0.24, 0.11 (81)
2.6	XTAX[d,]*	0.071 (2.33)	0.074 (2.42)	0.077 (2.58)	0.38, 0.18, 0.27 (55)
2.7	TAXTRD	0.025 (2.14)	0.026 (1.90)	0.053 (3.13)	0.34, 0.28, 0.03 (77)
2.8	TAXTRD*	0.020 (1.67)	0.023 (1.87)	0.033 (2.55)	0.25, 0.36, 0.05 (86)
2.9	BPA	0.71 (1.94)	0.71 (1.76)	1.19 (2.30)	0.23, 0.44, 0.24 (92)
2.10	BPA*	0.42 (1.31)	0.31 (0.91)	0.39 (1.08)	0.22, 0.43, 0.20 (93)
2.11	CURR	−0.40 (1.09)	−0.47 (1.19)	−0.29 (0.62)	0.23, 0.51, 0.26 (89)
2.12	CURR[d]	−0.98 (2.16)	−0.96 (1.99)	−1.22 (2.15)	0.16, 0.39, 0.33 (63)
2.13	CURR[d,]*	−0.14 (0.32)	−0.22 (0.48)	−0.30 (0.61)	0.15, 0.37, 0.34 (63)

The three-stage least square (3SLS) estimates use different instrumental variables for each equation.
The instruments are 5-year earlier log of (GDPSH) (for example, for 1965 in the 1970–1979 equation); 5-year lagged values of log (LIFE) (for example, for 1965–1969 in the 1970–1979 equation); actual values of TELPW, TROPIC, WATER, WAR, and REGIME. For trade volumes, constructed trade shares from Frankel and Romer (1999) are also used as instruments. For trade restriction measures, their 5-year lagged values and log values of total population and area are also used.
For instance, the 1990–1997 equation uses the averages of TARIFF for 1985–1989 period.
See Table 2.

differences and fixed estimations are very similar to each other. However, Table 6 shows that most variables lose their significance once we control for fixed effects. On the one hand, for intensity ratios, although TRADE still has a significant, positive coefficient, lagged TRADE is not significant. Furthermore, three measures of U.S. bilateral trade are not statistically significant and yet their 5-year lagged values are highly statistically significant with positive coefficients. On the other hand, TARIFF, XTAX, and BPA in all specifications, become insignificant while usually keeping the original signs. Note that lagged TARIFF for developing countries has still statistically significant and positive coefficient (0.10 (1.67)). TAXTRD and CURRENT have much higher and significant coefficients. Although fixed effects estimations for trade barriers are not as strong as the SUR or 3SLS estimates, supporting the conclusion that trade barriers have positive and strong association with growth, they by no means provide

Table 6
Growth regressions: fixed effects estimations

Eq.	Variable	First differences (SUR)			Fixed effects[a]		
		Log (GDPSH)	Openness	R^2 (# of obs.)	Log (GDPSH)	Openness	R^2 (# of obs.)
1.1	OPEN	− 9.63	0.029	0.21, 0.14	− 8.35	0.029	0.69
		(5.35)	(2.59)	(107)	(4.95)	(2.64)	(113)
1.2	OPEN*	− 7.40	0.014	0.18, 0.12	− 6.07	0.017	0.74
		(4.29)	(1.24)	(95.5)	(3.72)	(1.59)	(113)
1.3	MGDP	− 9.59	0.063	0.24, 0.16	− 7.79	0.070	0.73
		(5.47)	(3.29)	(100)	(4.78)	(3.74)	(111)
1.4	XGDP	− 10.06	0.065	0.23, 0.17	− 8.12	0.063	0.72
		(5.64)	(3.06)	(100)	(4.81)	(3.00)	(111)
1.5	TOECD	− 8.35	0.025	0.22, 0.16	− 6.52	0.016	0.72
		(4.61)	(2.87)	(92)	(3.86)	(2.10)	(106)
1.6	TNOECD	− 8.09	− 0.010	0.25, 0.04	− 6.47	− 0.003	0.72
		(4.53)	(0.86)	(92)	(3.78)	(0.27)	(106)
1.7	USBEXP	− 9.61	0.011	0.23, 0.06	− 7.32	0.0019	0.71
		(4.97)	(0.56)	(93)	(4.04)	(1.04)	(100)
1.8	USBIMP	− 9.71	− 0.00004	0.23, 0.06	− 7.34	0.0003	0.71
		(5.00)	(0.06)	(93)	(4.03)	(0.40)	(100)
1.9	USBTRD	− 9.68	0.00006	0.23, 0.06	− 7.33	0.0003	0.71
		(4.99)	(0.11)	(93)	(4.03)	(0.57)	(100)
1.10	USBTRD*	− 11.35	0.037	0.19, 0.24	− 9.24	0.032	0.75
		(5.71)	(4.35)	(86.5)	(4.91)	(4.03)	(100)
1.11	DENSITY	− 9.67	0.0035	0.21, 0.11	− 8.13	0.003	0.68
		(2.29)	(1.52)	(108.5)	(4.77)	(1.71)	(113)
2.1	TARIFF	− 11.17	− 0.004	0.29, 0.06	− 8.99	0.0015	0.72
		(5.66)	(0.12)	(87.5)	(4.66)	(0.04)	(107)
2.2	TARIFF[d]	− 11.53	0.002	0.34, 0.12	− 9.83	0.0016	0.72
		(5.05)	(0.05)	(59.5)	(4.45)	(0.36)	(79)
2.3	TARIFF*	− 10.97	− 0.10	0.55, 0.07	− 9.50	− 0.018	0.75
		(4.64)	(0.24)	(62.5)	(3.94)	(0.43)	(104)
2.4	XTAX	− 11.89	− 0.053	0.32, 0.05	− 10.34	− 0.06	0.73
		(6.01)	(1.00)	(84.5)	(5.49)	(1.16)	(104)
2.5	XTAX*	− 10.83	0.061	0.58, 0.07	− 9.19	0.05	0.76
		(4.65)	(1.46)	(62.5)	(3.82)	(1.04)	(104)
2.6	XTAX[d,*]	− 10.20	0.062	0.59, 0.09	− 9.22	0.05	0.73
		(3.56)	(1.25)	(42)	(3.09)	(0.89)	(77)
2.7	TAXTRD	− 10.72	0.024	0.30, 0.01	− 8.20	0.047	0.72
		(5.45)	(0.84)	(88.5)	(4.36)	(1.70)	(108)
2.8	TAXTRD*	− 10.27	0.054	0.29, 0.08	− 8.24	0.077	0.71
		(5.31)	(2.09)	(88)	(4.49)	(3.03)	(108)
2.9	BPA	− 9.63	0.63	0.22, 0.10	− 7.98	0.44	0.68
		(5.14)	(0.87)	(104.5)	(4.57)	(0.63)	(112)
2.10.	BPA*	− 10.19	0.56	0.24, 0.10	− 8.40	0.49	0.69
		(5.47)	(0.90)	(102)	(4.80)	(0.82)	(112)
2.11	CURRENT	9.55	− 1.55	0.25, 0.11	− 8.20	− 1.75	0.69
		(5.20)	(2.38)	(104.5)	(4.77)	(2.72)	(112)

Table 6 (*continued*)

Eq.	Variable	First differences (SUR)			Fixed effects[a]		
		Log (GDPSH)	Openness	R^2 (# of obs.)	Log (GDPSH)	Openness	R^2 (# of obs.)
2.12	CURRENT[d]	− 9.79	− 1.55	0.27, 0.11	− 8.51	− 1.78	0.67
		(4.64)	(2.08)	(77.5)	(4.32)	(2.37)	(84)
2.13	CURRENT[d,*]	− 10.49	− 0.38	0.28, 0.10	− 9.01	− 0.74	0.68
		(4.89)	(0.47)	(75)	(4.47)	(0.93)	(84)

See notes to Table 2.

[a] Country and time dummies included in the estimates (not reported here).

evidence for the conventional view on the issue. It is worthwhile to note that there are substantial discrepancies in the estimated convergence rates between the SUR estimates and fixed effects estimations. While the SUR estimates indicate 3% to 5% annual convergence rates, fixed effects regressions show roughly 10% annual converge rates. Barro (1997) claimed that elimination of the cross-sectional information in the fixed effects estimation might exacerbate measurement error bias, which would lead to higher convergence coefficients.[20,21] Overall, it is safe to conclude that our results do not seem to be sensitive to either the data set used or the simultaneity problem or the presence of outliers.

5. Conclusions

This paper investigates the relationship between a wide variety of trade openness measures and growth. We basically use two types of openness measures. The first group is various measures of trade volumes (except population densities). Trade shares, export shares, and import shares in GDP are widely used in the literature and are found to be significantly and positively correlated with growth. However, much less attention has been given to disaggregated measures of trade intensity in the empirical literature. Thus, this study employs several new measures of trade intensity, which are trade with OECD countries, non-OECD countries, and U.S. bilateral trade figures. Significant, positive coefficients for these measures show that

[20] See Barro (1997) for a more complete discussion of the issue.

[21] For further robustness checks, we first reestimate the regressions in Tables 2 and 3 with inclusion of three different policy measures (inflation rates, government spending, and black market premium) and the summary indicator of institutional quality from Knack and Keefer (1995). Second, to test the sensitivity of our results to different data sets, we reestimate the regressions in Tables 2 and 3 using the growth rates from the Penn World Tables instead of the growth rates from the World Bank database. Comparing these results with Tables 2 and 3 shows that these two sets of estimates surprisingly consistent with each other. In almost all cases, they have the same statistical significance level as before with the same signs. Third, our estimation results for both trade intensity ratios and trade barriers including oil-exporting countries do not alter our conclusions.

the growth effects of trade with developed countries are not considerably different from trade with developing countries. Further, population densities also positively affect growth through increasing trade volumes. Hence, the regression results for trade volumes provide substantial support for the hypothesis that trade promotes growth through a number of channels such as technology transfers, scale economies, and comparative advantage and are consistent with earlier empirical studies of the issue.

Surprisingly, unlike the literature on the growth effects of trade intensity ratios, findings of empirical studies of trade restrictions are considerably different from predictions of theoretical studies. Even though the theoretical growth studies provided no conclusive evidence about the direction of growth effects of trade barriers, especially for developing countries, a great majority of the empirical studies concluded that there exists a significant and negative relationship between trade restrictions and growth. Whereas, our results are much closer to the predictions of theoretical studies and evidently contradict the findings of earlier empirical studies. We believe that our results cast substantial doubts on the conventional view that suggests a robust and negative relationship between trade barriers and growth. In other words, all measures of trade barriers used in the study are significantly and positively correlated with growth except for restrictions on current account payments, which is negatively but insignificantly correlated with growth. Thus, our results actually provide considerable evidence for the hypothesis that restrictions on trade can promote growth, especially of developing countries under certain conditions. It is crucial to note that in this study, we have no intention of establishing a simple and straightforward positive association between barriers to trade and growth. Rather, our main goal is to show that there is no such relationship between trade restrictions and growth. On the contrary, this relationship mostly depends on certain characteristics of countries. In other words, restrictions on trade can benefit a country depending on whether it is a developed or developing country, whether it is a big or small country, and whether a country has comparative advantage in those sectors that are receiving protection.

Furthermore, this study has also addressed potential statistical problems inherent to this sort of estimation and to interpreting these results. Thus, we carry out a number of robustness tests as discussed in the text. Our results do not seem to sensitive to the different statistical methods, specifications, datasets, and outlier problems. Although the OLS, SUR, and 3SLS estimates somewhat similar to each other, the fixed effects estimates imply a much weaker relationship between growth and trade openness, especially for trade barriers.

Acknowledgements

I am particularly grateful to Stacie E. Beck, Evangelos M. Falaris, Larry Hotchkiss, and two anonymous referees. I am most grateful of all to James L. Butkiewicz, who contributed several rounds of insightful criticisms. Remaining errors belong to me.

Appendix A. Import duties as percent of imports (averages for various years)

Country	1970s	1980s	1990s
Argentina	0.00	14.28	9.11
Australia	10.62	8.54	5.10
Austria	4.16	1.70	1.09
Bahamas, The	3.28	14.46	26.63
Bangladesh	13.89	14.32	–
Barbados	10.68	9.37	–
Belgium	0.02	0.01	0.00
Benin	20.56	–	–
Bolivia	–	10.26	5.73
Botswana	18.21	18.39	20.75
Brazil	–	8.32	8.83
Burundi	–	20.56	18.63
Cameroon	26.32	20.43	20.75
Canada	5.65	3.94	2.44
Central African Republic	–	23.90	–
Chile	12.31	11.97	–
China	–	–	4.48
Colombia	14.04	15.55	11.44
Comoros	–	28.28	–
Costa Rica	7.03	10.23	8.82
Cote d'Ivoire	–	31.60	33.60
Cyprus	8.33	9.96	7.72
Denmark	0.43	0.09	0.09
Dominican Republic	26.81	16.48	15.33
Ecuador	16.17	16.52	9.90
Egypt, Arab Rep.	25.56	32.69	18.15
El Salvador	6.94	6.54	6.27
Ethiopia	29.15	15.78	19.67
Fiji	15.05	18.09	14.27
Finland	2.34	1.49	0.75
France	0.08	0.07	0.01
Gabon	23.85	27.98	26.73
Gambia, The	23.08	26.73	18.71
Germany	0.55	0.02	0.00
Ghana	17.31	20.54	14.46
Greece	6.95	1.73	0.11
Guatemala	8.66	6.83	8.71
Guinea	–	4.12	6.86
Guinea-Bissau	–	5.38	–
Guyana	5.17	3.68	–
Haiti	13.25	14.54	–
Honduras	8.91	9.49	–
Hungary	–	7.50	9.97
Iceland	19.80	13.76	4.98
India	29.27	41.30	30.74
Ireland	8.61	4.07	0.00
Israel	14.78	4.91	1.04

(continued on next page)

Appendix A (*continued*)

Country	1970s	1980s	1990s
Italy	0.40	0.06	0.02
Jamaica	4.83	4.83	–
Japan	3.32	2.62	3.53
Jordan	16.96	15.62	14.04
Kenya	14.61	17.46	13.48
Korea, Rep.	9.68	8.36	5.02
Lesotho	19.03	18.97	21.61
Luxembourg	0.02	0.01	0.00
Madagascar	21.98	24.51	24.12
Malawi	11.35	23.26	21.67
Malaysia	9.52	7.56	3.84
Mali	15.51	11.66	–
Malta	12.20	11.34	6.17
Mauritania	11.91	–	–
Mauritius	14.57	18.08	15.64
Mexico	9.31	6.81	4.29
Morocco	18.36	17.43	16.89
Myanmar	22.90	25.88	53.45
Nepal	18.42	13.54	10.11
Netherlands	0.22	0.00	0.00
New Zealand	5.77	5.78	4.05
Nicaragua	6.48	7.93	11.25
Niger	15.87	17.02	–
Norway	1.03	0.84	1.06
Oman	1.15	2.98	2.93
Pakistan	20.37	26.02	23.53
Panama	6.78	4.15	3.38
Papua New Guinea	8.45	11.97	16.12
Paraguay	13.36	6.83	5.53
Peru	14.15	20.87	11.86
Philippines	14.88	14.04	14.02
Poland	–	8.29	13.60
Portugal	8.63	3.24	0.33
Romania	0.00	0.00	5.36
Rwanda	20.74	21.74	22.06
Senegal	18.18	20.95	–
Sierra Leone	20.29	17.50	18.72
Singapore	1.54	0.72	0.30
Somalia	37.40	–	–
South Africa	5.75	5.59	3.26
Spain	16.00	5.45	0.60
Sri Lanka	9.46	14.23	11.91
Sudan	32.06	29.49	–
Suriname	–	9.31	–
Swaziland	22.56	19.39	21.26
Sweden	2.37	1.01	1.05
Switzerland	5.13	3.88	1.00
Syrian Arab Republic	11.51	12.84	25.46
Tanzania	9.85	9.21	–
Thailand	13.66	12.24	8.66

Appendix A (*continued*)

Country	1970s	1980s	1990s
Togo	16.20	17.55	–
Trinidad and Tobago	9.38	10.40	6.18
Tunisia	22.06	24.54	20.36
Turkey	26.33	6.86	3.66
Uganda	15.14	7.65	–
United Kingdom	1.49	0.12	0.11
United States	4.37	3.44	2.78
Uruguay	15.67	15.48	8.20
Zaire	19.23	13.88	9.27
Zambia	6.93	10.15	16.86
Zimbabwe	4.70	19.81	19.62

Source: World Bank, World Development Indicators 1999.
Countries listed are those for which there is data for at least one of the decades covered.

Appendix B. Growth regressions: six 5-year periods

Eq.	Variable	OLS	SUR	3SLS
1.1	OPEN	0.015 (6.29)	0.017 (5.16)	0.022 (4.57)
1.2	OPEN*	0.012 (4.81)	0.010 (3.06)	0.015 (3.05)
1.3	MGDP	0.027 (6.14)	0.030 (5.09)	0.038 (4.51)
1.4	XGDP	0.029 (5.77)	0.031 (4.84)	0.043 (4.22)
1.5	TOECD	0.0074 (2.03)	0.010 (2.27)	0.026 (3.60)
1.6	TNOECD	0.10 (1.86)	0.010 (1.74)	0.023 (2.24)
1.7	USBEXP	0.0025 (2.59)	0.0015 (1.76)	0.037 (5.79)
1.8	USBIMP	0.0003 (0.92)	0.0003 (0.98)	0.60 (5.67)
1.9	USBTRD	0.0004 (1.40)	0.0003 (1.19)	0.027 (6.28)
1.10	USBTRD*	0.015 (6.43)	0.014 (5.04)	0.018 (3.91)
1.11	DENSITY	0.0009 (4.71)	0.0008 (3.29)	0.003 (4.96)
2.1	TARIFF	0.058 (3.29)	0.036 (1.86)	0.042 (1.81)
2.2	TARIFF[d]	0.058 (2.79)	0.038 (1.69)	0.059 (2.51)
2.3	TARIFF*	0.030 (1.73)	0.027 (1.44)	0.036 (1.68)
2.4	XTAX	0.023 (0.81)	0.029 (0.96)	− 0.02 (0.52)
2.5	XTAX*	0.037 (1.61)	0.045 (1.87)	0.015 (0.42)
2.6	XTAX[d,*]	0.050 (1.90)	0.054 (2.00)	0.024 (0.61)
2.7	TAXTRD	0.032 (3.32)	0.034 (2.98)	0.039 (2.93)
2.8	TAXTRD*	0.022 (2.48)	0.026 (2.60)	0.029 (2.55)
2.9	BPA	0.76 (2.45)	0.83 (2.29)	0.77 (1.92)
2.10	BPA*	0.61 (2.09)	0.62 (1.81)	0.48 (1.32)
2.11	CURRENT	− 0.18 (0.59)	− 0.24 (0.67)	− 0.21 (0.57)
2.12	CURRENT[d]	− 0.71 (1.97)	− 0.69 (1.66)	− 0.70 (1.54)
2.13	CURRENT[d,*]	0.03 (0.09)	0.30 (0.75)	0.22 (0.51)

The system has six equations, where the dependent variables are the per capita growth rate over 5-year periods from 1970 through 1997. See also notes in Tables 2 and 4.

References

Anderson, J.E., Neary, J.P., 1992. Trade reform with quotas, partial rent retention, and tariffs. Econometrica 60, 57–76.

Andriamananjara, S., Nash, J., 1997. Have trade policy reforms led to greater openness in developing countries? World Bank Working Paper Series, No. 1730.

Auguste, B.G., 1997. The Economics of International Payments Unions and Clearing Houses. St. Martin's Press, New York.

Balassa, B., Balassa, C., 1984. Industrial protection in the developed countries. World Economy 7, 176–196.

Barro, R.J., 1997. Determinants of Economic Growth: A Cross-Country Empirical Study. MIT Press, Cambridge.

Clemens, M.A., Williamson, J.G., 2001. A tariff-growth paradox? Protection's impact the world around 1875–1997. NBER Working Paper Series, No. 8549.

Dollar, D., 1992. Outward-oriented developing economies really do grow more rapidly: Evidence from 95 LDCs, 1976–1985. Economic Development and Cultural Change 40, 523–544.

Easterly, W., 1999. Life during growth. Journal of Economic Growth 4, 239–275.

Edwards, S., 1992. Trade orientation, distortions and growth in developing countries. Journal of Development Economics 39, 31–57.

Edwards, S., 1993. Openness, trade liberalization, and growth in developing countries. Journal of Economic Literature 31, 1358–1393.

Edwards, S., 1998. Openness, productivity and growth: what do we really know? Economic Journal 108, 383–398.

Frankel, J.A., Romer, D., 1999. Does trade cause growth? American Economic Review 89 (3), 379–399.

Frankel, J.A., Rose, A.K., 2000. Estimating the effects of currency unions on trade and output. NBER Working Paper Series, No. 7857.

Grossman, G.M., Helpman, E., 1990. Comparative advantage and long-run growth. American Economic Review 80, 796–815.

Grossman, G.M., Helpman, E., 1991a. Quality ladders in the theory of growth. Review of Economic Studies 58, 43–61.

Grossman, G.M., Helpman, E., 1991b. Endogenous product cycles. Economic Journal 101, 1229–1241.

Harrison, A., 1996. Openness and growth: a time series, cross-country analysis for developing countries. Journal of Development Economics 48, 419–447.

Harrison, A., Hanson, G., 1999. Who gains from trade reform? Some remaining puzzles. Journal of Development Economics 59, 125–154.

International Monetary Fund. Annual Report on Exchange Arrangements and Exchange Restrictions. Washington, DC: IMF, various series.

International Monetary Fund. Direction of Trade Statistics Yearbook. Washington, DC: IMF, various series.

Irwin, D.A., 2002a. Interpreting the tariff-growth correlation of the late nineteenth century. NBER Working Paper Series, No. 8739.

Irwin, D.A., 2002b. Did import substitution promote growth in the late nineteenth century. NBER Working Paper Series, No. 8751.

Irwin, D.A., Tervio, M., 2002. Does trade raise income? Evidence from the twentieth century. Journal of International Economics 58, 1–18.

Knack, S., Keefer, P., 1995. Institutions and economic performance: cross-country tests using alternative institutional measures. Economics and Politics 7, 207–227.

Krueger, A.O., 1978. Liberalization Attempts and Consequences. Ballinger, Cambridge.

Krugman, P.R., 1986. Strategic Trade Policy and the New International Economics. The MIT Press, Cambridge.

Krugman, P.R., Smith, A., 1994. Empirical Studies of Strategic Trade Policy. The University of Chicago Press, Chicago.

Leamer, E.E., 1988. Measures of openness. In: Baldwin, R.E. (Ed.), Trade Policy Issues and Empirical Analysis. The University of Chicago Press, Chicago, pp. 147–204.

Lee, J.-W., 1993. International trade, distortions, and long-run economic growth. IMF Staff Papers 40 (2), 299–328.

Levine, R., Renelt, D., 1992. A sensitivity analysis of cross-country growth regressions. American Economic Review 82, 942–963.
Lucas, R.E., 1988. On the mechanics of economic development. Journal of Monetary Economics 22, 3–42.
Mankiw, N.G., Romer, D, Weil, D.N., 1992. A contribution to the empirics of economic growth. Quarterly Journal of Economics 107, 407–437.
Matsuyama, K., 1992. Agricultural productivity, comparative advantage, and economic growth. Journal of Economic Theory 58, 317–334.
Mehrotra, S., 1990. India and the Soviet Union: Trade and Technology Transfer. Cambridge Univ. Press, Cambridge.
Nuxoll, D.A., 1994. Differences in relative prices and international differences in growth rates. American Economic Review 84, 1423–1436.
O'Rourke, K.H., 2000. Tariffs and growth in the late nineteenth century. Economic Journal 110, 456–483.
Pritchett, L., Sethi, G., 1994. Tariff rates, tariff revenue, and tariff reform: some new facts. The World Bank Economic Review 8 (1), 1–16.
Rivera-Batiz, L.A., Romer, P.M., 1991a. Economic integration and endogenous growth. Quarterly Journal of Economics 106, 531–555.
Rivera-Batiz, L.A., Romer, P.M., 1991b. International trade with endogenous technological change. European Economic Review 35, 971–1004.
Rivera-Batiz, L.A., Xie, D., 1993. Integration among unequals. Regional Science and Urban Economics 23, 337–354.
Rodriguez, F., Rodrik, D., 2001. Trade policy and economic growth: a skeptic's guide to the cross-national evidence. In: Bernanke, B.S., Rogoff, K. (Eds.), NBER Macroeconomics Annual 2000. MIT Press, Cambridge. http://www.ksg.harvard.edu/rodrik/skepti1299.pdd.
Rodrik, D., 1999. The New Global Economy and Developing Countries: Making Openness Work. Overseas Development Council, Washington, DC.
Rodrik, D., 2000. Comments on Frankel and Rose, "Estimating the Effects of Currency Unions on Trade and Output". Harvard University. Unpublished paper, http://www.ksghome.harvard.edu/~.drodrik.academic.ksg/comments%20on%20Frankel-Rose.pdf.
Rodrik, D., 2001. Trading in illusions. Foreign Policy 123, 54–63 (Mar./Apr.).
Rodrik, D., Subramanian, A., Trebbi, F., 2002. Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development. Harvard University. Unpublished paper, http://www.ksghome.harvard.edu/~.drodrik.academic.ksg/institutionsrule,%205.0.pdf.
Romer, P.M., 1990. Endogenous technical change. Journal of Political Economy 98, S71–S102.
Sachs, J.D., Warner, A.M., 1995. Economic reform and the process of economic integration. Brookings Papers of Economic, 1–118.
Sachs, J.D., Warner, A.M., 1997a. Fundamental sources of long-run growth. American Economic Review 87, 184–188.
Sachs, J.D., Warner, A.M., 1997b. Natural resource abundance and economic growth. Center for International Development and Harvard Institute for International Development, p. 50.
Sala-i-Martin, X.X., 1997. I just ran two million regressions. American Economic Review 87, 178–183.
Summers, R., Heston, A., 1991. The Penn World Table (Mark 5): an expanded set of international comparisons, 1950–1988. Quarterly Journal of Economics 106, 327–368.
Temple, J., 1999. The new growth evidence. Journal of Economic Literature XXXVII, 112–156.
Triffin, R., 1976. Europe and the Money Muddle. Greenwood Press, Westport.
Trued, M.N., Mikesell, R.F., 1955. Postwar bilateral payments agreements. Princeton Studies in International Finance, vol. 4. Princeton Univ. Press, New Jersey.
World Bank, World Development Indicators 1999, CDROM.
Young, A., 1991. Learning by doing and the dynamics effects of international trade. Quarterly Journal of Economics 106, 369–405.