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Keywords: Information and Communication Technology (ICT); Emerging Market Economy (EME); Exports; Imports; Telecom investment; Internet bandwidth; Internet subscriptions; Internet hosts

JEL Classification: F12; F14; F15

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1 Introduction

Information and communications technology (ICT) has pervasive effects at micro as well as macro level of an economy. Some macro-level studies (e.g., Gordon 2000; Bailey and Lawrence 2001; Jorgenson 2001; Stiroh 2002) show that ICT advances in the 1990s raised productivity and contributed to growth. The use of ICT has been shown to have important implications for employment and wage as well. Several studies (e.g. Autor et al. 1998, 2003; Acemoglu and Autor 2010) argue that ICT has increased the demand for skilled workers and has been largely responsible for growing wage gap between skilled and unskilled workers. Although there are a few exceptions, most of these studies focus on the U.S. and other developed countries.[1]

This paper examines the effects of ICT on exports and imports in emerging market economies (EMEs). There are several intuitively plausible channels through which ICT may affect the flows of international trade. First, the use of ICT may reduce the fixed entry cost into a market and thus stimulates exports. As Freund and Weinhold (2004) discuss, these fixed costs include the costs of finding out information about the market (search cost), advertising, and establishing a distribution network. Second, international transactions often require advance planning that involves handling uncertainty. Some of these uncertainties are associated with the delay in acquiring and transmitting relevant information. The ICT advances reduce such delays and make planning more efficient and accurate. Consequently, the volume of trade between countries is expected to go up. Finally, ICT may directly facilitate international trade in services, particularly information-intensive services.[2] These services involve creating, processing, and communicating information. As ICT advances lower the costs of these processes, information-intensive services can be produced and delivered anywhere in the world. Furthermore, ICT facilitates global disaggregation of the production process for information-intensive services and thereby increases trade in those services.[3]

There have been a few studies that examine the effects of ICT on trade. For example, Freund and Weinhold (2002) investigate how the Internet affects international trade in services. They consider U.S. trade in 14 service industries from 1995 to 1999 and find that Internet development in

[1] Haacker (2010) examines the effects of ICT equipment investment on growth for low and lower middle income countries. In a recent paper, Dimelis and Papaioannou (2011) investigate the effects of ICT on aggregate technical efficiency for a group of 42 countries that include both developed and developing countries.

[2] Examples of such services include various customer services, education, medical transcriptions, tax returns, web design etc.

[3] See Apte and Mason (1995) and Mithas and Whitaker (2007) for a discussion on global disaggregation of information-intensive services.

countries that are trading partners with the U.S. in services trade facilitates increased trade with the U.S. They further extend this analysis to cover merchandise trade and to include 56 countries in a subsequent study (Freund and Weinhold 2004). In this article, they also include a theoretical model to explain how the Internet potentially affects trade. Using data for 98 countries, Clarke and Wallsten (2006) further show that access to the Internet improves export performance in developing countries and they export more to developed countries. More recently, Vemuri and Siddiqi (2009) analyze panel data for 64 countries for a period between 1985 and 2005 and conclude that ICT infrastructure and the availability of Internet for commercial transactions have a positive and significant impact on the volume of international trade. Choi (2010) provides further evidence of Internet usage raising services trade for 151 countries for a period from 1990 to 2006.

In contrast to the existing studies, we focus on the effect of ICT on both exports and imports in 40 emerging market economies (EMEs) during the period between1995 and 2010. These countries have witnessed substantial increases in trade and ICT adoption during this period and any evidence of a significant relationship between these two phenomena will have important policy implications. Most previous studies use the number of Internet hosts as the main independent variable of interest whereas we use four alternative variables that capture different aspects of ICT with the potential impact on trade. Furthermore, the studies mentioned above use bilateral trade between countries whereas we use total exports and total imports for each country in our sample. We also estimate the export and import models separately for goods and services.

Thus, we estimate fixed effect models of exports and imports on ICT and other control variables. Our ICT variables include growth of telecom investment, international Internet bandwidth, Internet subscriptions per 100 people, and the number of Internet hosts per 100 people. We use the percentage share of total exports and of total imports in GDP as the dependent variables. Additionally, we consider the GDP share of exports and imports for goods and services separately. The main control variables are: GDP per capita growth, population growth, and the GDP growth for the rest of the world. The empirical results overwhelmingly suggest that Internet bandwidth, Internet subscriptions, and Internet hosts have significant positive impact on export shares while all four ICT variables including telecom investment growth have significant positive impact on import shares in emerging market economies. This result is robust across shorter sample period, a subsample of EMEs, alternative estimation method, and alternative model specifications.

The rest of the paper is organized as follows. Section 2 includes a detailed discussion of the data and methodology used for the empirical analysis presented in this study. In section 3, we present and discuss the empirical results. In the last section, we summarize and include a few concluding remarks.

2 Data and Methodology

2.1 Data

We compile a list of 40 EMEs from five different sources: the FTSE Group, Morgan Stanley Capital International (MSCI), Standard and Poor (S&P), Dow Jones (DJ), and Banco Bilbao Vizcaya Argentaria (BBVA) Research. We exclude a few countries that have been identified as EMEs by one or more of these agencies, primarily due to a lack of relevant data for those countries. Table 1 lists the countries in our sample and, for each country, indicates which agency (agencies) has (have) identified it as an EME in its (their) latest report (reports). Note that 19 countries have been listed as EMEs by each of these five agencies.[4]

[Insert Table 1]

For our empirical analysis, the main sources of data are the World Development Indicators (WDI) and the Global Development Finance (GDF), compiled and published by the World Bank, and the World Telecommunication ICT Indicator database compiled and maintained by the International Telecommunication Union (ITU). Annual data on total exports (of goods and services together) and total imports are available in both current prices and 2000 USD constant prices from WDI. However, exports and imports data on goods and services separately are available only in current USD prices. In order to convert the current price export and import values for goods and services into constant prices, we first calculate an export deflator and an import deflator from current and constant price total exports and imports data mentioned above. We then apply the export deflator to both goods and services exports and import deflator to both goods and services imports.[5] Our sample covers a period from 1995 to 2010. Although the choice is primarily dictated

[4] South Korea (Republic of Korea) has been listed as an EME by three of these five agencies. The FTSE group and S&P do not list it as an EME. By most measures, South Korea is at a much advanced stage of development.

[5] A common deflator for both goods and services exports (imports) may lead to overestimation or underestimation of the real values due to a potential change in relative prices between goods and services. However, it is not possible to apply separate deflators due to a lack of appropriate data.

by the earliest and the latest year for which data on some of the ICT variables are available, this is also the period that witnessed significant expansion of trade and use of ICT in most EMEs.

It is almost impossible to find a single measure of ICT that reflects all different aspects of this general-purpose technology.[6] Previous studies use the number of Internet hosts (Freund and Weinhold 2002 & 2004; Clarke and Wallsten 2006; Choi 2010) or/and the number of telephone lines, personal computers, and Internet users (Vemuri and Siddiqi 2009). We use four alternative variables that capture different aspects of ICT and have potential impact on the growth of exports and imports. These ICT variables are: total annual investment in telecom, international Internet bandwidth (Mega Bits per second), total fixed (wired) broadband Internet subscriptions per 100 people, and the number of Internet hosts per 100 people. While the first variable reflects the building of ICT infrastructure, the second variable is a measure of technical capability for international transmission of data and communications. In contrast, the third and fourth variables indicate proliferation of ICT uses for obtaining and transmitting information.

The availability of data on these variables varies across countries and over time. For some countries, data are missing for several years. The data on the number of Internet hosts are available only for six years between 1999 and 2004. The telecom investment data are available in current USD. It is almost impossible to find data on prices of telecom capital goods by countries. However, it may be noted that prices of most ICT capital equipment have declined worldwide over last two decades. Therefore, it is not unreasonable to use the communications equipment price indices for the U.S., obtained from the Bureau of Economic Analysis (BEA), as harmonized deflators to construct constant USD data on telecom investment for all countries in our sample.[7]

Besides these variables of interest, we use a number of control variables that include per capita GDP, population, and GDP of the rest of the world (World GDP – Home Country GDP), obtained from WDI. Although we include these three control variables in our baseline model specification, we consider additional control variables in our sensitivity analysis. For example, we obtain data on nominal exchange rates from Penn World Table 7 and convert them into real exchange rates by using the Consumer Price Index (CPI) data for the U. S. and the respective countries. The CPI data are available from WDI. Data on Foreign Direct Investment (FDI) net inflow in current USD, gross fixed investment in both current and constant USD, and average tariff rates (in percentages) are

[6] Because of its broader application across different sectors, ICT is referred to as a general-purpose technology. For example, see Basu and Fernald (2007).
[7] See Schreyer (2000) for details on using a harmonized deflator.

obtained from WDI and GDF. We use an investment deflator calculated from gross fixed investment data to convert FDI net inflow from current USD into constant USD. We also use a dummy variable to represent each country's WTO membership status.[8] Finally, data on political openness are obtained from the World Bank WGI project. Appendix Table A.1 includes a description of the variables along with the period of availability and the source of the data.

[Insert Table 2]

The summary statistics of the dependent variables, the ICT variables, and the control variables for the baseline specification are presented in Table 3. We use the percentage share of exports and imports in GDP as the dependent variable in our empirical model specifications.[9] For the sample period 1995 – 2010, exports account for an average of about 45% of GDP for the countries in our sample. While goods exports average about 36 %, services exports average about 9 % of GDP. With an average export share of 111 % and an average goods export share of 97 % of GDP, Malaysia tops the list of 40 EMEs in our sample. Argentina with about 10 % and 9 % respectively is at the bottom of the list. In services exports, Estonia is at the top with an average GDP share of about 25 % whereas Iran is at the bottom with an average share of 1.5 %. Over the sample period, imports account for an average of about 46 % of GDP for the countries in our sample. While goods imports average 37 %, services imports account for an average of 9 %. In total and goods imports, Malaysia and Argentina again occupy the top and bottom spots respectively. In services imports, Jordan tops the list while Brazil is at the bottom of the list. In terms of volatility of export and import share, Hungary, Nigeria, and Philippines witnessed some of the largest volatilities and South Africa, Bangladesh, Argentina, and Colombia experienced some of the least volatilities in different categories of exports and imports during the sample period.

In our model specifications, we include the growth rate of telecom investment while we use natural log of bandwidth, and number of internet subscriptions and internet hosts per 100 people.[10]

[8] While most countries are WTO members throughout the period of 1995-2010, certain countries like Bulgaria, China, Estonia, Jordan, Latvia, Lithuania, Oman, and Viet Nam joined WTO during that period.
[9] Clarke and Wallsten (2006) use export share in GDP as the dependent variable.
[10] The potential for unit root in the data generating process for telecom investment justifies the use of growth rate. We would not use growth rate or first difference for the remaining three ICT variables to be consistent with previous studies (Freund and Weinhold 2002; Clarke and Wallsten 2006) and, most importantly, since bandwidth represents technical capability and the other two variables are per 100 people basis, we would not suspect them to have unit roots. We conduct panel unit root tests on all these ICT variables. The conventional test procedures overwhelmingly reject the null of unit root for last three variables. For telecom investment, we have mixed results. However, we do not report the unit root test results and interested reader may obtain them from the authors.

The average growth rate of telecom investment during the sample period across the 40 EMEs is about 13 % that varies between a minimum of – 11 % in Argentina and a maximum of 67 % in Ukraine. The natural log of bandwidth averages at 7.57 with a maximum of 10.34 for Czech Republic and a minimum of 3.64 for Mauritius. The broadband Internet subscriptions average at 5.04 per 100 people that vary between a minimum of 0.05 for Bangladesh and a maximum of 19.79 for South Korea. The average number of the Internet host per 100 people is 0.64 with a maximum of 3.96 in South Korea and a minimum of 0.0004 in Bangladesh.

We include the major control variables in growth rates. The average per capita GDP growth rate for the countries in our sample over the sample period is about 3 % with China at the top with about 9 % and Colombia at the bottom with -0.38 percent. The average population growth rate is about 1 % with Kuwait growing at 3.3 % and Latvia declining at about 1 %. The world GDP grew at an average rate of 2.8% during 1995 -2010 with the highest growth of over 4% in 2000 and a decline of 2.2% in 2009.

[Insert Table 3]

In order to get a sense of how the ICT variables may be correlated with the trade variables, we calculate correlation coefficients. Table 3 presents the average correlation coefficients (averaged across countries) along with the minimum and maximum. The average correlations are all positive. However, they are stronger for Internet bandwidth, Internet subscriptions, and Internet hosts. In general, these correlations are stronger for goods trade than for services trade.

2.2 Methodology

We estimate fixed effects panel data models for our empirical analysis. We estimate two sets of equations: the first set for three export variables and the second for three import variables. The export variables are: percentage share of total exports in GDP, goods export share in GDP, and services export share in GDP. The import variables are: percentage share of total imports in GDP, goods import share in GDP, and services import share in GDP. On the right-hand side of these models, we include one of the ICT variables: telecom investment growth, natural log of bandwidth, Internet subscriptions per 100 people, and the Internet hosts per 100 people, together with other

control variables and country fixed effects.[11] Thus, we estimate a total of 24 models, with 6 models for each ICT variable. Overall, our model takes the following form:

$$S_{it} = \alpha_i + \beta' ICT_{it} + \gamma' Z_{it} + \varepsilon_{it}$$

where S_{it} is the percentage share of exports (or imports) in GDP for country *i* in year *t*; ICT_{it} is the ICT variable of interest; Z_{it} is the vector of control variables; α_i is the country fixed effect; *i* indexes country with $i = 1, 2, .., N$; and *t* indexes time with $t = 1, 2, .., T$.[12]

In the baseline specification, we choose per capita GDP growth, population growth, the rest of the world (ROW) GDP growth along with country fixed effects as the control variables. This is the most parsimonious specification that can be estimated with the most available data. This is also consistent with the gravity model that has been the workhorse of most empirical trade models.[13] However, unlike some other studies (e.g.,Vemuri and Siddiqui 2009), we include the growth rates of the first three control variables to avoid the potential spurious regression problem due to the presence of unit root in the data generating process for each of these variables.[14] We do not explicitly include distance in our model. Since we use total exports from one country to all its trading partners and total imports into one country from all its trading partners, unlike bilateral exports or imports between two countries in the previous studies, we may include an average distance between the country and all its trading partners. However, in our model specification, country fixed effect will capture the effect of this time-invariant average distance and, therefore, we do not include it separately. The growth of per capita GDP measures a country's economic growth that reflects improvements in standard of living. As a country grows, the import demand is expected to go up due to greater consumption and investment demand. However, the effect on exports is not clear a priori. While as growth takes place, the economy may increase its exports due to increased production, an increase in domestic demand may, however, compete with external demand and thereby lowers exports.

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[11] Due to potential multicollinearity among themselves, we do not include more than one ICT variables. They are highly correlated and when they are entered together, the estimated coefficients either become statistically insignificant or have the wrong signs.

[12] Note that, by including percentage share of exports and imports in GDP, we are focusing on "accelerated growth" or "accelerated decline" effects of ICT. If both exports (imports) and GDP grow (or decline) proportionately, there will be no change in the percentage share of exports (or imports) in GDP. Thus, a positive (or a negative) effect on export or import share indicates a growth (decline) accelerating effect of ICT.

[13] See, for example, Kimura and Lee 2006.

[14] Using conventional panel unit root tests, we find overwhelming evidence of unit root in the level of these variables. The unit root results are not reported but can be obtained from the authors.

Like per capita GDP growth, the effect of population growth on exports is ambiguous a-priori. While, by increasing labor supply, it may increase domestic production and exports, a growing population can reduce exports by creating domestic demand. However, population growth is likely to increase the demand for imports. The ROW GDP growth creates demand for exports from a country. The effect on imports is not quite clear. While economic growth in the rest of the world increases the supply of imports into a country, growth and higher standard of living in the rest of the world may crowd out some of these imports and the net effect is not clear. Although year fixed effects can potentially be included and have been used in several previous studies (e.g. Vemuri and Siddiqui 2009), we decide to exclude them from our baseline specification. The ROW GDP growth is expected to capture the effects of some of the time variant common events that affect all countries. Furthermore, the year dummies may be correlated with the ICT variables as the advances in ICT spread throughout the globe quickly and simultaneously.[15] However, we examine whether our results are robust to the inclusion of year dummies as part of our sensitivity analysis.

Although country fixed effects control for the time-invariant cross-sectional differences among the countries in our sample, the problem of heteroscedasticty may not completely go away. Therefore, we use the feasible generalized least squares (FGLS) method that controls for any remaining heteroscedasticity. We rely on pooled Durbin-Watson (DW) test statistics to examine if the estimated residuals are serially correlated. Furthermore, there may be concerns over cross-correlations across countries although ROW growth is expected to control for common factors to some extent. We therefore examine the correlation coefficient matrix of the residuals obtained from the FGLS estimates of our baseline models and find little evidence of correlation between the residuals across countries. Thus, we decide not to explicitly control for cross-correlation in the model estimation.

3 Empirical Results

3.1 The Baseline Model Estimation

As discussed above, the baseline specification includes an ICT variable, per capita GDP growth rate, population growth rate, ROW GDP growth rate, and country fixed effects. We first report the

[15] The correlation coefficient matrix of real ICT investment across countries show strong cross-sectional correlations, which confirms the co-movement if ICT investment across countries over years.

estimation results for the exports equations and then present the results for imports. We use all available data for 40 countries in our sample.

3.1.1 Exports

Table 4 presents the estimation results for the baseline model for exports. Column (1) - (4) include the coefficient estimates for regression equation with total export share in GDP as the dependent variable. Of all the ICT variables, telecom investment growth has a negative but statistically insignificant effect on export share. The coefficient estimates for the remaining three ICT variables, namely international Internet bandwidth, broadband Internet subscriptions per 100 people, and the number of Internet hosts per 100 people, are positive and statistically significant. Because of the way these variables have been included in the estimated equations, it is important to take caution in interpreting the coefficients. For example, since bandwidth is included as the natural log of total bandwidth (in Mega Bits per second), the estimated coefficient indicates that a 1 % increase in bandwidth increases the export share in GDP by 1 % point. In contrast, an increase in Internet subscriptions and Internet hosts per 100 people by 1 raises the export share by 0.83 and 1.64 % point respectively.

[Insert Table 4]

Among the control variables, per capita GDP growth has a significant positive effect on export share with telecom investment growth and Internet hosts as the relevant ICT variables; a significant negative effect with bandwidth, and a positive but statistically insignificant effect with Internet subscriptions. The growth of population has a negative but statistically insignificant effect on export share in the model with telecom investment while it has a positive and significant effect with the other three ICT variables. GDP growth in the rest of the world, which is expected to capture the growth of external demand, has a significant positive effect on export share when we use bandwidth and Internet subscriptions as the relevant ICT variables while it has a negative effect when we use telecom investment growth and internet host as the ICT variable but weakly significant only with telecom investment growth. Note that the magnitudes and signs of the coefficient estimates for each control variable cannot be directly compared to each other across these model specifications as the estimates are based on different samples depending on the data availability for corresponding ICT variables. As for the significance of the signs of their effects, the estimated coefficients for the

control variables reflect the net effects of various forces working in different directions as we have discussed in details in Section 2.

Column (5) – (8) include the coefficient estimates for the models with goods export share in GDP as the dependent variable while column (9) – (12) report the corresponding estimates for the models with services export share as the dependent variable. The coefficient estimates for the ICT variables in both sets of equations are qualitatively similar to those for total export shares except that the coefficient estimate for telecom investment growth is now positive (although not statistically significant) for services exports. The estimated coefficients for services exports are quantitatively much smaller. The effect of the growth of per capita GDP is positive significant in three of the four cases for goods exports while it is negative in three cases (statistically significant in one) for services exports. The coefficient estimates for population growth are positive and significant in only two cases for goods exports. GDP growth of the rest of the world has positive significant effects on goods exports in two cases and has positive effects on services exports in three cases and significant in two cases.

3.1.2 Imports

Table 5 presents the estimation results for the baseline model for imports. The coefficient estimates for the regression equation with total import share in GDP as the dependent variable are included in column (1) – (4). All ICT variables have significant positive impact on imports. The coefficient estimates are statistically significant at the 5 % significance level for telecom investment growth and at the 1 % significance level for each of the remaining three ICT variables. According to these coefficient estimates, a 1 % point increase in telecom investment growth increases the import share by 0.006 % point. Furthermore, a 1 % increase in Internet bandwidth raises the import share by 1.36 % point while as Internet subscriptions and Internet hosts increase by 1 per 100 people, import share rises by 0.88 % and 1.64 % point respectively.

[Insert Table 5]

Among the control variables, per capita GDP growth has a significant positive effect on import share in all four model specifications. Similarly, the coefficient estimates for population growth are positive and statistically significant in all four cases. GDP growth in the rest of the world has a significant negative effect on import share in the model with telecom investment as the relevant ICT variable while it has a positive effect in all the remaining three model specifications but statistically

significant at conventional levels of significance only when we use Internet bandwidth or Internet subscriptions as the ICT variable.

Column (5) – (8) include the coefficient estimates for the models with GDP share of goods imports as the dependent variable while column (9) – (12) report the corresponding estimates for the models with services import share as the dependent variable. The coefficient estimates for the ICT variables in both sets of equations are qualitatively similar to those for total import share equations. As in the case of exports, the estimated coefficients in the models for services imports are quantitatively much smaller. The effect of the per capita GDP growth is positive and statistically significant in all four cases for goods import share while it is negative in all four cases and statistically significant only in two cases for services import share. The coefficient estimates for population growth are positive and significant in all four cases for goods import share. For services import share, although the coefficients are positive, they are statistically significant only in two cases. The ROW GDP growth has a positive significant effect on goods import share only when bandwidth is used as the relevant ICT variable. In all other cases, the coefficient estimate is either negative significant or positive but statistically insignificant. Interestingly, the ROW GDP growth has a highly significant negative effect on services import share when the model is estimated with telecom investment growth or Internet host as the relevant ICT variable while it has a highly significant positive effect with bandwidth or Internet subscriptions as the ICT variable.

Overall, growth in telecom infrastructure does not seem to have any significant impact on the export shares. However, technical capability of the Internet as reflected in bandwidth and use of the Internet for acquiring and transmitting information as captured by Internet subscriptions and Internet hosts have a significant positive impact on export share. All four ICT variables including telecom investment growth have significant positive impact on the share of imports of both goods and services in the EMEs.

3.2 Sensitivity Analysis

In order to examine if the results with regards to the effects of ICT on exports and imports are robust, we conduct several experiments. *First*, we use a shorter sample period 2002 -2008 to estimate the baseline model. This period witnessed significant steady growth of both exports and imports in the EMEs in our sample. Also, there was substantial proliferation of ICT during this period. We cut off the sample period in 2008 because most countries experienced a large drop in their respective

international trade flows in 2009, primarily due to the global financial and economic crisis. *Second*, the countries in our sample have been classified as EMEs based on a wide range of criteria and, therefore, there are wide variations in their economic performances in terms of growth, international trade, and technology adoption. In order to have some uniformity among them, we pick 20 countries that are listed by at least three (out of five) agencies. The fact that they are classified as EMEs by multiple agencies suggests that some common criteria have been used and, therefore, we would expect more similarities among them than in the full sample. *Third*, the pooled Durbin-Watson statistics estimated for each specification in the previous section indicate that we cannot reject the null of no serial correlation in most cases. Therefore, we also estimate a dynamic version of the baseline model with 1-year lagged dependent variable on the right hand side.[16] *Fourth*, our empirical model is based on assumption that the causality runs from ICT to export and import shares. However, it is possible that exports and imports may also cause ICT.[17] Clarke and Wallsten (2006) and Vemuri and Siddiqi (2009) have extensively discussed the issue of reverse causality from trade to ICT. In order to take into account the potential endogeneity of ICT and per capita GDP growth, we use a panel GMM estimation method with lagged values of ICT variables and per capita growth as the instruments.[18]

Furthermore, since some previous studies (e.g., Vemuri and Siddiqui 2009) include time fixed effects, we also conduct an experiment that includes year dummies. However, when these fixed effects are included along with ROW GDP growth, the coefficient estimates for ROW growth become statistically insignificant in most cases, suggesting that there may be multicollinearity between ROW GDP growth and time fixed effects. Therefore, in this experiment, we drop ROW

[16] Since the lagged dependent variable is correlated with country fixed effects, the coefficient estimates are biased and inconsistent. However, our objective for this experiment is to examine if the estimates are qualitatively similar to our baseline estimates when we control for any potential autocorrelation in the error terms.

[17] In our model, at least in two cases it is unlikely that trade would cause ICT, For example, when we use the growth of telecom investment as the ICT variable, it is the growth between last year and the current year whereas the dependent variable - the export (import) share - is for the current year. Therefore, it is not intuitively clear how the export (import) share in current period will cause the growth in investment since last year. For the same reason, trade in current period does not seem to cause growth of per capita income between last year and the current year, a major control variable that we have included in our model. In order to verify this, we estimate fixed effects regression models of per capita GDP growth on export and import shares. The estimated coefficients are statistically insignificant. These results are held as evidence against the potential reverse causality from trade to per capita GDP growth. Note that there is a substantial literature (e.g., Frankel and Romer 1999) that argues that trade causes growth. Furthermore, while an increase in export and import share may cause increases in Internet bandwidth and the number of Internet hosts, it does not seem to be the case with Internet subscriptions.

[18] Choi (2010) uses a similar method.

GDP growth. Finally, there are additional variables that may potentially affect trade. We estimate two models with additional variables. In the first specification, we include changes in real exchange rates, average tariff rates, and FDI share in total fixed investment as additional control variables. In the second specification, we include real exchange rates, FDI share in total fixed investment, WTO membership, a dummy variable for oil exporting countries, and political openness.[19] The exchange rate appreciation (depreciation) is expected to have a negative (positive) effect on exports and a positive (negative) effect on imports. Lower tariff rates reflect trade openness and are expected to have a direct positive effect on imports and an indirect positive effect on exports. As imports become cheaper, a country may increase imports of capital goods that enhance its ability to export. WTO membership also indicates trade openness and, therefore, we drop average tariffs from our second model. An increase in FDI share may increase trade as well. When FDI takes place, imports of capital goods rise and exports may also increase particularly when FDIs are of efficiency-seeking variety. We use a dummy variable with the value 1 if more than 30% of a country's exports are oil and 0 otherwise. Since exports of oil is the main source of revenue and foreign exchange reserves for these countries, their exports and imports will be heavily influenced by the fluctuations in oil exports. Therefore, we would like to control for a country being an oil exporter. Finally, a country with more political openness is expected to be more open to trade and investment. In general, there are other variables that may potentially affect exports and imports in a country. However, a lack of appropriate data is a formidable constraint against using these variables.

[Insert Table 6]

Since our objective is to check if the results with respect to the effects of ICT on trade are robust, we only report the coefficient estimates for the ICT variables from these experiments in Table 6. The first row of Panel A and B of Table 6 reproduces the estimated ICT coefficients from the baseline model estimates reported in Table 4 & 5 so that they can be compared with the results from the above experiments. When we estimate the baseline model with a shorter sample period: 2002 – 2008, the coefficient estimates are qualitatively similar except that the signs of the estimated coefficients for telecom investment growth change in export equations. Also, it becomes statistically significant in case of services exports. Furthermore, the effects of Internet bandwidth on total export share and on goods export share as well as the effects of bandwidth and internet subscriptions on total import share and goods import share are substantially larger. Note that there

[19] This specification is somewhat similar to Clark and Wallsten (2006).

were significant increases in international Internet bandwidth during this period of time which facilitated substantial data transfer that may have a significant positive impact on trade. The effects of the Internet hosts are positive and significant but quantitatively much smaller than in the baseline model. With only 20 EMEs, all the ICT variables have positive and statistically significant effects on export and import shares. The Internet subscriptions and internet hosts have slightly smaller effects on total export and import shares as well as on goods export and goods import shares than in the baseline estimation. However, all the ICT variables have quantitatively larger effects on services imports.

The coefficient estimates for the ICT variables are qualitatively very similar when we include 1-year lagged dependent variable. However, they are quantitatively much smaller. The GMM estimates with lagged values of the ICT variables as the instruments yield coefficient estimates that are qualitatively very similar but in most cases quantitatively larger than the baseline estimates. When the GDP growth in the rest of the world is replaced by a time fixed effects, most of the estimated coefficients are qualitatively similar to the baseline estimates but they are quantitatively smaller. Finally, when we include additional control variables, barring a few exceptions the coefficient estimates for the ICT variables are qualitatively similar to our baseline model estimates with both sets of additional control variables. For example, the coefficients of telecom investment growth in the import equations with both sets of additional control variables become statistically insignificant while they are positive and significant in the baseline estimation. Also, the coefficients of telecom investment growth in services export equation with the first set of additional control variables and in goods export equation with the second set of additional control variables turn out to be negative and statistically significant whereas they are insignificant in the baseline model.

The results from these experiments indicate that the significant positive impact of ICT as represented by international Internet bandwidth, the Internet subscription, and the Internet hosts on export and import share in emerging market economies is a robust result. In most cases, growth of investment in telecom services does not seem to affect trade share, particularly export share.

4 Concluding Remarks

This paper examines the effects of information and communications technology (ICT) on exports and imports in emerging markets. Using panel data for 40 EMEs for a period from 1995 to 2010, we

estimate fixed effects models of exports and imports on ICT and other control variables. Our ICT variables include growth of investment in telecom services, international Internet bandwidth, Internet subscriptions per 100 people, and the number of Internet hosts per 100 people. We use the percentage share of total exports and total imports in GDP as dependent variables. Additionally, we consider the GDP share of exports and imports for goods and services separately. The main control variables are: per capita GDP growth, population growth, and the GDP growth for the rest of the world. The empirical results overwhelmingly suggest that Internet bandwidth, Internet subscriptions, and Internet hosts have significant positive impact on export shares while all four ICT variables including telecom investment growth have significant positive impact on import shares in emerging market economies. This result is robust across shorter sample period, subsample of EMEs, and alternative model specifications.

The evidence of trade enhancing impact of ICT is particularly important for developing countries that have been trying to promote international trade. Policies that facilitate and encourage adoption and use of ICT will go a long way in boosting trade in those countries. The biggest advantage of ICT is that over the years the price of ICT has gone down substantially and it is relatively inexpensive to build the capacity for ICT adoption and use.

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Table 1 List of Emerging Market Economies (EMEs)

Country	FTSE	MSCI	S&P	Dow Jones	BBVA Research	Common
Argentina					x	
Bahrain					x	
Bangladesh					x	
Brazil	x	x	x	x	x	x
Bulgaria					x	
Chile	x	x	x	x	x	x
China	x	x	x	x	x	x
Colombia	x	x	x	x	x	x
Czech Republic	x	x	x	x	x	x
Egypt	x	x	x	x	x	x
Estonia					x	
Hungary	x	x	x	x	x	x
India	x	x	x	x	x	x
Indonesia	x	x	x	x	x	x
Iran					x	
Jordan					x	
South Korea		x		x	x	x
Kuwait					x	
Latvia					x	
Lithuania					x	
Malaysia	x	x	x	x	x	x
Mauritius					x	
Mexico	x	x	x	x	x	x
Morocco	x	x	x	x	x	x
Nigeria					x	
Oman					x	
Pakistan	x				x	
Peru	x	x	x	x	x	x
Philippines	x	x	x	x	x	x
Poland	x	x	x	x	x	x
Romania					x	
Russian	x	x	x	x	x	x
Slovak Republic					x	
South Africa	x	x	x	x	x	x
Sri Lanka					x	
Thailand	x	x	x	x	x	x
Tunisia					x	
Turkey	x	x	x	x	x	x
Ukraine					x	
Viet Nam					x	

Note: This list has been compiled from the latest reports published by various agencies listed in the top row. The last column "Common" indicates that a country has been identified as an EME by at least three agencies.

Table 2 Summary statistics of the major variables

Variables	Mean			Standard Deviation		
	Overall	Min	Max	Overall	Min	Max
% share of exports in GDP	44.84	10.39 (Argentina)	111.26 (Malaysia)	24.65	0.73 (South Africa)	24.82 (Hungary)
% share of goods exports in GDP	35.55	8.79 (Argentina)	97.38 (Malaysia)	21.04	0.61 (South Africa)	27.55 (Nigeria)
% share of services exports in GDP	9.03	1.50 (Iran)	25.35 (Estonia)	6.34	0.07 (Bangladesh)	6.37 (Philippines)
% share of import in GDP	45.62	11.31 (Argentina)	95.87 (Malaysia)	24.35	0.88 (Argentina)	23.70 (Hungary)
% share of goods import in GDP	37.25	8.41 (Argentina)	77.16 (Malaysia)	20.03	0.59 (Bangladesh)	21.59 (Hungary)
% of services import in GDP	8.52	2.62 (Brazil)	17.84 (Jordan)	4.91	0.12 (Colombia)	9.04 (Nigeria)
Telecom investment growth	12.52	-10.86 (Argentina)	67.15 (Ukraine)	62.74	3.72 (Vietnam)	194.53 (Nigeria)
Log of Internet bandwidth	7.57	3.64 (Mauritius)	10.34 (Czech Republic)	3.31	1.1 (Bahrain)	4.60 (Bulgaria)
Internet subscriptions per 100 people	5.04	0.05 (Bangladesh)	19.79 (South Korea)	6.49	0.03 (Bangladesh)	13.43 (Russian Federation)
Internet hosts per 100 people	0.64	0.0004 (Vietnam)	3.96 (South Korea)	1.24	0.0002 (Vietnam)	4.53 (South Korea)
Per capita GDP growth	2.96	-0.38 (Colombia)	8.65 (China)	4.13	0.50 (Bangladesh)	8.03 (Ukraine)
Population growth	0.96	-0.89 (Latvia)	3.29 (Kuwait)	1.10	0.02 (Vietnam)	1.54 (Kuwait)
Rest of the world GDP growth	2.78	-2.2 (2009 rate)	4.12 (2000 rate)	1.65	--	-- --

Note: The name of the country that has the minimum or the maximum value of the relevant variable is in bracket.

Table 3 Average correlations between trade variables and ICT variables across 40 EMEs, 1995 - 2010

	Telecom Investment Growth	Natural log of Internet bandwidth	Internet subscriptions per 100 people	Internet hosts per 100 people
	(1)	(2)	(3)	(4)
Export share	0.008 (-0.45, 0.69)	0.43 (-0.83, 0.97)	0.48 (-0.97, 0.96)	0.47 (-0.80, 0.99)
Goods export share	0.02 (-0.73, 0.67)	0.51 (-0.93, 0.97)	0.51 (-0.95, 0.95)	0.53 (-0.95, 0.99)
Services export share	0.04 (-0.60, 0.94)	0.35 (-0.93, 0.98)	0.29 (-0.93, 0.94)	0.19 (-0.90, 0.92)
Import share	0.11 (-0.51, 0.88)	0.43 (-0.86, 0.96)	0.40 (-0.90, 0.97)	0.49 (-0.88, 0.998)
Goods import share	0.15 (-0.67, 0.86)	0.48 (-0.91, 0.95)	0.44 (-0.80, 0.98)	0.44 (-0.97, 0.99)
Services import share	0.03 (-0.86, 0.62)	0.25 (-0.995, 0.94)	0.24 (-0.86, 0.95)	0.30 (-0.80, 0.95)

Note: The minimum and maximum correlation coefficients are in parentheses. Since data on some ICT variables are available only for 2 to 3 years in Iran, Kuwait, and Vietnam, the correlation coefficients with trade variables are 1 (perfect correlation). However, we do not report those correlation coefficients as the maximum values because they are outliers.

Table 4 ICT and export share: Fixed effects panel estimates for 40 EMEs

Independent Variables	Dependent Variables											
	Export share				Goods export share				Services export share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Telecom investment Growth	-0.0004				-0.001				0.0004			
	(0.002)				(0.002)				(0.0004)			
Natural log of Internet bandwidth		1.00***				1.25***				0.13***		
		(0.103)				(0.103)				(0.012)		
Internet subscription per 100 people			0.83***				0.86***				0.08***	
			(0.069)				(0.065)				(0.007)	
Internet hosts per 100 people				1.64***				1.64***				1E-13***
				(0.103)				(0.089)				(2E-14)
Per capita GDP growth	0.09**	-0.07**	0.07	0.37***	0.15**	-0.05**	0.08***	0.36***	-0.007	-0.02**	-0.0001	0.01**
	(0.039)	(0.032)	(0.057)	(0.092)	(0.064)	(0.025)	(0.026)	(0.084)	(0.007)	(0.012)	(0.004)	(0.005)
Population growth	-0.19	0.90***	0.89***	1.55***	-0.14	1.77***	-0.13	1.08***	-0.0002	0.06	0.04	-0.04
	(0.341)	(0.189)	(0.296)	(0.427)	(0.443)	(0.422)	(0.545)	(0.241)	(0.070)	(0.084)	(0.078)	(0.040)
Rest of the world (ROW) GDP growth	-0.26*	0.51***	0.42***	-0.11	-0.20	0.53***	0.43***	-0.007	-0.05**	0.04**	0.01	0.03*
	(0.146)	(0.103)	(0.101)	(0.112)	(0.123)	(0.091)	(0.083)	(0.106)	(0.022)	(0.015)	(0.011)	(0.019`)
R-squared	0.965	0.969	0.971	0.992	0.939	0.973	0.985	0.987	0.982	0.984	0.982	0.991
Adj R-squared	0.961	0.966	0.968	0.990	0.932	0.970	0.984	0.984	0.980	0.982	0.979	0.989
Durbin-Watson stat	0.671	0.679	0.860	1.454	0.301	0.712	0.689	1.401	0.786	0.871	0.857	1.338
Number of observations	444	492	447	240	430	463	430	234	430	463	430	234
Number of countries	40	40	40	40	40	40	40	40	40	40	40	40

Note:***Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors are reported in parentheses.

Table 5 ICT and import share: Fixed effects panel estimates for 40 EMEs

Independent Variables	Dependent Variables											
	Import share				Goods import share				Services import share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Telecom investment Growth	0.006**				0.009***				0.001**			
	(0.003)				(0.003)				(0.0005)			
Natural log of Internet bandwidth		1.36***				1.33***				0.13***		
		(0.161)				(0.182)				(0.009)		
Internet subscriptions per 100 people			0.88***				0.82***				0.09***	
			(0.092)				(0.086)				(0.007)	
Internet hosts per 100 people				1.64***				1.30***				0.16***
				(0.254)				(0.254)				(0.023)
Per capita GDP growth	0.34***	0.22***	0.33***	0.39***	0.22***	0.20***	0.33***	0.31***	-0.002	-0.03***	-0.03**	-0.006
	(0.082)	(0.054)	(0.090)	(0.060)	(0.065)	(0.042)	(0.024)	(0.042)	(0.009)	(0.009)	(0.014)	(0.007)
Population growth	1.04***	0.78**	1.09***	1.48**	0.58*	1.93***	2.03***	0.59*	0.02	0.01	0.10**	0.15**
	(0.368)	(0.311)	(0.276)	(0.660)	(0.309)	(0.586)	(0.556)	(0.310)	(0.064)	(0.052)	(0.043)	(0.074)
Rest of the world (ROW) GDP growth	-0.43***	0.37**	0.27*	0.18	-0.34***	0.42**	0.23	0.18	-0.06***	0.04***	0.05***	-0.09***
	(0.145)	(0.164)	(0.140)	(0.263)	(0.102)	(0.191)	(0.145)	(0.196)	(0.020)	(0.010)	(0.014)	(0.030)
R-squared	0.964	0.961	0.967	0.987	0.964	0.955	0.973	0.986	0.980	0.970	0.966	0.989
Adjusted R-squared	0.960	0.957	0.963	0.984	0.960	0.950	0.970	0.983	0.978	0.967	0.963	0.986
Durbin-Watson Stat	0.642	0.681	0.699	1.388	0.680	0.812	0.882	1.434	0.624	0.676	0.761	1.396
Number of Observations	444	492	447	240	430	463	430	234	430	463	430	234
Number of Countries	40	40	40	40	40	40	40	40	40	40	40	40

Note: ***Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors are in parentheses.

Table 6 Sensitivity analysis results

Panel A

Experiment	Export Share				Goods Export Share				Service Export Share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	TI	BD	IS	IH	TI	BD	IS	IH	TI	BD	IS	IH
Baseline Model	-0.0004	1.00***	0.83***	1.64***	-0.001	1.25***	0.86***	1.64***	0.0004	0.13***	0.08***	1E-13***
	(0.002)	(0.103)	(0.069)	(0.103)	(0.002)	(0.103)	(0.065)	(0.089)	(0.0004)	(0.012)	(0.007)	(2E-14)
Sample period: 2002-2008	0.002	1.10***	0.71***	0.63***	0.008**	1.47***	0.93***	0.49***	0.002***	0.23***	0.09***	3E-13***
	(0.002)	(0.071)	(0.090)	(0.048)	(0.003)	(0.054)	(0.066)	(0.018)	(0.0008)	(0.016)	(0.012)	(5E-14)
20 countries	0.004	1.54***	0.81***	1.68***	0.004	1.62***	0.86***	1.59***	0.0006	0.16***	0.08***	2E-13***
	(0.005)	(0.180)	(0.074)	(0.127)	(0.005)	(0.159)	(0.067)	(0.146)	(0.0009)	(0.019)	(0.008)	(3E-14)
With 1-year lagged dependent variable	-0.002	0.17***	0.10***	0.89***	-0.002	0.25***	0.10***	0.96***	0.0007**	0.04***	0.02*	1E-13***
	(0.001)	(0.043)	(0.031)	(0.119)	(0.002)	(0.046)	(0.036)	(0.192)	(0.0003)	(0.010)	(0.010)	(3E-14)
GMM estimates with instruments	0.05	1.42***	1.17***	1.47***	0.11	1.60***	1.20***	1.69***	-0.004	0.25***	0.12***	0.04
	(0.035)	(0.166)	(0.116)	(0.415)	(0.072)	(0.169)	(0.123)	(0.587)	(0.010)	(0.031)	(0.020)	(0.075)
With year fixed effects	-0.01*	-0.23	0.73***	0.72***	-0.01	0.18	0.68***	0.77***	0.0004	0.06	0.08***	5E-14*
	(0.007)	(-0.678)	(0.155)	(0.000)	(0.008)	(0.743)	(0.129)	(0.084)	(0.001)	(0.100)	(0.017)	(3E-14)
Additional variables 1	0.0007	1.42***	0.82***	1.68***	0.002	1.66***	0.95***	1.77***	-0.001***	0.12***	0.07***	8E-14***
	(0.002)	(0.140)	(0.055)	(0.191)	(0.002)	(0.148)	(0.054)	(0.201)	(0.0005)	(0.014)	(0.009)	(2E-14)
Additional variables 2	-0.002	0.90***	0.74***	1.21***	-0.004**	1.10***	0.71***	1.23***	-0.0003	0.13***	0.08***	2E-13***
	(0.002)	(0.097)	(0.037)	(0.137)	(0.002)	(0.106)	(0.041)	(0.113)	(0.0005)	(0.013)	(0.008)	(3E-14)

Note: 1. TI: Telecom investment growth; BD: Internet bandwidth; IS: Internet subscriptions; IH: Internet hosts.

2. ***Significant at 1% level; ** significant at 5% level; * significant at 10% level; Robust standard errors are in parentheses.
3. Additional control variables: change in real exchange rate, percentage of FDI in fixed domestic investment and average tariffs are included in Additional variables 1.
4. Additional control variables: change in real exchange rate, percentage of FDI in fixed domestic investment, WTO memberships, oil exporters (countries whose oil export exceeds 30% of the total export), and political openness are included in Additional Variable 2.

Table 6 Sensitivity analysis results
Panel B

Experiment	Import Share				Goods Import Share				Service Import Share			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	TI	BD	IS	IH	TI	BD	IS	IH	TI	BD	IS	IH
Baseline Model	0.006**	1.36***	0.88***	1.64***	0.009***	1.33***	0.82***	1.30***	0.001**	0.13***	0.09***	0.16***
	(0.003)	(0.161)	(0.092)	(0.254)	(0.003)	(0.182)	(0.086)	(0.254)	(0.0005)	(0.009)	(0.007)	(0.023)
Sample period: 2002-2008	0.005	2.67***	1.40***	0.16***	0.02***	2.50***	1.34***	0.13***	0.003***	0.20***	0.11***	0.03***
	(0.004)	(0.077)	(0.070)	(0.029)	(0.003)	(0.078)	(0.077)	(0.040)	(0.0006)	(0.010)	(0.007)	(0.007)
20 countries	0.02***	1.50***	0.74***	1.17***	0.01***	1.34***	0.65***	0.94***	0.0002	0.16***	0.10***	0.19***
	(0.004)	(0.157)	(0.087)	(0.221)	(0.004)	(0.150)	(0.070)	(0.226)	(0.0008)	(0.018)	(0.009)	(0.033)
With 1-year lagged dependent variable	0.004**	0.29***	0.19***	1.28***	0.007***	0.36***	0.23***	0.81***	0.0009**	0.04***	0.02***	0.15***
	(0.002)	(0.052)	(0.031)	(0.277)	(0.002)	(0.051)	(0.023)	(0.233)	(0.0004)	(0.010)	(0.007)	(0.023)
IV estimation	0.016	1.70***	1.03***	1.56**	0.05	1.74***	1.02***	1.36**	-0.003	0.18***	0.12***	0.21***
	(0.023)	(0.158)	(0.117)	(0.690)	(0.045)	(0.156)	(0.105)	(0.565)	(0.014)	(0.031)	(0.018)	(0.071)
With year fixed effects	-0.010*	1.51***	0.63***	0.62***	-0.007	1.19*	0.51***	0.51***	0.002	0.004	0.11***	0.08**
	(0.005)	(0.532)	(0.101)	(0.110)	(0.006)	(0.615)	(0.076)	(0.154)	(0.001)	(0.103)	(0.017)	(0.032)
Additional variables 1	0.004	1.72***	0.32***	2.06***	0.008**	1.76***	0.86***	1.69***	0.001**	0.10***	0.08***	0.09***
	(0.003)	(0.195)	(0.093)	(0.330)	(0.004)	(0.193)	(0.071)	(0.358)	(0.0006)	(0.012)	(0.008)	(0.023)
Additional variables 2	0.004	1.19***	0.80***	1.32***	0.009**	1.14***	0.68***	1.01***	0.001*	0.12***	0.08***	0.10***
	(0.003)	(0.170)	(0.086)	(0.186)	(0.004)	(0.186)	(0.066)	(0.229)	(0.0007)	(0.012)	(0.007)	(0.036)

Note: 1. TI: Telecom investment growth; BD: Internet bandwidth; IS: Internet subscriptions; IH: Internet hosts.

2. ***Significant at 1% level; ** significant at 5% level; * significant at 10% level; Robust standard errors are in parentheses.
3. Additional control variables: change in real exchange rate, percentage of FDI in fixed domestic investment and average tariffs are included in Additional variables 1.
4. Additional control variables: change in real exchange rate, percentage of FDI in fixed domestic investment, WTO memberships, oil exporters (countries whose oil export exceeds 30% of the total export), and political openness are included in Additional Variable 2.

Table A.1 Variables Description

Variable name	Variable description	Years available	Data source
Telecom Investment	Gross investment in Telecom in current USD.	1995-2010	International Telecommunication Union
Internet bandwidth	Total capacity of international Internet bandwidth in Mega Bits Per Second (Mbit/s).	1995-2010	International Telecommunication Union
Internet subscriptions	The number of total Internet subscriptions with fixed (wired) Internet access.	1995-2010	International Telecommunication Union
Internet hosts	The total number of Internet Hosts.	1999-2004	International Telecommunication Union
Total export	Exports of goods and services in constant 2000 US$.	1995-2010	World Development Indicators (WDI)
Total import	Imports of goods and services in constant 2000 US$.	1995-2010	World Development Indicators (WDI)
Total goods export	Goods exports, BoP, in current US$	1995-2010	World Development Indicators (WDI)
Total goods import	Goods imports, BoP, in current US$	1995-2010	World Development Indicators (WDI)
Total services export	Service exports, BoP, in current US$	1995-2010	World Development Indicators (WDI)
Total services import	Service imports, BoP, in current US$	1995-2010	World Development Indicators (WDI)
GDP per capita	GDP per capita in constant 2000 US$	1995-2010	World Development Indicators (WDI)
Local GDP	Local GDP in constant 2000 US$	1995-2010	World Development Indicators (WDI)
World GDP	World GDP in constant 2000 US$	1995-2010	World Development Indicators (WDI)
Population	Total population	1995-2010	World Development Indicators (WDI)
Exchange rate	Nominal exchange rate	1995-2010	Penn World Table 7
FDI net inflow	Net inflows of Foreign direct investment, BoP, in current US$	1995-2010	the Global Development Finance (GDF)
Fixed domestic investment	Gross fixed capital formation in constant 2000 US$	1995-2010	the Global Development Finance (GDF)
Tariffs	Simple average of tariff rate in percentages, applied on all products	1995-2010	World Development Indicators (WDI)
Consumer price index	Consumer price index , 2005 = 100	1995-2010	World Development Indicators (WDI)
WTO membership	=1 if country is a WTO membership	1995-2010	World Trade Organization
Political openness	Voice and accountability	1996, 1998, 2000, 2002-2010	World Bank, WGI project
Oil export	Value of oil exports in current US$	1995-2010	International Monetary Fund