THE EFFECTS OF KNOWLEDGE AND TECHNOLOGY VARIABLES ON TERMS OF TRADE

BİLGİ VE TEKNOLOJİ DEĞİŞKENLERİNİN TİCARET HADLERİ ÜZERİNE ETKİSİ

Dr. Ali ŞEN[1]
Dr. Fatih ÇELEBİOĞLU[2]
Dr. Hüseyin ALTAY[3]

ABSTRACT

This paper examines the role of knowledge and technology variables in determining terms of trade in emerging market countries and developed countries. The empirical analysis is used data set of 22 emerging markets and 15 developed countries from 2001 to 2005. The results have showed that: (1) the changes of knowledge and technology variables are more significant in explaining both developed countries' terms of trade and their net trade; (2) with including non-technological variables, model's explaining power has increased for emerging markets, whereas it has decreased for developed countries; (3) the effects of knowledge and technology variables on net trade are less important in both countries groups.

ÖZET

Bu çalışma, yükselen piyasa ülkelerinde ve gelişmiş ülkelerde ticaret hadlerinin belirlenmesinde bilgi ve teknoloji değişkenlerinin rolünü inceler. Ampirik analiz, 2001–2005 yılları arasında 22 yükselen piyasa ve 15 gelişmiş ülkenin veri seti kullanılmıştır. Sonuçlara göre, (1) bilgi ve teknoloji değişkenlerinde değişiklikler, gelişmiş ülkelerin hem dış ticaret hadlerini hem de net dış ticaretlerini açıklamada daha anlamlıdır; (2) teknoloji dışı değişkenlerin ilave edilmesiyle, modelin açıklama gücü yükselen piyasalar için artarken gelişmiş ülkeler için azalmıştır; (3) bilgi ve teknoloji değişkenlerinin dış ticaret üzerindeki etkisi her iki ülke grubunda da az önemlidir.

Terms of trade, net trade, knowledge and technology variables.
Dış ticaret hadleri, net ticaret, bilgi ve teknoloji değişkenleri.

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[1] Department of Economics, Dumlupinar University, Kutahya. e-mail: alisen71@mynet.com
[2] Department of Economics, Dumlupinar University, Kutahya. e-mail: fcelebi@dumlupinar.edu.tr
[3] Department of Economics, Bilecik University, Bilecik. e-mail: haltay16@hotmail.com

1. INTRODUCTION

There has been considerable interest in the effects of knowledge and technological progress on international trade. This progress has highly affected the international trade since World War II. Quality of knowledge and technological change has also played a part in the increase of this effect.

The composition of technological activities differentiated in the 1970s and 1980s. In the 1970s, countries, which developed technologically, got active different in technological fields, though in the 1980s technical change mostly proceeded faster in specific technological fields. Also in the 1980s they were mostly concentrated on ICTs and in the classes related to instrumentation technologies, such as new materials and biotechnology (Meliciani, 2001: 3-5).

Economists generally believe that knowledge and technological change is an important factor in the international trade. Keesing (1967: 45) tested the effects of R&D activities on American competitive ability in manufacturing industries and compared with other hypotheses advanced to explain American trade patterns. He found a powerful correlation between R & D activities in American industries and their export performance. Gruber and others (1967: 33) tested whether there was a link between American exports and its research effort. They found typical evidence which relates the research effort by the U.S. industry to the U.S. trade performance. The relationship of the U.S. foreign trade level and composition of its R&D expenditures was reviewed by Mansfield and others (1979: 54-55). They found positive relation between two variables.

Baldwin (1971: 140-142) founded a significant positive relationship between the percentage of engineers and scientists, craftsmen, and farmers in an industry and export of the industry. He also indicated that research and development activities were more important in export than in import substitution. Krugman (1979: 263) has developed a model of international trade. The model assumed technical progress appear as a development of new products instead of increased productivity in the manufacture of old products. Grossman and Helpman (1994: 66-67) have surveyed the relationship between technology and trade. They asked how changes in technology affect trade and welfare. They have found differences in technological capabilities have much to offer trade.

Laursen (1997: 16) has explored the impact of technological change on trade at country level. He has demonstrated that there is a positive relationship between trade performance and technological change. Freunda and Weinhold (2004: 187) have presented a theoretical model of the impact of the Internet on international trade. Their model has showed that trade expand because fixed costs of entry into a foreign market are reduced. If the new technology reduces entry costs through Internet then export will increase. In their other paper (2002: 238-239), they also offered evidence that the Internet is related to the growth in services trade. Internet provides a medium of exchange that overcomes such trade barrier for many services,

such as reducing transport costs. Andersson and Ejermo (2006: 19-20) have examined how technology specialization affects trade flows. They found that investments in technology and knowledge can create comparative advantages.

These papers generally have focused on the effects of certain knowledge and technological variables on international trade. However our paper has a much more comprehensive variable set. It also includes non technological variables, such as interest rate, exchange rate, and inflation. Thus we can compare the effects of both variable sets on foreign trade. These current researches only analyses the effects of knowledge and technology variables on foreign trade. Our paper also differs from the others that it has multi-numbered variables and examines their effects on terms of trade.

Our paper is concerned with the effect of a wide variety of knowledge and technological elements on the terms of trade and the net trade. The purpose of this paper is to provide a broad empirical characterization of the determinants of terms of trade and net trade for a sample of developed countries and emerging markets. Gross Barter Terms of Trade has been used instead of terms of trade in model. The gross barter terms of trade is the ratio (expressed as a percent) of a quantity index of exports to a quantity index of inputs. Net trade in goods is the difference between exports and imports of goods.

Improvement in gross barter terms of trade means to import more goods versus to export one unit goods. In spite of improvement in gross barter terms of trade, net trade may worsen. That is, improves in gross barter terms of trade of a country may have reduced foreign exchange returns. On the contrary, deterioration of gross barter terms of trade may have increased foreign exchange returns. Because of the development of knowledge and technology enhances quality and/or productivity, net trade is affected from this situation.

Remaining of this paper is organized as follows. The next section discusses the data, model and empirical results. Conclusions are given in the last section.

2. DATA, MODEL AND EMPIRICAL RESULTS

2.1. Data and Model

Dataset has been drawn from the World Bank WDI (World Development Indicator) and IFS (International Financial Statistics) online database, at the annual frequency. We use a panel of 110 annual observations from 22 emerging markets and also a panel of 75 annual observations from 15 OECD countries over the period 2001–2005.

In this paper two different country groups have been used. The first has been selected from countries in MSCI (Morgan Stanly Capital International) Emerging Market Index. Three countries (The Czech Republic,

Russia and Taiwan) have been excluded because of data inadequacy. The model includes: Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Israel, Jordan, South Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, South Africa, Thailand and Turkey (http://www.msci.com/equity/indexdesc.html). The second group consists of fifteen OECD countries (Australia, Belgium, Canada, Denmark, France, Ireland, Italy, Japan, Netherlands, New Zealand, Sweden, Norway, Spain, England and USA). Some countries (The Czech Republic, Hungary, South Korea, Mexico, Poland and Turkey) have been excluded since they are also included in the emerging markets. Some countries have also been excluded (Austria, Germany, Greece, Luxemburg, Portugal, Slovakia, Switzerland and Finland) because of data inadequacy.

Variable definitions and data sources are presented in the Appendix. We used two different dependent variables in models. The first dependent variable is gross barter terms of trade; the second is net trade. All variables are measured in annual percent change.

The variables in regressions have been symbolized: (y_1) is the dependent variable (gross barter terms of trade) for knowledge and technological variables; (Y_1) is the dependent variable (gross barter terms of trade) for knowledge and technological variables and non-technological variables; (y_2) is the dependent variable (net trade) for knowledge and technological variables; (EM) is emerging markets; (DC) is developed countries; (tert) is expenditure per student, tertiary (% of GDP per capita); (ict) is information and communication technology expenditure (current US$); (band) is international internet bandwidth (bits per person); (intuser) is internet users (per 1,000 people); (patnon) is patent applications, non resident; (patres) is patent applications, residents, (researcher) is researchers in R&D (per million people); (rp) is royalty and license fees, payments (BoP, current US$), (rr) is royalty and license fees, receipts (BoP, current US$); (rd) is research and development expenditure (both public and private); (fdi) is foreign direct investment, net inflows (% of GDP); (grow) is GDP growth (annual %); (inf) is inflation, consumer prices (annual %); (exch) is real effective exchange rate index (2000 = 100); (int) is real interest rate (%); (cre) is domestic credit to private sector (% of GDP).

The regressions are as follows:

$$y_{1,EM} = \beta_0 + \beta_1 tert + \beta_2 ict + \beta_3 band + \beta_4 \operatorname{int} user + \beta_5 patnon + \beta_6 patres$$
$$+ \beta_7 researcher + \beta_8 rp + \beta_9 rr + \beta_{10} rd \qquad (1)$$

Above regression $(y_{1,EM})$ demonstrates the relationship between knowledge and technological variables and gross barter terms of trade in EM. Below regression shows the relationship among all variables (knowledge, technology and non-technology) and gross barter terms of trade in EM.

$$Y_{1,EM} = \beta_0 + \beta_1 tert + \beta_2 ict + \beta_3 band + \beta_4 \text{ int } user + \beta_5 patnon + \beta_6 patres$$
$$+ \beta_7 researcher + \beta_8 rp + \beta_9 rr + \beta_{10} rd + \beta_{11} fdi + \beta_{12} grow + \beta_{13} \inf$$
$$+ \beta_{14} exch + \beta_{15} \text{int} + \beta_{16} cre \qquad (2)$$

Next regression reveals relationship between knowledge and technological variables and net trade in EM.

$$y_{2,EM} = \beta_0 + \beta_1 tert + \beta_2 ict + \beta_3 band + \beta_4 \text{ int } user + \beta_5 patnon + \beta_6 patres$$
$$+ \beta_7 researcher + \beta_8 rp + \beta_9 rr + \beta_{10} rd \qquad (3)$$

The regression (4) displays relationship between knowledge and technological variables and gross barter terms of trade in DC.

$$y_{1,DC} = \beta_0 + \beta_1 tert + \beta_2 ict + \beta_3 band + \beta_4 \text{ int } user + \beta_5 patnon + \beta_6 patres$$
$$+ \beta_7 researcher + \beta_8 rp + \beta_9 rr + \beta_{10} rd \qquad (4)$$

The regression (5) shows relationship between all variables (knowledge, technology and non-technology) and gross barter terms of trade in DC.

$$Y_{1,DC} = \beta_0 + \beta_1 tert + \beta_2 ict + \beta_3 band + \beta_4 \text{ int } user + \beta_5 patnon + \beta_6 patres$$
$$+ \beta_7 researcher + \beta_8 rp + \beta_9 rr + \beta_{10} rd + \beta_{11} fdi + \beta_{12} grow + \beta_{13} \inf$$
$$+ \beta_{14} exch + \beta_{15} \text{int} + \beta_{16} cre \qquad (5)$$

The regression (6) displays relationship between knowledge and technological variables and net trade in DC.

$$y_{2,DC} = \beta_0 + \beta_1 tert + \beta_2 ict + \beta_3 band + \beta_4 \text{ int } user + \beta_5 patnon + \beta_6 patres$$
$$+ \beta_7 researcher + \beta_8 rp + \beta_9 rr + \beta_{10} rd \qquad (6)$$

2.3. Empirical Results

We worked with a panel data set that contains annual percent change of the data for each country and we used OLS specifications for our baseline results. Table 1 shows results from panel OLS regressions for emerging markets (EM) and developed countries (DC). The first column of Table 1 shows the results for emerging markets, while the second shows the results from regressions in developed countries, respectively.

Table 1: Panel data regressions (Dependent Variable — Gross Barter Terms of Trade)

Knowledge and Technology Variables	Emerging Markets	Developed Countries
Expenditure per student, tertiary (% of GDP per capita)	-0.243* (0.099)	-0.169 (0.057)
Information and communication technology expenditure (current US$)	0.921*** (0.166)	-
International Internet bandwidth (bits per person)	-	0.620*** (0.008)
Internet users (per 1,000 people)	-	-
Patent applications, resident	-	0.831*** (0.097)
Patent applications, nonresidents	-0.292* (0.155)	0.556*** (0.019)
Researchers in R&D (per million people)	-	0.562*** (0.107)
Royalty and license fees, payments (BoP, current US$)	-	0.241 (0.029)
Royalty and license fees, receipts (BoP, current US$)	-0.274 (0.043)	-
Research and development expenditure (both public and private)	0.542*** (0.402)	-0.779*** (0.162)
Adjusted R squared	0.73	0.79
Number of observations	110	75
F	9.765	9.093

Notes: Standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

One of results that is carried over from the panel regressions is that, there is a strong positive relationship between only two of the independent variables (information and telecommunication technologies and research and development expenditures) and dependent variable (gross barter terms of trade) for emerging markets. The coefficients of these independent variables suggests that a 1 percentage point increase in the information and telecommunication technologies (ict) and research and development expenditures (rd) is associated with about a 0.92 and 0.54 percentage point increase in gross barter terms of trade (y_1), respectively. The coefficient estimates show that in EM, ict and rd provides a significant improvement in y_1. The effects of the same variables on net trade will be examined later. For DC, there is not any relation between ict and y_1. It appears to have been a strong but negative relationship between rd and y_1.

The relationship between patent applications, non residents (patnon) and y_1 is a significant for both country groups. However, the relationship is strong and positive for DC, weak and negative for EM. Expenditure per student, tertiary (tert) is a significant for EM but insignificant for DC. For EM, the relationship is both weak and negative. International internet bandwidth (band), patent applications, resident (patres) and researchers in R&D (researcher) are not only significant but also there is a strong positive association with y_1 for DC. Notwithstanding there is not a relationship for EM. There is no relationship for internet users (intuser) for both countries groups. There is not a relationship between royalty and license fees, payments (rp) and y_1 any for EM and it is insignificant for DC. There is an insignificant relation between royalty and license fees, receipts (rr) and y_1 for EM. There is no relation between rr and y_1 for DC.

Table 2: Panel data regressions (Dependent Variable — Gross Barter Terms of Trade)

All Variables	Emerging Markets	Developed Countries
Expenditure per student, tertiary (% of GDP per capita)	-0.131 (0.089)	-
Information and communication technology expenditure (current US$)	0.758** (0.255)	-
International Internet bandwidth (bits per person)	-	-0.037 (0.006)
Internet users (per 1,000 people)	-	-
Patent applications, resident	-0.283 (0.242)	0.715*** (0.082)
Patent applications, nonresidents	-0.225 (0.132)	0.551*** (0.019)
Researchers in R&D (per million people)	-	1.174*** (0.174)
Royalty and license fees, payments (BoP, current US$)	-0.207 (0.144)	-
Royalty and license fees, receipts (BoP, current US$)	-0.251 (0.047)	-0.104 (0.023)
Research and development expenditure (both public and private)	0.431** (0.386)	-0.699*** (0.128)
Foreign direct investment, net inflows (% of GDP)	-	0.419** (0.009)
GDP growth (annual %)	-0.216 (0.010)	-0.467** (0.002)
Inflation, consumer prices (annual %)	-	-0.790*** (0.030)
Real effective exchange rate index (2000 = 100)	-0.436* (0.088)	-0.265*** (0.100)
Real interest rate (%)	-0.314* (0.037)	0.383* (0.008)
Domestic credit to private sector (% of GDP)	-0.303* (0.195)	-
Adjusted R squared	0.87	0.76
Number of observations	110	75
F	10.864	7.016

Notes: Standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Adjusted R^2 is 0.73 for EM and 0.79 for DC in Table 1; it shows that knowledge and technological variables are more important for DC than for EM. But when we re-estimated the panel regression with including of non technology variables to model, the adjusted R^2 for EM increased from 0.73 to 0.87 and for DC, it decreased from 0.79 to 0.76 (Table 2). This means that non technological variables are more important for EM than for DC.

According to Table 2 both significant levels and coefficients of knowledge and technology variables decreased for EM. While tert and patnon were significant in the first regression, they were insignificant in second. Intuser, band and researcher are not related to the dependent variable again. Significant levels and coefficients of ict and R&D reduced.

While band was significant for DC in Table 1, it was insignificant in Table 2. The relationship between y_1 and patres-patnon-R&D weakened but their significant did not change. There is still no relationship between y_1 and intuser, ict. Although researcher remained in significant level, the association was stronger.

Table 3 Panel data regressions (Dependent Variable — Net Trade)

Knowledge and Technology Variables	Emerging Markets	Developed Countries
Expenditure per student, tertiary (% of GDP per capita)	0.215 (1.367)	-0.236 (1.388)
Information and communication technology expenditure (current US$)	-	-
International Internet bandwidth (bits per person)	-0.727** (0.180)	-0.494** (0.218)
Internet users (per 1,000 people)	0.339 (1.004)	-0.722*** (0.780)
Patent applications, resident	-0.964*** (3.232)	-0.304 (2.714)
Patent applications, nonresidents	-0.804** (3.928)	-
Researchers in R&D (per million people)	-	-
Royalty and license fees, payments (BoP, current US$)	-	-0.848*** (0.999)
Royalty and license fees, receipts (BoP, current US$)	-	0.398* (.679)
Research and development expenditure (both public and private)	0.183 (6.046)	0.506* (4.629)
Adjusted R squared	0.37	0.52
Number of observations	110	75
F	2.669	4.052

Notes: Standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 3 shows results from net trade panel OLS regressions for emerging markets (EM) and developed countries (DC). One of results obtained from Table 3 is that, there is a strong negative relationship between only one of the independent variable (patres) and dependent variable (net trade) for EM. The coefficient of this independent variable suggests that a 1 percentage point increase in patres is related to 0.96 percentage point increase in net trade (y_2). Also the relationship between band, patnon and y_2 is negative and less strong (respectively 0.72 and 0.80). The insignificant variables are tert, intuser and rd and no relation variables are ict, researcher, rp and rr. Having negative sign of band, patres and patnon indicates the increasing import of qualified labor and technological based equipment. Band, patres and patnon have reduced foreign exchange return.

It appears to have been a strong but negative relationship between rp, intuser and y_2 for DC. There is not any relation between ict, patnon, researcher and y_2. Tert and patres are insignificant variables. Rr and R&D have positive sign and they are significant at 10 percent level. Band has a negative sign and it is significant at 5 percent level. That is, band, intuser and rp have negatively affected foreign exchange return. After all rr and R&D have increased foreign exchange return.

Explaining power of knowledge and technology variables (adjusted R^2) is far greater for DC than EM in Table 3. Adjusted R^2 is 0.37 for EM and 0.52 for DC. Table 4 consists of the results of Table 1 and 3 to compare with each other. Patnon is only significant variable in both models for EM. Patnon has a negative sign both in y_1 and in y_2 models. Not only has patnon decreased foreign exchange return of EM but also has deteriorated barter terms of trade. For DC, band is associated with y_1 positively but with y_2 negatively. That is, while the terms of trade are improving, the net trade is worsening. In the models, R&D has taken different signs (negative in y_1; positive in y_2). Band also has different signs (positive in y_1; negative in y_2). Although band has shortened foreign exchange return, R&D has increased foreign exchange return. According to Table 4, adjusted R^2 is bigger for DC than for EM in both y_1 and y_2. It means that knowledge and technology variables have better explained terms of trade and net trade of DC.

Table 4: The Effects of Knowledge and Technology Variables on y_1 and y_2

Knowledge and Technology Variables	Emerging Markets		Developed Countries	
	Dependent Variable: y_1	Dependent Variable: y_2	Dependent Variable: y_1	Dependent Variable: y_2
Expenditure per student, tertiary (% of GDP per capita)	-0.243* (0.099)	0.215 (1.367)	-0.169 (0.057)	-0.236 (1.388)
Information and communication technology expenditure (current US$)	0.921*** (0.166)	-	-	-
International Internet bandwidth (bits per person)	-	-0.727** (0.180)	0.620*** (0.008)	-0.494** (0.218)
Internet users (per 1,000 people)	-	0.339 (1.004)	-	-0.722*** (0.780)
Patent applications, resident	-	-0.964*** (3.232)	0.831*** (0.097)	-0.304 (2.714)
Patent applications, nonresidents	-0.292* (0.155)	-0.804** (3.928)	0.556*** (0.019)	-
Researchers in R&D (per million people)	-	-	0.562*** (0.107)	-
Royalty and license fees, payments (BoP, current US$)	-	-	0.241 (0.029)	-0.848*** (0.999)
Royalty and license fees, receipts (BoP, current US$)	-0.274 (0.043)	-	-	0.398* (.679)
Research and development expenditure (both public and private)	0.542*** (0.402)	0.183 (6.046)	-0.779*** (0.162)	0.506* (4.629)
Adjusted R squared	0.73	0.37	0.79	0.52
Number of observations	110	110	75	75
F	9.765	2.669	9.093	4.052

Notes: Standard errors are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. y_1 denotes Gross Barter Terms of Trade; y_2, Net Trade.

3. CONCLUSION

This paper examined the effects of knowledge and technology variables on foreign trade in Emerging Market Countries and Developed Countries. Their effects have also been compared with non-technological variables. The results for the pooled sample suggest that knowledge and technology variables are more important in explaining terms of trade for DC than for EM. Additionally, these variables are much more significant net trade for DC. Especially R&D, information and communication technology, researchers in R&D, patent applications (resident, non resident), international internet bandwidth (bits per person) have a strong impact on terms of trade in both country groups. With including non-technological variables, explaining

power of model has increased for EM but has decreased for DC (in turn from 0.73 to 0.87 and from 0.79 to 0.76).

The effects of knowledge and technology variables on net trade have decreased in both country groups. Interestingly some variables have different signs in both models for DC. For example, R&D has a negative sign in terms of trade but has a positive sign for net trade. So, while R&D has worsened the terms of trade, it increases the foreign exchange returns. ,

APPENDIX

a) Gross Barter Terms of Trade (y_1): We have formulated Gross Barter Terms of Trade as import quantum index divided by export quantum index.

Export Quantum Index: Export volumes for low- and middle-income economies are from UNCTAD's quantum index series and for high-income economies from export data deflated by the IMF's trade price deflators. United Nations Conference on Trade and Development, Handbook of Statistics, and International Monetary, International Financial Statistics

Import Quantum Index: Import volumes for low- and middle-income economies are from UNCTAD's quantum index series and for high-income economies from import data deflated by the IMF's trade price deflators. United Nations Conference on Trade and Development, Handbook of Statistics, and International Monetary, International Financial Statistics

b) Net trade (y_2) in goods is the difference between exports and imports of goods. The category includes goods previously included in services: goods received or sent for processing and their subsequent export or import in the form of processed goods, repairs on goods, and goods procured in ports by carriers. Trade in services is not included. Data are in current U.S. dollars.

Source: International Monetary Fund, Balance of Payments Statistics Yearbook and data files.

c) Expenditure per student, tertiary (% of GDP per capita) (tert): Break in series between 1997 and 1998 due to due to change from International Standard Classification of Education (ISCED76) to ISCED97. Recent data are provisional.

Public expenditure per student is the public current spending on education divided by the total number of students by level, as a percentage of GDP per capita.

United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.

d) Foreign direct investment, net inflows (% of GDP) (fdi): Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-

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term capital as shown in the balance of payments. This series shows net inflows in the reporting economy and is divided by GDP. International Monetary Fund, International Financial Statistics and Balance of Payments databases, World Bank, Global Development Finance, and World Bank and OECD GDP estimates.

e) GDP growth (annual %)(grow): Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

World Bank national accounts data, and OECD National Accounts data files.

f) Inflation, consumer prices (annual %)(inf): Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.

International Monetary Fund, International Financial Statistics and data files.

g) Information and communication technology expenditure (current US$)(ict): Information and communications technology expenditures include computer hardware (computers, storage devices, printers, and other peripherals); computer software (operating systems, programming tools, utilities, applications, and internal software development); computer services (information technology consulting, computer and network systems integration, Web hosting, data processing services, and other services); and communications services (voice and data communications services) and wired and wireless communications equipment.

World Information Technology and Services Alliance, Digital Planet: The Global Information Economy, and Global Insight, Inc.

h) International Internet bandwidth (bits per person) (band): Please cite the International Telecommunication Union for third-party use of these datas. International Internet bandwidth is the contracted capacity of international connections between countries for transmitting Internet traffic. International Telecommunication Union, World Telecommunication Development Report and database, and World Bank estimates.

i) Internet users (per 1,000 people) (intuser): Please cite the International Telecommunication Union for third-party use of these data. Internet users are people with access to the worldwide network. International Telecommunication Union, World Telecommunication Development Report and database, and World Bank estimates.

j) Patent applications, resident/nonresidents (patnon/patres): Patent applications are applications filed with a national patent office for exclusive rights for an invention--a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent

provides protection for the invention to the owner of the patent for a limited period, generally 20 years.

World Intellectual Property Organization (WIPO), WIPO Patent Report: Statistics on Worldwide Patent Activity. The International Bureau of WIPO assumes no responsibility with respect to the transformation of these data.

k) Real effective exchange rate index (2000 = 100) (exch): Real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs. International Monetary Fund, International Financial Statistics.

l) Real interest rate (%) (int): Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. International Monetary Fund, International Financial Statistics and data files using World Bank data on the GDP deflator.

m) Researchers in R&D (per million people) (Researcher): Researchers in R&D are professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and in the management of the projects concerned. Postgraduate PhD students (ISCED97 level 6) engaged in R&D are included.

United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.

n) Royalty and license fees, payments/receipts (BoP, current US$)(Rp –Rr): Royalty and license fees are payments and receipts between residents and nonresidents for the authorized use of intangible, nonproduced, nonfinancial assets and proprietary rights (such as patents, copyrights, trademarks, industrial processes, and franchises) and for the use, through licensing agreements, of produced originals of prototypes (such as films and manuscripts). Data are in current U.S. dollars.

International Monetary Fund, Balance of Payments Statistics Yearbook and data files.

o) Expenditures for research and development are current and capital expenditures (rd) (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development. United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.

p) Domestic credit to private sector (% of GDP) (Cre): Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.

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