

EFFECTS OF INVESTMENT IN INFORMATION TECHNOLOGY ON INTERNATIONAL TRADE

Shouhong Wang and Hai Wang

ABSTRACT

There have been propositions in the information technology (IT) literature that IT stimulates international business. This paper describes the research framework that relates to IT investment and international trade. Based on a literature survey, five hypotheses are developed. The data of IT expenditures and international trade of forty-four large trading countries over the 1995-2009 period are collected through the World Bank and United Nation's databases. These data are used to test the five hypotheses. The research findings strongly suggest that IT investment has positive effects on international trade for all countries. Such positive effects are not significantly influenced by cultural factors such as geographical region and language, even are not influenced by the economy strength factor. Free trade can stimulate the effects of IT on international trade; however, such stimulus seems to be diluted when the trade association becomes large. The findings of this empirical test lead to conclusions and recommendations for the international trade communities to proactively make IT investments for international trade.

Keywords: Information technology investments, international trade, global e-commerce, impacts of information technology.

INTRODUCTION

Over the past several years, information technology (IT) has become the most important catalyst in international business (Barovick, 2004). The Internet-based e-commerce tends not to be perceived as just another example of the alliance of business and the new IT; instead, the cross-countries dimension of e-commerce gives it a distinctive character in contrast to other applications of technology to international business (Kucuk, 2002; Mayer & Vambery, 2008). Specifically, the Internet provides the impetus for IT enabled international business process reengineering, and this in turn, improves international trade (Tang, 2006). In conjunction with streamlining trade processes, the Internet provides a rich media of information about government regulations, duty rates, market studies, and sources of suppliers and consumers.

The global spending in the year 2013 on information and communications technology (ICT) will reach \$3.8 trillion (IDC, 2012). Despite the huge amount of IT investment worldwide, little research into theoretical frameworks of the IT impact on the global economy in a general global context has been reported.

Shouhong Wang is a Professor of Management Information Systems at University of Massachusetts Dartmouth. He received his Ph.D. in Information Systems from McMaster University. His teaching and research interests include IT in business and global knowledge management. He has published over 100 papers in academic journals and several books.

Hai Wang is an Associate Professor at the Sobey School of Business at Saint Mary's University. He received his Ph.D. in Computer Science from the University of Toronto. His research interests are in the areas of data mining and global knowledge management. He has published over 30 papers in academic journals.

Much of the literature on the relationships between IT investment and international trade has a macroeconomics orientation rather than global IT management orientation. Consequently, strategic issues of IT enabled international trade have yet to be fully investigated (Javalgi and Ramsey, 2001).

To understand more about the impact of IT on international trade, this research study empirically tested the correlation between IT expenditure and international trade. The test provided more information about how investment in IT has an impact on international trade and raised issues about how global IT utilization can improve international trade.

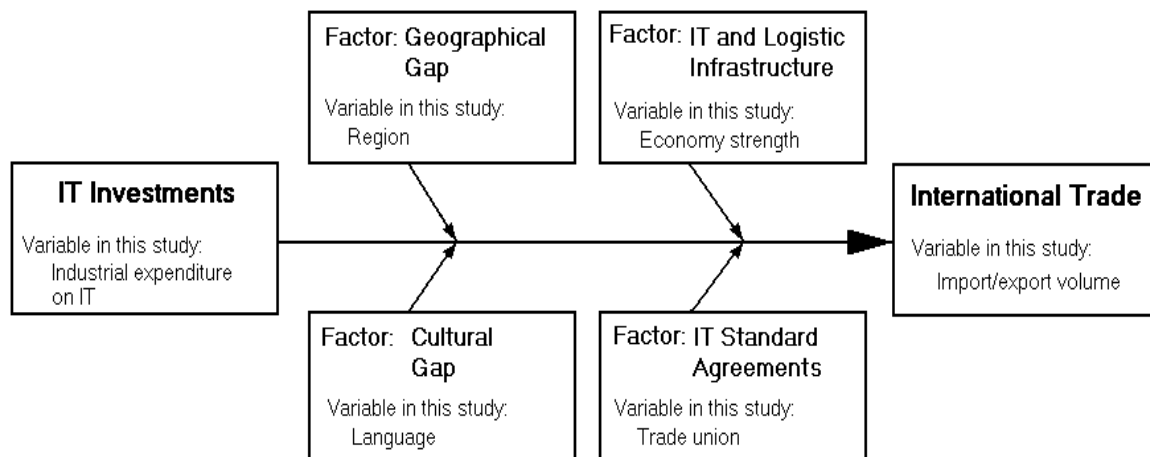
This paper describes the research framework that relates to IT investment and international trade, and tests five research hypotheses related to the framework. The study also describes the methodology used to test the hypothesis. Based on the empirical test results, the paper draws conclusions and makes recommendations on the need for proactive investment in IT by the international trade community to improve international trade.

THE RESEARCH FRAMEWORK

In this study IT investment of a country is referred to as all expenditures on IT spent by businesses, households, governments, and education institutions of the country. The expenditures includes spending on IT projects, equipment, telecommunications purchased from vendors or organizations outside the purchasing entity, as well as spending on internally customized software and capital depreciation. International trade of a country is referred to as the total dollar value of import and export of the country.

In the literature few underlying structures and theoretical models for the relationships between IT investment and international trade are available. We propose a conceptual model for this study as shown in Figure 1. The model is based on the attitude literature. Specifically, we recognize that IT adoption for international trade is determined by many cultural, political, and regional characteristics of the countries (Slamecka, 1985). Language is one of the major cultural aspects in the Internet environment for international trade (Haveman, 1998; Law & Perez, 2005). The IT infrastructures and logistic infrastructures are critical for the success of IT in international trade. World large trade associations, such as European Union (EU), play significant roles in using IT for international trade (Myers, 1997), and have adopted their own IT standards, agreements, policies in their domains (Monahan, 1998). Accordingly, four factors (geographical gap, cultural gap, IT and logistic infrastructure, and IT standard agreement) represented by four variables (region, language, economy strength, and trade association) are used in this study to examine how these factors influence the impact of IT investment on international trade. Next, we develop hypotheses and specify these variables.

Figure 1. The Research Framework of the Study



RESEARCH HYPOTHESES

Relationship between IT and International Trade

Research (Dou *et al.*, 2002) suggests that the Internet provides a widely-reaching and economic medium for export marketing. IT helps to reduce the incessant document work in international business, and shortens the time needed for carrying out various processes in word trade by using online procurement and funds transfer. It provides the environment of accelerate international information flows beyond the physical boundaries (Johnston & Gregor, 2000). The Internet-based IT replaces the "inflated" processes based on mail, telephone, and faxes with more efficient online procedures such as trade Web portals (Croom, 2000). In fact, IT supports international supply chains through e-commerce (White *et al.* 2005). It makes it easier than ever for the import and export enterprises to search for new partners and customers. Likewise, IT supports international links not only in the actual import and export processes, but also in sharing information relevant to international trade. IT allows international trade organizations to maintain centralized data resource but prompt decentralized actions made by individual enterprises (IT06, 2013). Accordingly, the following hypothesis was formulated.

Hypothesis 1: A positive association exists between the IT investment and international trade.

Geographical Differences in IT Enabled International Trade

Modern IT has created bridges over the geographical gaps between regions of the world. Nevertheless, the global IT diffusion does not wipe out the cultural differences between the Internet user segments (Tian & Emery, 2002). The relationship between cultural context and the use of IT remains complicated (Buragga, 2002; Afriyie *et al.*, 2012). On the other hand, the literature survey found few research reports that systematically assess the differences of productivity of IT in international trade between the geographical regions of the entire world. Hence, the following neutral hypothesis was suggested.

Hypothesis 2: Geographical region does not have significant impact on the relationship between IT investment and international trade.

Influence of Languages Used for the Internet

The commonality of language among international trading partners has significant effects on the trade volumes (Hutchinson, 2002). Among many cultural factors that influence e-commerce (Hickey, 2000a; Chau *et al.*, 2002), language is perceived to be one of the most important issues (Cottrill, 2000). Since the Internet was first developed in the US, English has been and will continue to be the dominant language on the Internet (Ulfelder; 2000). Although many non-English speaking countries promote their own languages and cultures on the Internet, English is still the first business language on the Internet for international trade (Hickey, 2000b). On the other hand, non-English speaking citizens want to view Web sites in their own indigenous language and culture which has caused a digital divide (Cuneo, 2003).

Hypothesis 3: The relationship between IT investment and international trade in English speaking countries is significantly stronger than that in non-English speaking countries.

IT Infrastructure and Logistic Infrastructure for International Trade

Research (Wang, 1997) has pointed out that IT does not assure success of business. The impact of IT on international business highly relies on the socio-technical design of IT in the country (Kao & Wang, 2003). The maturity of IT infrastructure and logistic infrastructure is the determinant of the profitable use of IT for international trade (Leitao & Faustino, 2009; Haughton, 2006). Research (Kurlantzick, 2002; Coates, 2002) indicates that developing countries have IT infrastructure and logistics disadvantages in implementing e-commerce for international trade.

Hypothesis 4: The relationship between IT investment and international trade in developed countries is significantly stronger than that in developing countries.

World Trade Associations Promote the Use of IT in International Trade

International participation in Free Trade Areas (FTA) grew rapidly in the past several decades. FTA expand regional economic integration and promote world free trade (GLOBAL-ECO, 2013). The largest and most successful world free trade associations are the European Union (EU) which involves 25 member European countries (EUROPA, 2013) and accounts for over 40% of world exports, and the North American Free Trade Agreement (NAFTA) which combines the United States, Canada, and Mexico and accounts for about 18% of the world's exports. There have been other international trade organizations towards FTA, such as The Asia-Pacific Economic Cooperation (APEC) which involves more than twenty countries spanning four continents, Southeast Asian Nations (ASEAN), and Southern Cone Free Trade Area (MERCOSUR) in South America.

Research (Mitchell, 2001; Monahan, 1998) indicates that the impact of IT-based e-commerce on international trade highly depends upon the technological agreements among the trade partners. World trade associations, such as EU and NAFTA, are harmonizing information regulations and standards across nations (Kumar & van Hillegersberg, 2004). A free trade association can have advantages in using IT for international trade. The duty-free treatment of electric information transmissions within a free trade association would further advance IT in international trade (Feinschreiber & Kent, 2001).

Hypothesis 5: World trade association has significant impact on the relationship between IT investment and international trade.

DATA AND SAMPLE

The Investigation Scope and Sampling

Forty four counties (see Appendix A), each of which has relatively large IT investments and import/export volumes, were examined in this study. The data of IT expenditures, import/export of these trading countries over the 1995-2009 period, as well as other background information related to this study are collected through the World Bank (WorldBank, 2013) and United Nation's (UNStats, 2013) databases. Given the prestigious status of the two organizations of the data sources, we consider that data are dependable. As this study is to investigate the relationship between IT investment and international trade as well as the effects of relevant factors, the time dimension is not a concern of this study although aggregated panel data are used for the investigation.

Variables, Factors and Their Definitions

This study applies regression techniques to test the above five hypotheses. The variables and the data sources used for the tests are described as follows.

Dependent Variable (y) - International trade volume

The average annual increase in percentage of the total dollar value of import and export of the country over the 1995-2009 period.

Independent Variable (x) – IT investment

The average annual increase in percentage of total expenditures on IT of the country over the 1995-2009 period. IT expenditures include external spending on information technology (tangible spending on information technology products purchased by businesses, households, governments, and education institutions from vendors or organizations outside the purchasing entity), internal spending on information technology (intangible spending on internally customized software, capital depreciation, and the like), and spending on telecommunications and other office equipment.

Factor A - Geographical Gap: Region

For this study, the world is divided into six geographical regions: North America, Latin America, Pacific, West Europe, East Europe, and Middle East/Africa. Each country is classified to be in a particular region.

Factor B - Cultural Gap: Language

Each country is classified to be English speaking and non-English speaking depending upon the official language used in the country. Commonwealth countries such as India and South Africa are classified to be English speaking countries. Special cases in the classification are also given special considerations. For instance, Canada has two official languages: English and French. However, the majority of Canadians use English. Hence, Canada is classified to be an English speaking country.

Factor C - IT and logistic infrastructure: Development degree

Each country is classified to be developed country or developing country depending upon the economy strength measured by the GNI per capita. In this study, \$10,000 of GNI per capita (Atlas method) in 2004 is used for the classification boundary.

Factor D - IT standard agreements: World trade association

This study investigates the effects of two influencing free trade associations of international trade: EU and NAFTA. Each country is classified to be a member/non-member of each of these trade associations.

The coding of the four factors for the investigated countries is shown in Appendix A.

TEST OF THE HYPOTHESES AND FINDINGS

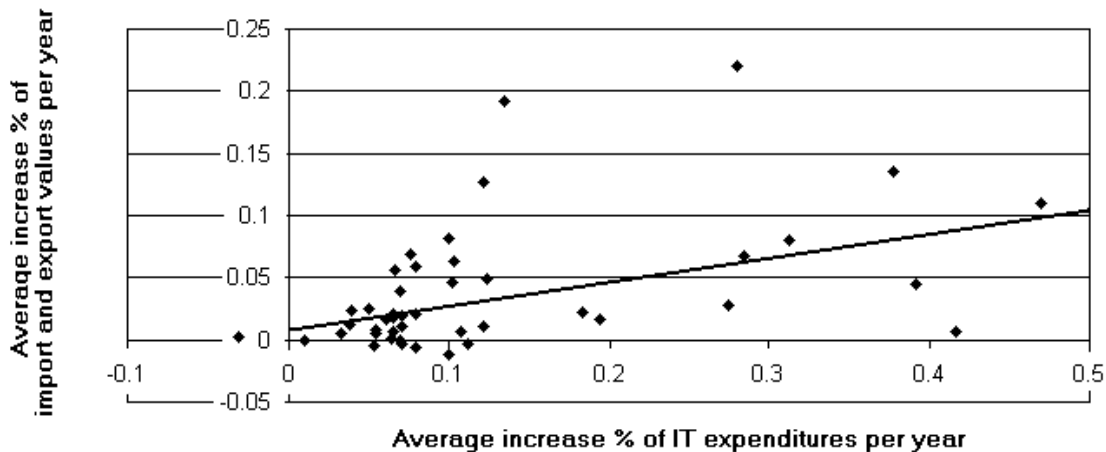
1. Hypothesis 1 - A positive association exists between the IT investment and international trade

The data related to this hypothesis is plotted in Figure 2. A regression analysis, which included x (IT investment),

$$y = \alpha + \beta x + \varepsilon$$

was conducted. The regression analysis indicates that a positive association exists between the IT investment and international trade. The regression result ($t=3.42$, $p=0.0013$) shows that the positive relationship between the IT expenditures and the import and export trade of a country is statistically significant.

Figure 2. The relationship between IT investment and International Trade



Clearly, the statistical relationship between IT investment and international trade does not reveal any causality. The objective of this study is to investigate the effects of global organizational, cultural, and social factors on the relationships of IT investment and international trade, as discussed next.

2. Hypothesis 2: Geographical region does not have significant impact on the relationship between IT investment and international trade

To investigate an impact of a factor on the relationship between IT investment and international trade, we applied factor ANOVA analysis (see Appendix B for all ANOVA tables). The population mean is the ratio of international trade volume over IT investment of each country. In testing Hypothesis 2, the factor is region that has six levels as shown in Appendix A. The ANOVA shows that the overall impact of the region factor on the relationship between IT investment and international trade is significant ($F=5.40$, $p=0.0008$). Accordingly, Hypothesis 2 is rejected. However, we excluded the North America region from the six global regions for the test. The ANOVA shows that the impact of factor region on the relationship between IT investment and international trade is not significant ($F=1.51$, $p=0.22$). Accordingly, Hypothesis 2 is not rejected if the North America region is excluded. We conclude that the North America region does have significant impact on the relationship between IT investment and international trade, but the region factor in other five regions does not have significant impact on the relationship between IT investment and international trade.

3. Hypothesis 3 - The relationship between IT investment and international trade in English speaking countries is significantly stronger than that in non-English speaking countries

A single factor ANOVA analysis on the impact of the language factor on the relationship between IT investment and international trade was conducted. The ANOVA shows that the impact of the language factor on the relationship between IT investment and international trade is not significant ($F = 1.31, p=0.26$). Accordingly, Hypothesis 3 is rejected. We conclude that languages do not have significant impact on the relationship between IT and international trade, even though the volume of IT tools and information on the Internet in English language is significantly greater than that in other languages.

4. Hypothesis 4: The relationship between IT investment and international trade in developed countries is significantly stronger than that in developing countries

A single factor ANOVA analysis on the impact of IT and logistic infrastructures on the relationship between IT investment and international trade was conducted. The ANOVA shows that the impact of IT and logistic infrastructure on the relationship between IT investment and international trade is not significant ($F = 0.0004, p=0.98$). Accordingly, Hypothesis 4 is rejected. We conclude that developing countries do not have significant disadvantages in using IT for international trade.

5. Hypothesis 5: World trade association has significant impact on the relationship between IT investment and international trade

To further investigate the utilization of IT investments for international trade, we examined large world trade associations. We found that Mexico, the US, and Canada were among the top ten countries with the highest ratio of annual increase of trade volume versus annual increase of IT investment. The three countries are the NAFTA international trade network. To further examine whether NAFTA was effectively applying IT for trade, a single factor ANOVA analysis on the impact of NAFTA on the relationship between IT investment and international trade was conducted. The ANOVA shows NAFTA has a significant impact on the relationship between IT investment and international trade ($F = 20.3, p=0.00005$). We conclude that NAFTA is a small winners' circle, in terms utilization of IT for word trade.

The next top tier with a high ratio of annual increase of trade volume versus annual increase of IT investment is the counties of EU. To further examine whether EU was effectively applying IT for international trade, a single factor ANOVA analysis with the factor EU-Member was conducted. The ANOVA shows that the impact of EU-Member on the relationship between IT investment and international trade is insignificant ($F=0.92, p=0.34$). We conclude that EU is not a winners' circle in terms utilization of IT for word trade. Overall, the mixed conclusion for this hypothesis indicates that the factor free trade association does not necessarily advance the impact of IT on international trade.

DISCUSSION AND RESEARCH IMPLICATIONS

Limitation of the Study

Although this empirical study is factual, it has several limitations. First, statistically, the sample size is relatively moderate. Second, the time period investigated (1995-2009) is relatively short. Furthermore, definitions of IT investment and import/export are relatively general. More studies are needed to verify and extend our findings. Thus, extensive generalization of the research results could become speculative.

The further research into IT investment and international trade in the context of global business and technology could be developed. In the management direction, more managerial factors that influence the

correlations between IT and global trade could be further identified and tested. In the economics direction, it worth pursuing to apply econometrical tools to a set of high frequency time series data to reveal interesting dynamic relationships between IT and global trade.

Discussion

The impact of IT investment on international trade is a complicated issue involving many other factors we have not explored in this study. Nevertheless, this study has revealed interesting facts besides these hypothesis tests results, as discussed below.

The significant positive relationship between IT investment and international trade indicates that Internet-based e-commerce plays great roles in the global economy. Surprisingly, on an average, within the past several years developing countries invested equally heavily on IT as developed countries did, in terms of the ratio of the increase of IT investment over the increase of trade volume (i.e., 3.34 for developed countries, and 3.32 for developing countries). We are convinced that the cross-countries dimension of the modern IT has provided powerful leverage to international business for all countries.

This study has verified that one of the main requirements for business relations in international trade is the establishment of communication channel. Although English is the most popular language on the Internet, non-English speaking countries do not have significant disadvantages in using IT for international trade. Nevertheless, non-English speaking countries have made more investment in IT than English speaking countries do in terms of the ratio of the increase of IT investment over the increase of trade volume (i.e., on an average, 3.85 for non-English speaking countries, and 2.44 for English speaking countries).

Our data set shows that NAFTA uses IT for international trade much more effectively than other countries (i.e., the ratios of the increase of IT investment over the increase of trade volume are 0.98 and 4.04, respectively). There are feature articles (e.g., (JoC (2000)) about the policies of information technology adopted by the three NAFTA countries for international trade; yet, few academic research reports on the information architecture of NAFTA have been found in the literature.

Research Implications

Currently, in the literature of global IT management emphases have been placed on comparative analysis of IT practices and facts in different countries. On the other hand, the literature of economics on IT and international trade has more of a macroeconomics orientation. People have no doubt that IT increases the interconnectivities of world trade partners leading to increased interactions of international trade; however, the effects of global organizational, cultural, and social factors on the relationships of IT investment and international trade are rather under exposed. This study makes contributions by adding the results of the investigation on these cultural and global social factors to the global IT management field. Its implications in several aspects are discussed below. Its implications in several aspects are discussed below.

- (1) There are many other factors that might be critical for the effects of IT on international trade, such as IT education, knowledge level of the use of IT for trade, and government's IT policies. However, data for those factors are unavailable. This makes research difficult to get into IT management in the global context beyond comparative analyses. A global research infrastructure that can help accumulate those data for global IT management is imperative.
- (2) The IT diffusion in international trade is rapid. To better understand the role of IT in international trade, more research frameworks in this field are expected in the near future. Periodical longitudinal studies would be particularly useful for global IT management.

- (3) At the time being, the roles of world trade organizations such as WTO (WTO, 2013) have not extended into the establishment of a global alliance for IT and international trade. One of the major tasks for the global IT management community is to create such a global alliance that would facilitate the inter-linkage of networks for international trade to meet regional and national needs, and catalyze innovative and multi-stakeholder partnerships across the IT policies in international trade.

CONCLUSIONS AND RECOMMENDATIONS

The research findings strongly suggest that IT investment has positive effects on international trade for all countries. Such positive effects are not significantly influenced by cultural factors such as geographical region and language, even are not influenced by the economy strength factor. Free trade can stimulate the effects of IT on international trade; however, such stimulus seems to be diluted when the trade association becomes large.

As indicated by the results of this study, the growing international trade calls for radical changes in business processes for import, export and negotiation. The e-commerce enabled international trade makes the association between IT and international trade stronger. In international trade, cultural factors and economy strength may contribute to the usage of IT in a country, but such contributions (positive or negative) will be transferred to its international trade partners. The overall effects of these factors on the usage of IT for international trade will be about equally distributed to the world, regardless there exist small winners' circles such as NAFTA.

The results support the following recommendations.

- (1) The globalization of economy requires globalization of IT. The world must continue to invest on IT to exploit the advantages of IT for international trade.
- (2) The borderless international trade market must be aware of cross-cultural issues in IT. Social-cultural factors will influence the IT-based international market in a collective way. The social-cultural impacts on the use of IT in international trade follow the same rules as the trade itself does that no party gains unless all partners are beneficial. Countries and trade organizations must be able to draw IT resources cross-culturally to create long term, sustainable, and equal relations among international trade partners.
- (3) The interdependence between the globalization of IT and international trade has become a global issue rather than national. World trade organizations ought to learn from NAFTA how a free trade area can have significant use of IT for international trade through imposing IT standardization and specifying their agreements on the use of IT for trade.
- (4) Developed countries must help the developing countries to establish IT infrastructure and logistic infrastructure in order to fully develop IT-enabled international trade. The digital divide between the developed counties and developing countries will influence the IT-based international trade in a collective way. The disadvantages of under-developed IT infrastructure and logistic infrastructure in developing countries are actually shared by all counties in international trade. Without improving the global IT infrastructure and logistic infrastructure, the impact of IT on international trade will be restricted.

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APPENDIX A: COUNTRIES INVESTIGATED IN THIS STUDY

Country	Language: English (1); Non-English (2)	Region/Member of Trade Associations: North America(1); Latin America (2); Pacific (3); West Europe (4); East Europe (5); Middle East or Africa(6)	GNI: (per capita \$10,000): Developed (1); Developing (2)	Rank: of the ratio $\Delta\text{Trade}/\Delta\text{IT}$
Argentina	2	2	2	9
Australia	1	3	1	17
Austria	2	4 /EU	1	31
Belgium	2	4 /EU	1	11
Brazil	2	2	2	30
Bulgaria	2	5	2	13
Canada	1	1 /NAFTA	1	7
Chile	2	2	2	27
China	2	3	2	14
Hong Kong China	2	3	1	33
Colombia	2	2	2	35
Czech Republic	2	5 /EU	2	5
Denmark	2	4 /EU	1	29
Egypt, Arab Rep.	2	6	2	32
Finland	2	4 /EU	1	18
France	2	4 /EU	1	25
Germany	2	4 /EU	1	15
Greece	2	4 /EU	1	34
Hungary	2	5 /EU	2	6
India	1	3	2	23
Indonesia	2	3	2	42
Ireland	1	4 /EU	1	2
Italy	2	4 /EU	1	19
Japan	2	3	1	41
Korea, Rep.	2	3	2	16
Malaysia	2	3	2	24
Mexico	2	1 /NAFTA	2	1
Netherlands	2	4 /EU	1	38
New Zealand	1	3	1	40
Norway	2	4 /EU	1	10
Philippines	1	3	2	8
Poland	2	5 /EU	2	22
Portugal	2	4 /EU	1	21
Romania	2	5	2	20
Russian Federation	2	5	2	44
Singapore	1	3	1	39
South Africa	1	6	2	43
Spain	2	4 /EU	1	4
Sweden	2	4 /EU	1	36
Switzerland	2	4	1	26
Thailand	2	3	2	37
Turkey	2	6	2	28
United Kingdom	1	4 /EU	1	12
United States	1	1 /NAFTA	1	3

APPENDIX B. ANOVA TABLES OF HYPOTHESIS TESTS

ANOVA (Hypothesis 2 –All 6 regions)

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	2.12438481	5	0.424877	5.402839	0.000754	2.462549
Within Groups	2.98830411	38	0.07864			
Total	5.11268892	43				

Groups: 6 geographic regions

ANOVA (Hypothesis 2 – Regions without North America)

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.45744449	4	0.114361	1.506087	0.220981	2.633534
Within Groups	2.7335735	36	0.075933			
Total	3.191018	40				

Groups: Global regions without North America

ANOVA (Hypothesis 3)

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.154725	1	0.154725	1.310708	0.258749	4.07266
Within Groups	4.957964	42	0.118047			
Total	5.112689	43				

Groups: English Speaking, Non-English Speaking

ANOVA (Hypothesis 4)

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	4.2775E-05	1	4.28E-05	0.000351	0.985133	4.07266
Within Groups	5.11264614	42	0.12173			
Total	5.11268892	43				

Groups: Developed Countries and Developing Countries

ANOVA (Hypothesis 5 –NAFTA vs. Others)

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	1.666940312	1	1.66694031	20.31822	5.17E-05	4.07266
Within Groups	3.445748603	42	0.08204163			
Total	5.112688915	43				

Groups: NAFTA, Non-NAFTA

ANOVA (Hypothesis 5 –EU vs. Non-EU)

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.109547335	1	0.10954733	0.91962	0.343063	4.07266
Within Groups	5.00314158	42	0.11912242			
Total	5.112688915	43				

Groups: EU and Non-EU

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