Internet Adoption and Task-based Comparative Advantage between OECD Countries

Yingting Yi*
KU Leuven
Mar 1st, 2013

Abstract

I use sector-level bilateral trade data between 21 high-income OECD countries in 2006, to show that internet adoption affects the composition of trade between developed countries. Specifically, I find that OECD countries with higher broadband rankings have comparative advantage in less routine sectors. The broadband ranking index for each country is from ITIF, which examines three aspects of the internet: number of users per 100 households, average speed, and price of the fastest technology. The routine task intensity evaluates the importance of analytical or interactive tasks in each sector, and it is obtained by aggregating different occupations' routine index with the weight as occupations' corresponding employment shares in each sector of US. The underline mechanism of the finding is that information and communication technology (ICT) complements workers in performing non-routine tasks. It has been firstly highlighted by Autor, Levy and Murnane (2003) but never applied in studying countries' comparative advantage. As the network effect of the bilateral internet adoption seems missing, the pattern suggests that the internet facilitate trade within developed countries via a channel other than simply reducing the bilateral transaction costs. The pattern survives various robustness checks such as adding all sorts of controls, changing the sample year(s) to 2007 or 2002-2006, and using alternative measures of routine task intensity. By using alternative internet measures and switching to ICT development index or computer density, I find that broadband is more important for workers to perform the interactive tasks than the analytical tasks. I also use PPML (Poisson Pseudo Maximum Likelihood) and IV (Instrument Variable) approach to tackle problems brought by zero-trade flows and possible endogeneity, and the baseline pattern sustains.

Key words: internet, routine tasks, comparative advantage

JEL code: F10, F14

----

*Center for Economic Studies, KU Leuven, Naamsestraat 69, 3000, Leuven, Belgium. I would like to thank Jozef Konings, Wen-Jen Hsieh and conference participants in EBES 2013 for insightful comments, Maarten Goos for useful discussions, Alejandro Cuñat and Marc J. Melitz for generously sharing the volatility index. Funding from KU Leuven and support from Filip Abraham and Erick Buyst are greatly appreciated. All remaining errors are mine. Email: yingting2009@gmail.com.

1. Introduction

Our life has been changed remarkably in the 21st century due to the world-wide usage of internet. Despite the great revolution brought by the internet, its role in facilitating the international trade is still far from clear. Some researchers manage to find a positive and significant impact of internet on trade (Freund and Weinhold, 2004; Mattes, Meinen and Pavel, 2012; Tang, 2006; Vemuri and Siddiqui, 2009), but not everyone is convinced. For instance, Clarke and Wallsten (2006) separate the total exports from each country in 2001 into two groups based on whether the destination is developing or developed countries, and find that the trade-enhancing effect of the internet is only significant for exports from developing countries to developed countries, after using the competition level of telecommunication sector as an instrument for the number of internet hosts[1]. Timmis (2012) shows that the internet's enhancing effect becomes insignificant for trade between OECD countries during 1990-2010, when using the bilateral internet adoption as the key explanatory variable and fully controlling for the multilateral resistance terms (both the time-varying country specific effects and unobserved bilateral factors)[2].

Moreover, the existing literature on internet and trade focuses mostly on whether the internet reduces bilateral transaction costs and studies the relationship between the internet and the aggregate bilateral trade volume. Is it possible that the internet or broadband facilitate trade between developed countries via other channels? Is there any asymmetry of benefits from the internet across sectors? Also, does the composition of internet matter somehow as well? In other words, can the difference in the level and composition of internet adoption generate a source of comparative advantage among developed countries?

I aim at answering the above questions, by carefully exploring the sector-level bilateral trade data between 21 high-income OECD countries in 2006[3]. Luckily, I find that countries with higher broadband rankings export more in less routine sectors. To be specific, the bilateral trade flows are from the BACI database compiled by CEPII. As the primary measure of internet adoption for each country, the broadband ranking index is constructed by ITIF, which examines three aspects of the internet: number of users per 100 households, average speed, and price of the fastest technology. The routine task intensity for each sector is obtained by merging different occupations' routine index with their corresponding employment shares in each

[1] They aggregate each country's exports in the two groups, which make them unable to use the traditional gravity equation for estimation. Also, there are concerns about the validity of their instrument when studying the exports from developed countries, but they succeed to find that the impact of internet on exports from developed countries and developing countries is different.

[2] Multilateral resistance term firstly appeared in Anderson and van Wincoop (2003). It highlights the fact that bilateral trade costs matter also in a relative way. More details about Timmis (2012) can be found in section 4.2.

[3] According to the World Bank country classification, high-income OECD countries are Australia, Austria, Canada, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Korea, New Zealand, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States.

sector of US[4]. In order to measure each sector's routine **analytical** task intensity, I use the ranking of importance of "making decisions and solving problems" in each occupation provided by the latest O*NET database. For the routine **interactive** task intensity, I focus on the importance of "establishing and maintaining interpersonal relationships" instead. The employment share for each occupation in each sector is from the Occupational Employment Statistics collected by US Department of Labor.

In line with recent literature on countries' comparative advantage (Costinot, 2009a; Chor, 2010; Cuñat and Melitz, 2012; Manova, forthcoming; Nunn, 2007; Levchenko, 2007; Tang, 2012), I use country pair fixed effects and sector fixed effects to control for the baseline trade flows between countries, and then let the coefficient of the interaction term composed by sectors' routine task intensity and countries' broadband ranking index capture the task-based comparative advantage. The obtained negative and significant coefficient hence indicates that countries with higher broadband rankings export more and have comparative advantage in less routine sectors.

The trade pattern in the baseline model passes various robustness checks such as adding controls for other sources of comparative advantage, controlling for alternative channels for either sectors' routine task intensity or countries' broadband ranking index to affect the trade pattern, changing the sample year from 2006 to 2007, estimating panel data during 2002-2006 and fully controlling for the multilateral resistance terms, or using alternative measures of sectors' routine task intensity. By varying the measure of countries' internet adoption and switching to the ICT development index or computer density, I find that the pattern in the analytical aspect is always valid, while the interactive aspect is not so robust. It suggests that price and speed of the broadband are more important when the internet facilitates the fulfillment of interactive tasks, because these two factors are not taken into account by the other ICT indexes except the broadband ranking index from ITIF.

In order to take care of the zero-trade flows, I change the estimation method from the traditional OLS to PPML (Poisson Pseudo Maximum Likelihood), and the pattern sustains. Also, to alleviate the possible endogeneity problem, I instrument the routine task intensity in 2006 by the lagged routine task intensity in 2002, and the broadband ranking index in 2006 by cable TV penetration in 1996. Again, the pattern remains valid.

The underline mechanism of the key finding in the current paper is that the information and communication technologies (ICT) complements workers in performing non-routine

[4] Due to data availability, it is impossible to construct different sector indexes for different countries. So it is common for literature in international trade to use the index of a reference country (normally US) for all the countries and assume that the indexes for the rest countries are correlated with the reference country's index.

analytical and interactive tasks, which induce countries with higher broadband rankings to have higher productivity and cost advantage in less routine sectors.

The mechanism has firstly been highlighted by Autor, Levy and Murnane (2003), and widely explored by literature in labor economics on skill-biased technological change (SBTC) and job polarization (Goos and Manning, 2007; Michaels, Natraj and Van Reenen, forthcoming; etc). So it is well-acknowledged that wage inequality and the demand for educated workers increase due to the development of ICT, because ICT complements workers with higher pay and high education in performing non-routine analytical and interactive tasks, substitutes workers with middle pay and some education in performing routine tasks, and leaves workers with little education and lower paid manual jobs unaffected. However, to the best of my knowledge, I am the first to apply the mechanism in the context of countries' comparative advantage. Because in the existing literature of international trade, the nature of non-routine analytical or interactive tasks has only been used to study the hold-up problems and firms' choices either between intra-firm sourcing and arm's length transaction (Costinot, Oldenski and Rauch, 2011), or between exports and FDI (Oldenski, 2012).

Furthermore, although current literature on job polarization have considered the impact of offshoring or trade openness, they focus mainly on the impact of exports from developing countries such as China to developed countries (Van Reenen, 2011), and often conclude that the effect of offshoring or trade openness on wage inequality is not quite significant and robust (Goos, Manning and Salomons, 2012; Michaels, Natraj and Van Reenen, forthcoming; etc). However, the trade pattern revealed by the current paper suggests that trade within developed countries might potentially be an important drive for job polarization, or at least it reinforces the link between the difference in ICT and job polarization in developed countries.

In a broader sense, the current paper is related to the literature on the impact of ICT on productivity. For instance, Stiroh (2002) finds the IT-producing and IT-using industries account for all of the productivity revival in US in the late 1990s that is attributable to the direct contributions from specific industries. Van Ark, O'Mahony, and Timmer (2008), on the other hand, argues that the productivity slowdown in Europe after late 1990s is attributable to the slower development of ICT compared to the US. In the current paper, I focus on the asymmetry of the impact of ICT on productivity across different sectors. More specifically, I calculate each sector's routine task intensity, which is more complicated than a dummy defined by whether the sector produces or uses ICT, and I argue that the productivity of less routine sectors can be enhanced more by the development of ICT than routine sectors.

As mentioned earlier, the current paper follows recent literature on countries' comparative advantage in terms of using fixed effects and interaction terms in the empirical specification. Among these literature, Beck (2003) and Manova (forthcoming) investigate how countries' financial development turns into a source of comparative advantage. Levchenko (2007), Nunn (2007) and Costinot (2009a) show that countries with better contract enforcement have comparative advantage in sectors with respectively higher input variety, contract intensity or complexity. Focusing on the labor law, Cuñat and Melitz (2012) find that countries with higher labor market flexibility export more in sectors with higher volatility, while Tang (2012) shows that countries with more protective labor law export more in sectors with higher firm/industry- specific skill intensity. Chor (2010) extends the country-level theoretical model in Eaten and Kortum (2002) to the sector-level, and study the relative importance of almost all the above trade patterns. The current paper adds internet adoption as a new source of comparative advantage, and checks whether all the above-mentioned trade patterns are sustainable after restricting the trade flows to those between the high-income OECD countries. Especially, I use two-way clustering proposed by Cameron, Gelbach and Miller (2012) to obtain the robust standard errors, which is a more accurate procedure but has never been implemented by this strand of literature before[5].

Finally, the paper also contributes to the literature on trade-in-tasks. Purely theoretically, Grossmann and Rossi-Hansberg (2012) shows that between advanced economies with relatively similar factor endowments and technology, non-routine tasks tend to be performed by countries with higher wage and higher aggregate output. The current paper fits their theory in the sense that countries with higher broadband rankings tend to have higher labor productivity and hence higher wages.

The rest of the paper is organized as follows. Section 2 provides the empirical specification, followed by data description in section 3. Section 4 shows that the network effect of bilateral internet adoption is missing in trade data. Section 5 presents the baseline empirical results, robustness checks, and results after taking care of zero trade flows and endogeneity. Section 6 concludes.

2. Econometric Specifications

The baseline specification in the current paper is equation (1):

$$\mathrm{X}_{\mathrm{cd}}^{\mathrm{s}} = \alpha_{cd} + \beta^{s} + \gamma_1 r^s BR_c + \gamma_2 h^s H_c + \gamma_3 k^s K_c + \gamma_4 m^s M_c + \gamma_5 sc^s CC_c + \varepsilon_{\mathrm{cd}}^{\mathrm{s}} \quad (1)$$

Where $\mathrm{X}_{\mathrm{cd}}^{\mathrm{s}}$ denotes exports from country c to destination d in sector s; α_{cd} are country pair fixed effects which aim to capture the baseline trade flows between country c and d; β^{s} are the

[5] Among the above-mentioned literature, Chor(2010), Tang (2012) and Manova (forthcoming) cluster the standard errors, but they only use the country pair as the cluster variable. Here in the current paper, I use both the country pair and sector as the cluster variables, and I show that the significance level will bias upward if only using one of two clustering variables, especially only using the country pair.

sector fixed effects, which aim to capture the variation of trade flows across sector s; r^smeasures the routine task intensity in sector s, with higher index denoting more routine sectors; BR_c is the broadband ranking index of country c; h^s, $k^s$and $m^s$are respectively skill, capital and material intensities of production in sector s, while H_c, K_c and M_c are respectively country c's stock of skilled labor, capital and natural resources; $sc^s CC_c$ captures all the rest trade patterns appeared in recent trade literature, with sc^s denoting measures of sector characteristics such as capital intensity, input variety, contract intensity, complexity, volatility and industry-specific skill intensity; ${CC_c}^s$denotes the corresponding country characteristics including physical capital stock, legal quality, human capital stock and rigidity of labor law; ε_{cd}^s is an error term which is assumed to be independent across sector s and country pair c and d.

The essence of the specification is the same as Chor (2010), with $r^s BR_c$ as the key interaction term. As suggested by Autor, Levy and Murnane (2003), the ICT complements workers in performing the non-routine tasks, so I expect γ_1 to be negative, which means that countries with higher broadband rankings export more in less routine sectors. According to the traditional H-O model and previous literature (Debaere, 2003; Romalis, 2004; etc), γ_2, γ_3 and γ_4 should all be positive.

For sensitivity analysis, I use the bilateral distance and other observable geographic variables instead of country pair fixed effects to control for the baseline bilateral trade. It is worth trying, because in Timmis (2012), only the former approach gives significant results. So the specification becomes equation (2):

$$\begin{aligned} X_{cd}^s = {} & \alpha_1 Distw_{cd} + \alpha_2 Colony_{cd} + \alpha_3 Lang_{cd} + \alpha_4 Border_{cd} + \alpha_5 Legal_{cd} + \alpha_6 Currency_{cd} \\ & + \alpha_7 RTA_{cd} + \beta^s + \gamma_1 r^s BR_c + \gamma_2 h^s H_c + \gamma_3 k^s K_c + \gamma_4 m^s M_c + \gamma_5 sc^s CC_c \\ & + \varepsilon_{cd}^s \qquad (2) \end{aligned}$$

Where $Distw_{cd}$ measures the bilateral distance between country c and destination d; $Colony_{cd}$ is an indicator which becomes 1 if the two countries have a colonial tie; $Lang_{cd}$ is an indicator which becomes 1 if the two countries share a common official language; $Border_{cd}$ is an indicator which becomes 1 if the two countries share a common border; $Legal_{cd}$ is an indicator which becomes 1 if the two countries have the same legal origin; $Currency_{cd}$ is an indicator which becomes 1 if the two countries use the same currency; RTA_{cd} is an indicator which becomes 1 if the two countries have joint membership of a regional trade agreement; the rest notations are the same as in equation (1).

Another variation is to control for importer-sector fixed effects instead of simply the sector fixed effects. It isolates more influence from the importer side, but increases the computation difficulty by adding much more dummies into the regression. The specification turns into equation (3):

$$X_{cd}^{s} = \alpha_{cd} + \beta_{d}^{s} + \gamma_1 r^s BR_c + \gamma_2 h^s H_c + \gamma_3 k^s K_c + \gamma_4 m^s M_c + \gamma_5 sc^s CC_c + \varepsilon_{cd}^{s} \quad (3)$$

Where β_{d}^{s} indicates importer-sector fixed effects, which aim to capture the variation in preferences and policy barriers across destination d and sector s; the rest notations are the same as in equation (1).

3. Data

3.1 Bilateral trade flows and gravity factors

The sector-level bilateral trade data of the 21 countries is from the BACI database compiled by CEPII[6]. It is originally classified by 6-digit HS 1996 code. I transfer it into 4-digit NAICS 1997 code using the concordance table provided by Pierce and Schott (2012) in order to match the data on sector characteristics. An alternative would be keeping the classification of trade data while transferring all the variables into 6-digit HS 1996 code, but it will not change the key finding of the current paper[7].

I choose only the 21 high-income OECD countries for at least two more reasons, besides the fact that the trade-enhancing effects of the internet seems to be less clear within OECD countries[8]. Firstly, it is more proper to use the US index for each sector as the proxy for the other high-income OECD countries, because they tend to share similar technology and have similar sector characteristics. The second reason is that the quality of both the trade and internet data for high-income OECD countries are better.

The bilateral distance and geographic variables, such as whether countries have a colonial tie, whether countries share a common language, border, legal origin, currency, whether countries have joint membership of any regional trade agreements, are from the CEPII GeoDist Database and Gravity Dataset.

---

[6] BACI is the World trade database developed by the CEPII at a high level of product disaggregation. BACI is developed using an original procedure that reconciles the declarations of the exporter and the importer. Original data are provided by the United Nations Statistical Division (COMTRADE database). The harmonization procedure enables to extend considerably the number of countries for which trade data are available, as compared to the original dataset. BACI provides bilateral values and quantities of exports at the HS 6-digit product disaggregation, for more than 200 countries over the period 1995-2007. Further information can be found online, http://www.cepii.fr/anglaisgraph/bdd/baci.html, or in the reference document Gaulier and Zignago (2010).

[7] Results are available upon request.

[8] Evidence on how internet facilitates trade from developing to developed countries is relatively ample. For example, Clarke and Wallsten (2006) find that the internet only promotes trade flows from developing countries to developed countries after instrumenting the number of internet hosts by the competition level of the telecommunication sector. Tang (2006) finds that the communication facilities including internet hosts helps developing countries export more differentiated goods to the US. Antras, Garicano and Rossi-Hansberg (2007) use a model on international production hierarchies to predict that advanced communication technology in the host country can compensate the possible weakness of lacking middle skilled workers in attracting offshoring.

3.2 Routine task intensity

I define each occupation with a 6-digit occ code as a task. The routine task intensity for each sector is then obtained by merging different occupations' routine index with the occupations' corresponding employment shares in each sector of US. As the primary measure of each occupation's routine **analytical** task index, I use the importance of "making decisions and solving problems" in each occupation provided by the July 2012 version of O*NET Database. The original score on the importance level is ranged from 1-100. If the score is higher, it means that "making decisions and solving problems" is relatively more important in the occupation.

Following equation (4), I am able to get the routine index for each task: occ^r, which is obtained by one minus the original score on importance divided by 100. Now the index is normalized between 0 and 1, with a high index denoting more routine task.

$$occ^r = 1 - importance/100 \qquad (4)$$

I have totally 903 tasks with the above index. In order to show a more vivid picture, I list the 10 most routine and the 10 most non-routine tasks in table 1. For the analytical aspect, "historians" is the most routine task, with the index as high as 0.76. On the other hand, the most non-routine task is "government property inspectors and investigators", with the index as low as 0.

[Insert Table 1 Approximately Here]

Similarly, for the **interactive** aspect, I examine the importance of "establishing and maintaining interpersonal relationships" in each occupation. Table 1 show that "pressers, textile, garment, and related Materials" is the most routine task in the interactive aspect (0.76), while "clergy" is the most non-routine task (0.03).

Later, I also check the sensitivity of the baseline results by switching to the importance of "thinking creatively" to measure the analytical aspect and "communicating with supervisors, peers and subordinates" for the interactive aspect.

The employment shares for each task in every 4-digit NAICS2002 sector during 2002-2007 are from Occupational Employment Statistics collected by United States Department of Labor. Data in the year 2006 are used for the baseline estimation, while data in the other years are used for either robustness checks or constructing the instrument variable.

$$r^s = \sum_{occupation} occ^r\, emp^s \qquad (5)$$

As shown in equation (5), in order to calculate the routine task intensity in sector s (r^s), I aggregate the routine index of all the tasks in sector s (occ^r : obtained from equation (4)), using each occupation's employment share in sector s (emp^s : directly from OES) as the weight. I have totally 287 sectors with the above routine task intensity. However, lots of the sectors are non-tradable. So after linking the routine task intensity to the trade data, I get finally 92 sectors. In order to link to the other control variables, the routine task intensity is transferred from 4-digit NAICS2002 to 4-digit NAICS1997 using the publicly-available concordance table[9].

[Insert Table 2 Approximately Here]

Table 2 shows the 10 most routine and the 10 most non-routine sectors ranked by the final routine task intensity. It seems that the two aspects tend to give similar rankings. For example, the most routine sector is "meat product manufacturing" for both aspects. Also, ranking No.1 of the most non-routine sectors in the analytical aspect, "Motor Vehicle Manufacturing" also ranks No.2 of the most non-routine sectors in the interactive aspect.

[Insert Table 3 Approximately Here]

More details such as summary statistics and correlation between the final indexes are presented in table 3 and table 4. For instance, we can see from table 4 that the correlation between the two aspects is between 0.870 and 0.938.

[Insert Table 4 Approximately Here]

My approach in constructing sectors' routine task intensity is quite similar with Costinot, Oldenski and Rauch (2011) and Oldenski (2012). But neither of them focuses on countries' comparative advantage. Specifically, Costinot, Oldenski and Rauch (2011) adopts a routiness index similar with the routine analytical task intensity based on the June 2007 version of O*NET database. Due to the difference in databases, they have only 71 sectors with the routiness index, which are 21 sectors less than the routine analytical task intensity[10]. They find that firms tend to keep the less routine tasks performed within the firm to avoid ex-post bargaining, while outsourcing the routine tasks to save the costs.

Oldenski (2012) uses both analytical and interactive indexes, but for the interactive aspect, she focuses on the importance of "working with the public" or "communicating inside the organization". And her construction approach is a little different, with higher index

[9] It is available at: http://www.census.gov/eos/www/naics/concordances/concordances.html

[10] The index in the current paper contains more sectors mainly because the latest version of O*NET database has much more available occupations. More details about different versions of O*NET database can be seen from here: http://www.onetcenter.org/db_releases.html. Another source of difference comes from the trade database, as I use the BACI database, which has less zeros compared to other trade databases, but this is not likely to be the major cause.

denoting more non-routine sectors. Her key argument is that multinationals are more likely to perform the activities requiring direct communication with consumers in the destination market, while producing goods and services requiring complex within-firm communication in the headquarters for exports.

3.3 The ICT measures

I have several options for the internet measures. The first one is the number of internet users per 100 households from ITU (International Telecommunication Union). It has been used by Clarke and Wallsten (2006), Timmis (2012), Vemuri and Siddiqui (2009), etc. Another option is the broadband ranking index from ITIF (The Information Technology & Innovation Foundation). It has an overall score for each OECD country, which is the sum of the standard deviation score for each of the three indicators about internet: penetration measured by subscribers per household, average speed, price per month for 1 mbps measured using the fastest technology.

I choose the broadband ranking index from ITIF to estimate the baseline model, based on the following considerations: the broadband ranking index is more comprehensive, as it contains not only the quantity of internet users but also the speed and price of the broadband; it has already been scaled to the relative terms, which can better reflect the essence of "comparative" advantage; it is also proved to be more robust later by the empirical results. One factor restraining the broadband ranking index from ITIF from being popular is that it ranks only 30 OECD countries in 2006 and 2007, while the internet penetration index and many other indexes from ITU are publicly-accessible for more than 200 countries during 2000-2011. However, the limited number of countries is not a problem for the current study, as I focus only on the 21 high-income OECD countries.

Apart from the internet penetration index from ITU, I also use the broadband penetration index from OECD broadband portal for robustness check, which measures the number of fixed broadband subscribers per 100 inhabitants. It has been used by Czernich, et al. (2011) to check whether broadband infrastructure has brought economic growth to the OECD countries. As mentioned by Czernich, et al. (2011), the broadband penetration index is not perfect, because it does not consider the variety of the broadband across countries and it omits the mobile broadband subscription. Similar with Timmis (2012), I calculate the percentage of broadband connections by dividing the number of fixed broadband subscribers per 100 inhabitants by the number of fixed telephone line subscribers per 100 inhabitants, both of which are from ITU.

Though I focus mainly on the internet, I also check other ICT measures such as the ICT development index and the computer density. The ICT development index (hereafter IDI) is again from ITU and it considers three aspects of the ICT: ICT infrastructure and access, ICT use intensity, and ICT related skills. Mattes, Meinen and Pavel (2012) adopt the IDI to study whether the level of ICT development affects trade flows within EU and between EU and its main trading partners. And they find significant results due to not controlling for the unobserved bilateral factors. Here in the current paper, I use the IDI from year 2007, as it is the closest available index to the sample period of the baseline model. The computer density is from Econstats and measured by the log of number of computers per 100 inhabitants. In order to control for alternative communication channels, fixed phone density and mobile phone density are also needed. They are again from ITU and measured respectively by the log of number of fixed/mobile phones per 100 inhabitants.

Table 5 reports the summary statistics of all the ICT measures, along with other country characteristics. We can see that the standard deviation of the broadband ranking index is 1.851, which is much larger than the other ICT measures and other country characteristics. So there is large enough variance across the 21 countries' broadband ranking index and it is good for the identification.

[Insert Table 5 Approximately Here]

Table 6 shows the correlation of all the country characteristics. We can see that the number of internet users can only explain 45% of the variations in the broadband ranking, while the number of broadband subscribers accounts for 70%. Moreover, the correlation between the internet users and computer density is as high as 0.785, which fits our intuition, as most people use computers to log on the internet. Furthermore, the negative correlation between the cell phone intensity and the internet measures suggests that these two communication tools are substitutes to some extent.

[Insert Table 6 Approximately Here]

More details can be found in table 7, which ranks the 21 countries based on the 6 different internet-related indexes. One thing worth noticing is that though Portugal and Hungary rank relatively low based on the internet penetration and broadband penetration index, they have quite high percentage of broadband connections, which is probably caused by the later-mover advantage.

[Insert Table 7 Approximately Here]

3.4 Other control variables

Data on the skill, capital and material intensities of production are from the updated version of NBER-CES Database provided by Becker and Gray. Specifically, skill intensity is measured by the ratio of number of non-production workers to the total employment. Capital intensity is the ratio of capital stock to the total employment. Material intensity is the ratio of materials costs to the sum of materials costs and value-added. As data on 2006 is not available, all the above indexes used in the current paper are obtained by averaging the indexes in 2003-2005.

Following Becker (2003), countries' financial development in 2006 is measured by the log of each country's private bank credit to GDP ratio, which is obtained from World Bank database. Herfindahl index of input concentration, adopted by Levcheko (2007), measures the number of varieties used in production as inputs. Based on Rauch (1999), contract intensity from Nunn (2007) measures the intensity of using contracts in input purchases in each sector of US in 1997. There are two sets of contract intensities and I choose the one constructed by utilizing both reference-priced and differentiated inputs[11]. From Costinot (2009a), complexity measures how long it takes to make a worker become fully trained and qualified at a job, given that he/she has already had entry-level experience and education.

Volatility measures the variation of sales growth in each sector during 1980-2004, and it is constructed by Cuñat and Melitz (2012). Industry-specific skill intensity is from Tang (2012), which measures the importance of relationship-specific investment from the employees in each sector during 1985-1993. Both the volatility index and industry-specific skill intensity are originally classified by SIC code. So I again use the concordance tables from Pierce and Schott (2012) to transfer them to 4-digit NAICS 1997 code.

Data on countries' stocks of human capital and physical capital are from Caselli (2005). A country's stock of human capital is the natural log of the ratio of workers with a high school degree to those who did not. The stock of physical capital is the natural log of the average capital stock per worker. The measure for human capital is from 1995, while the physical capital is from 1996. Natural resources endowment is the natural log of the estimated dollar value of natural resources stock per worker. It is from the World Bank's (1997) "Expanding the Measure of Wealth" dataset. So all the three measures are around a decade prior to the date of trade flows in the baseline model, but they are the closest data available. An interesting thing is that table 5 shows that the correlation between internet users/computer density and the stock of human capital is as high as 0.833, which fits the skill-biased technological change (SBTC) hypothesis in labor economics and meanwhile gives us more confidence in using the data on human capital in the baseline model.

[11] It will not change the main results by switching to the other index, which is constructed by using only the differentiated inputs.

Countries' legal quality is from Gwartney and Lawson (2004)[12]. Countries' labor law rigidity is from Tang (2012). Each country's GDP in 2006 is from the World Bank.

4. Missing network effects for bilateral internet adoption

4.1 Effects for unilateral internet adoption

In this section, I check whether the increase of either exporter's or importer's internet adoption would lead to higher bilateral trade. As a quick check, I calculate the average log bilateral exports of every country across destinations and sectors, and link it to the exporting country's broadband ranking index. As shown in Figure 1, the upward line indicates that countries with higher broadband ranking index generally export more. It means that the impact of exporter's internet adoption on trade volume is large and significant if not controlling for other variables.

[Insert Figure 1 Approximately Here]

The next step is to estimate equation (7) and (8), with r_c and r_d as the key parameters in both equations. Equation (7) controls for the observable bilateral factors and time-varying country specific effects. If r_c and r_d in equation (7) are positive and significant, it means that higher internet adoption of either the exporter or the importer can increase bilateral trade.

$$\mathrm{X_{cdt}} = \alpha_1 Distw_{cd} + \alpha_2 Colony_{cd} + \alpha_3 Lang_{cd} + \alpha_4 Border_{cd} + \alpha_5 Legal_{cd} + \alpha_6 Currency_{cd} + \alpha_7 RTA_{cd} + \beta_{ct} + \theta_{dt} + r_c Internet_{ct} + r_d Internet_{dt} + \varepsilon_{\mathrm{cdt}} \quad (7)$$

Where $\mathrm{X_{cdt}}$ is the bilateral trade volume from country c to destination d in year t; the seven gravity factors are the same as in equation (2); β_{ct} and θ_{dt} are respectively exporter-year and importer-year fixed effects; $Internet_{ct}$ is the internet measure of country c; $Internet_{dt}$ is the internet measure of country d; $\varepsilon_{\mathrm{cdt}}$ is an error term which is assumed to be independent across year t and country pair c and d.

Equation (8) uses country pair fixed effects to capture the baseline trade flows between country pairs. In this case, all the time invariant observable bilateral factors drop out, such as distance, common language, etc. If r_c and r_d in equation (8) are positive and significant, it still means that higher internet adoption in either the exporter or the importer can increase bilateral trade. Since equation (8) controls for unobservable bilateral factors and does not have the concern of possible nonlinear impacts of the bilateral factors such as distance, r_c and r_d in equation (8) is more trustworthy than in equation (7).

$$\mathrm{X_{cdt}} = \alpha_{cd} + \beta_{ct} + \theta_{dt} + r_c Internet_{ct} + r_d Internet_{dt} + \varepsilon_{\mathrm{cdt}} \quad (8)$$

[12] Again, the results will not change if switching to the rule of law from Kaufmann, Kraay, and Mastruzzi (2003).

Where α_{cd} denotes the country pair fixed effects, and the rest notations are the same as in equation (7).

[Insert Table 8.1 Approximately Here]

I use totally four sets of internet indexes: 1) internet penetration index from ITU, 2) percentage of fixed broadband connections, 3) fixed broadband penetration index from OECD and 4) broadband ranking index from ITIF. And the estimation results are reported in table 8.1. Column (1) - (6) are obtained using data in 2002-2007. Specifically, column (1) and (2) use the internet penetration index to estimate equation (7) and (8). Column (3) and (4) add the percentage of broadband connection as another explanatory variable. Column (5) and (6) use broadband penetration index directly. Column (7) - (8) use the broadband ranking index and hence only have data in 2006-2007. We can see that the coefficients for both the exporter and importer's coefficients are almost all positive and highly significant. So the unilateral internet adoption certainly facilitates trade within developed countries[13]. The only exception is in column (5), the importer's coefficient is negative. But as mentioned earlier, we trust the result of column (6) in this case, which has positive and significant coefficient for the importer.

4.2 The network effects of bilateral internet adoption

In this section, I check whether the network effects of bilateral internet adoption vanish with the 21 high-income OECD countries in 2002-2007. Following Timmis (2012), the bilateral internet index are calculated and normalized by the most connected country pair, which is shown by equation (9). I again use the total four sets of internet indexes to obtain the bilateral internet connection indexes.

$$Internet_{cdt} = \frac{Internet_{ct} * Internet_{dt}}{max_{i,j}(Internet_{it} * Internet_{jt})} \quad (9)$$

Where $Internet_{cdt}$ is the bilateral internet connection between country c and destination d in year t; $Internet_{ct}$ measures the internet adoption in country c in year t; $Internet_{dt}$ measures the internet adoption in country d in year t; $max_{i,j}(Internet_{it} * Internet_{jt})$ measures the most connected country pair's bilateral internet connection.

Then equation (10) and (11) are estimated, with γ as the key parameter in both equations. If γ in equation (10) and (11) are both positive and significant, it means that country

[13] The general conclusion holds with estimating a cross-section using only one year data during 2002-2007, or even using the cable TV penetration in 1996 as an instrument to solve the possible endogeneity. The results are available upon request.

pairs with higher bilateral internet index tend to trade more with each other than the rest country pairs, so it indicates the existence of network effects for bilateral internet adoption.

$$\mathrm{X_{cdt}} = \alpha_1 Distw_{cd} + \alpha_2 Colony_{cd} + \alpha_3 Lang_{cd} + \alpha_4 Border_{cd} + \alpha_5 Legal_{cd} + \alpha_6 Currency_{cd} + \alpha_7 RTA_{cd} + \beta_{ct} + \theta_{dt} + \gamma Internet_{cdt} + \varepsilon_{\mathrm{cdt}} \quad (10)$$

Where $Internet_{cdt}$ is obtained from equation (9) and the rest variables are the same as in estimation (7).

The difference between equation (10) and (11) are the same as between equation (7) and (8). So if γ in equation (10) has different sign from γ in equation (11), results in equation (11) are more trustworthy.

$$\mathrm{X_{cdt}} = \alpha_{cd} + \beta_{ct} + \theta_{dt} + \gamma Internet_{cdt} + \varepsilon_{\mathrm{cdt}} \quad (11)$$

Where α_{cd} denote the country pair fixed effects, and the rest notations are the same as in equation (10).

[Insert Table 8.2 Approximately Here]

Table 8.2 reports the estimation results. The arrangement of specifications is similar as in table 8.1. Specifically, Column (1) and (2) adopt the bilateral internet penetration index to estimate equation (10) and (11). We can see that the coefficient of the internet penetration index is positive and significant in column (1), and then become negative in column (2). Column (3) and (4) add the percentage of broadband connection, but the coefficients for this new variable are negative in both columns. Column (5) and (6) adopt bilateral broadband penetration index, which still give us negative coefficients. So consistent with Timmis (2012), I find that the trade-enhancing effects of the internet are more prominent when not controlling for the unobservable bilateral factors, and there are no positive effects for the broadband, either adding the percentage of broadband connection or directly using the broadband penetration.

The above internet index does not consider the difference in broadband across countries, while the truth is that the 21 high-income OECD countries vary vastly in terms of the speed and price of the broadband, apart from the number of subscription. In order to check whether the speed and price of broadband affect the aggregate trade volume, we switch to the broadband ranking index in column (7) and (8). Due to availability of the broadband ranking index, I have to restrict the sample years to 2006-2007. Now the coefficient stays negative in column (7), and becomes positive in column (8), but it is still insignificant. Overall, I find no network effects of the internet adoption across borders, which suggests that reducing the bilateral transaction costs might not be the dominant channel for the internet to affect the trade flows within developed countries. So the next step is to identify what is the possible specific channel.

5. Internet adoption and sector-level bilateral trade

5.1 The baseline results

In this section, I examine whether the internet facilitate trade via increasing the productivity of less routine sectors. Before estimating the baseline model, I run another check on the raw data. Specifically, I classify the 21 countries into two groups based on whether they have above-average broadband ranking index, and then divide the sectors into two groups based on whether they have above-average routine task intensity. After aggregating the trade volume into totally four groups, I find that for countries with lower internet penetration, only 78.7% of exports are from less routine sectors, while the corresponding ratio is 83.2% for countries with higher internet penetration. If switching from routine analytical task intensity to routine interactive task intensity, the two ratios become 66.0% and 73.2% respectively. It means that compared to countries with lower internet penetration, countries with higher internet penetration export more in less routine sectors.

Now let us look at the estimation results of equation (1), which are reported by table 9 and 10. As shown in the first row, the coefficients for the interaction term composed by routine task intensity and countries' broadband ranking index are always negative and significant at the 1% level. It means that countries with higher broadband ranking export more in less routine sectors. So it fits the famous mechanism in labor economics: information and communication technology (ICT) complements workers in performing non-routine analytical and interactive tasks. The mechanism has firstly been highlighted by Autor, Levy and Murnane (2003), and then explored by a bunch of literature on job polarization such as Goos and Manning (2007), Michaels, Natraj and Van Reenen (2011), etc. However, to the best of my knowledge, I am the first to apply it in studying countries' comparative advantage.

[Insert Table 9 Approximately Here]

More specifically, table 9 focuses on the analytical aspect. Column (1) reports the results without any control. Column (2) adds two endowment interaction terms: skill intensity times human capital and capital intensity times physical capital. Column (3) adds another endowment control: material intensity times the natural resources. It seems that among the three typical endowment controls, only the skill intensity interaction term have significant impact on trade pattern between developed countries, while the other two always have insignificant coefficients.

Column (4) controls for all the trade patterns appeared in the recent literature. The interaction term of capital intensity and financial development has positive and significant coefficient, which matches Beck (2003) and Manova (forthcoming). It also shows that development countries with better financial development instead of higher physical capital stock have comparative advantage in sectors with high capital intensity. The next are the three interaction terms of legal quality: only the complexity channel is positive and significant at 10% level, which means that the patterns in Levchenko (2007) and Nunn (2007) are not sustainable after restricting the trade flows to those within the high-income OECD countries. The interaction term of complexity and human capital have positive and highly significant coefficient, which supports Costinot (2009a). Consistent with Cuñat and Melitz (2012), the coefficient of the interaction term of volatility and labor law rigidity is negative and significant at 10% level, which means that countries with more flexible labor law export more in the volatile sectors. Though not significant, the positive sign of the interaction between specific skill intensity and labor law rigidity indicates that countries with more rigid labor law export more in sectors requiring more specific skills from the workers, which is in line with Tang (2012). The above results for the trade patterns are robust with dropping the internet interaction term, or switching the year of trade data from 2006 to 1998, which is the earliest year of the BACI database, so it is safe to say that the results are not driven by the time gap between the trade data and some of the sector or country characteristics[14].

So far all the t-statistics in the brackets are obtained by two-way clustering, with the cluster variables including both the country pair and the sector. The existing literature in countries' comparative advantage only cluster the standard errors by country pair (Chor, 2010; Manova, forthcoming; Tang, 2012), which is insufficient in the current case. In order to illustrate the significance of two-way clustering, I use the same specification as column (4) in column (5) and (6), but report the t-statistics obtained with either only the sector or only the country pair as the cluster variable. Specifically, column (5) shows that if clustering the standard errors only by sector, the t-statistics tend to be a little larger in the absolute magnitude than two-way clustering. Column (6) indicates that the t-statistics become doubled or even tripled, if only clustering the country pair. For example, the material intensity interaction term now becomes negative and highly significant. So is the interaction term of contract intensity and legal quality, which does not make any sense.

As all the reported coefficients are standard beta coefficients, I can easily check the relative contribution of each term by comparing the coefficients across all the interaction terms. For instance, results in column (3) show that a one standard deviation decrease in the broadband ranking interaction term increases the dependent variable by 0.65 standard

[14] The results for year 1998 are available upon request.

deviations, while a simultaneous one standard deviation increase in the human capital interaction only increase the dependent variable by 0.46 standard deviations. Obviously, broadband ranking is a non-negligible source of comparative advantage between developed countries.

[Insert Table 10 Approximately Here]

With the specifications arranged the same as in table 9, table 10 shows that the pattern sustains after changing the focus from the analytical to interactive aspect. The only difference is that the magnitude of coefficients and explanatory power of the broadband ranking interaction term now drop a little.

5.2 Variations of the specification

Table 11 reports the results of equation (2), which use observable bilateral factors instead of country pair fixed effects. Column (1) – (3) use the routine analytical task intensity, while column (4) - (6) focus on the routine interactive task intensity. All the bilateral gravity factors have the expected sign when the coefficients are significant, and their coefficients are almost the same when using the two routine task intensity. All the coefficients of the interaction terms have similar sign, magnitude and significance level with estimation results of equation (1), indicating that ignoring the unobservable bilateral factors are not a big issue here.

[Insert Table 11 Approximately Here]

Table 12 shows the estimates of equation (3), which adopts the importer-sector fixed effects instead of simply the sector fixed effects. We can see that the key coefficients are close to the results in table 9 and 10, indicating that it does not matter to only control for the sector fixed effects in the baseline model.

[Insert Table 12 Approximately Here]

5.3 Isolating the effects of other country and sector characteristics

Table 13 reports the results after controlling for other channels for either the routine task intensity or the internet penetration to affect the trade pattern. Again, column (1)-(3) focus on the analytical aspect, and column (4)-(6) on the interactive aspect. In all the regressions, I keep the key interaction term composed by routine task intensity and broadband ranking index, and also the three endowment interaction terms as explanatory variables. In order to control for other communication tools, I use the log of number of fixed/mobile phones per 100 inhabitants from ITU to measure the fixed-phone and mobile phone density, and add their interactions with routine task intensity as controls. The results are listed in column (1) and (4). In column (2) and (5), I control for the interaction terms composed by routine task intensity and other country characteristics such as human capital, physical capital, etc. In column (3) and (6), I take into account the interaction terms composed by other sector characteristics and internet penetration. Shown by the first row, the coefficients for both the analytical and interactive aspects are still negative and significant.

[Insert Table 13 Approximately Here]

I have also tried all the regressions without the three endowment controls. Shown by table A1 of the appendix, the results are essentially the same.

5.4 Variations of the sample period

In the baseline model, estimates are obtained by using the cross-section data in year 2006. For sensitivity analysis, I firstly change the sample year to 2007. As shown by panel A in table 14, the key parameter remains negative and significant.

[Insert Table 14 Approximately Here]

In order to further check the validity of the basic pattern in a panel dataset, I also use the trade flows from 2002-2006 as the dependent variable. As shown in equation (9), I now use four sets of fixed effects to capture the baseline trade flows[15]. This way I control for both time-varying country specific effects and unobservable bilateral factors, which means I fully control for the multilateral resistance terms. Given access to the yearly employment data, I am able to construct the yearly routine task intensity. But due to data constrain, I have to let almost all the rest sector characteristics and country endowments remain constant during 2002-2006. Fortunately, the key parameters stay negative and significant, which can be seen from panel B of table 14.

$$\mathrm{X}_{\mathrm{cdt}}^{\mathrm{s}} = \alpha_{cd} + \theta_{ct} + \varphi_{dt} + \beta_t^s + \gamma_1 r^s BR_c + \gamma_2 h^s H_c + \gamma_3 k^s K_c + \gamma_4 m^s M_c + \gamma_5 sc^s CC_c + \varepsilon_{\mathrm{cdt}}^{\mathrm{s}} \quad (9)$$

Where $\mathrm{X}_{\mathrm{cdt}}^{\mathrm{s}}$ denotes exports from country c to destination d in sector s and year t; θ_{ct} and φ_{dt} are time-varying country pair fixed effects; β_t^s are the sector-year fixed effects, which aim to capture the variation across sector s in year t; the rest notations are the same as in equation (1).

[15] It will not make any difference if using the following specification: $\mathrm{X}_{\mathrm{cdt}}^{\mathrm{s}} = \alpha_{\mathrm{cdt}} + \beta_{\mathrm{t}}^{\mathrm{s}} + \gamma_1 \mathrm{r}^{\mathrm{s}}\mathrm{BR}_{\mathrm{c}} + \gamma_2 \mathrm{h}^{\mathrm{s}}\mathrm{H}_{\mathrm{c}} + \gamma_3 \mathrm{k}^{\mathrm{s}}\mathrm{K}_{\mathrm{c}} + \gamma_4 \mathrm{m}^{\mathrm{s}}\mathrm{M}_{\mathrm{c}} + \gamma_5 \mathrm{sc}^{\mathrm{s}}\mathrm{CC}_{\mathrm{c}} + \varepsilon_{\mathrm{cdt}}^{\mathrm{s}}$, where α_{cdt} are the country pair-year fixed effects.

5.5 Variations of either the routine task intensity or the ICT measurements

Table 15 provides more robustness check by varying the measures of either the routine task intensity or the internet index. In panel A, I change the measures of the routine task intensity. For the analytical aspect, I focus on the importance of “thinking creatively” instead of “making decisions and solving problems”. For the interactive aspect, I check the importance of “communicating with supervisors, peers or subordinates” instead of “establishing and maintain interpersonal relationships”. But the results are not much difference from the baseline results.

[Insert Table 15 Approximately Here]

In panel B, I switch from the broadband ranking index to the internet penetration index from ITU: the number of internet users per 100 households in each country. Then I use the broadband penetration index from OECD in panel C, the ICT development index in panel D, and computer density in panel D. Results of panel B-D exhibit the same pattern: the coefficient for the analytical aspect remains significant, but the interactive aspect turns insignificant after adding the endowment controls. It means the features of the broadband, i.e, the average speed and price for the fastest technology, seem to be vital when workers use the internet to perform non-routine interactive tasks. It fits our common sense, as video-conferences via Skype or other software indeed need relatively larger bandwidth to transfer the sound and image.

5.6 Zeros trade flows

When I use the traditional OLS estimation, the independent variable is the log of bilateral exports, so all the zero trade flows are omitted. Omitting the zeros can bias the results, though in the current paper the bias tends to be less severe, as I focus on trade within developed countries and only 6.4% (=2,467/38,640*100%) of the observations are zeros.

[Insert Table 16 Approximately Here]

Anyway, in order to take care of the zeros, I switch to PPML (Poisson Pseudo Maximum Likelihood) proposed by Santos-Silva and Tenreryo (2006). In table 16, I repeat estimating the main specifications, and the coefficients of the key interaction term are still negative and significant. Meanwhile, since there is no way to implement two-way clustering with PPML, the standard errors are obtained by bootstrapping.

5.7 Endogeneity

Another problem is the endogeneity. One concern is the reverse causality, which suggests that countries’ trade openness and trade composition might affect its internet penetration. Another concern is simultaneity or omitted variables, as data on the trade flows and internet adoption are both from the year 2006, which means that they might be all affected by some systematic shocks in 2006 or some government policies implemented in 2006. Similarly, the employment shares of US in 2006, which is used to construct the routine task intensity, might be influenced by the trade flows or internet penetration of US in 2006[16]. Moreover, both the routine task intensity and the broadband ranking index in 2006 may be correlated to other sector and country characteristics in 2006, which causes biases when controlling for the other trade patterns. Finally, there might be some measurement errors in both the broadband ranking index and routine task intensity. In order to alleviate the above concerns, I use an Instrument Variable (IV) approach.

Specifically, the broadband ranking index in 2006 is instrumented by cable TV penetration index in 1996. It is a good candidate for instrument variable of the broadband ranking index in 2006, because the deployment of broadband started after 1996, and it is been proved by Czernich, et al. (2011) that the cable TV penetration in 1996 is correlated with the diffusion of broadband across countries but not other technologies such as mobile phone and computer[17]. Additionally, the cable TV penetration index in 1996 is not likely to be affected by the trade flows, shocks or governments' policies in 2006.

Meanwhile, the routine task intensity in 2006 is instrumented by the lagged routine task intensity in 2002, which is the earliest available routine task intensity. Obviously, routine task intensity in 2002 is correlated to the routine task intensity in 2006, but it is less likely to be affected by the trade flows or internet penetration of US in 2006.

Consequently, the interaction term composed by the two instrument variables gives me a superb instrument for the key interaction term in the baseline model, and the results of the IV approach are in table 17. As shown in Panel A, the instrument interaction term is highly significant and the F-statistics are quite high in the first-stage estimation.

[Insert Table 17 Approximately Here]

Panel B reports the second-stage results. We can see that the coefficients of the key interaction term remain negative and highly significant. The coefficients also exhibit a pattern which is not shown by the previous OLS or PPML results: the standard beta coefficient decreases after adding the three endowment controls, and then decreases further after adding

[16] Literature in labor economics has long argued that offshoring to developing countries such as China has changed the labor market structure of developed countries. Also, Crandall, Lehr and Litan (2007) find that nonfarm private employment and employment in several industries is positively associated with broadband use.

[17] Czernich et. al (2011) adopt both the cable TV penetration and voice telephone line penetration as the instrument variables. They use a probit model in the first stage. But here I use OLS in the first stage, because I don't need to predict the yearly diffusion and the results of linear first-stage estimations tend to give more accurate results. Hence, I have to drop the voice telephone line penetration, because it turns out to be insignificant in the first-stage linear estimation.

all the rest controls. One may suspects that OLS and PPML results do not show the pattern because the number of observations changes after adding the controls, which make the coefficients not comparable. So I try all the estimations again with the same sample. Results in table A2 of the appendix show that even after using the same sample, results obtained by OLS and PPML still cannot give the pattern of sequential decreasing, while the IV results still exhibit the pattern. Hence, the sequential decreasing of the IV results indicates the reliability and superiority of the IV approach.

However, the endogeneity tests of the internet interaction term are larger than 0.05, except in column (1) and (4). It suggests that in specification (2)-(3) and (5)-(6), the IV estimates are not significantly different from the OLS estimates, so it is not necessary to use the IV approach. It makes sense, because trade openness is not likely to be a significant determinant of Internet penetration (Chinn and Fairlie, 2007), and OLS has already taken care of the omitted variables with adoption of fixed effects and controlling for all the major sources of comparative advantage.

6. Conclusion

In this paper, I try to shed some light on the relationship between internet adoption and trade structure between developed countries. It is a novel research direction, as the existing literature on internet and trade focus only on aggregate bilateral trade, and the network effect for bilateral internet connections on trade between developed countries seems missing. I find that countries with higher broadband ranking index have comparative advantage in less routine sectors. The pattern is robust to various specifications, even after taking care of zero-trade flows and possible endogeneity. It indicates that the internet facilitates trade via a channel other than simply reducing the bilateral transaction costs. Actually, it fits the famous phenomenon high-lightened by labor economists: Information and Communication Technology (ICT) complements workers in performing non-routine analytical and interactive tasks. It also proves that the ICT affects productivity asymmetrically across sectors.

The empirical methodology in the current paper is in line with existing literature on countries' comparative advantage, but I add internet adoption as another source of comparative advantage, and check the sustainability of all the trade patterns in recent literature after restricting the trade flows to those within high-income OECD countries. Especially, I use two-way clustering to obtain the robust standard errors, which is more accurate but has never been implemented by this strand of literature before.

Reference

Anderson, J. E., van Wincoop, E., 2003. Gravity with gravitas: a solution to the border puzzle. American Economic Review 93(1), 170-192.

Antras, P., Garicano, L., and Rossi-Hansberg, E., 2008. Organizing offshoring: middle managers and communication costs. The Organization of Firms in a Global Economy, Harvard University Press, 311-339.

Autor, D. H., Levy, F., and Murnane R. J., 2003. The skill content of recent technological change: an empirical exploration, The Quarterly Journal of Economics 118(4), 1279-1333.

Beck, T., 2003. Financial dependence and international trade. Review of International Economics 11, 296–316.

Bartelsman, E., Wayne G., 1996. The NBER Manufacturing Productivity Database, Technical Working Paper 205. National Bureau of Economic Research.

Caselli, F., 2005. Accounting for cross-country income differences. In Aghion, P. and S. Durlauf (eds.) Handbook of Economic Growth.

Cameron, A. C., Gelbach J. B., and Miller D. L., 2011. Robust inference with multi-way clustering, Journal of Business & Economic Statistics 29(2), 238-249.

Chinn, M. D., Fairlie, R. W., 2007. The determinants of the global digital divide: a cross-country analysis of computer and internet penetration, Oxford Economic Papers, 59(1), 16-44.

Clarke, G., Wallsten, S., 2006. Has the internet increased trade? Developed and developing Country evidence. Economic Inquiry 44(3), 465-484.

Chor, D., 2010. Unpacking source of comparative advantage: a quantitative approach. Journal of International Economics 82(2), 152–167.

Costinot, A., 2009a. On the origins of comparative advantage. Journal of International Economics 77(2), 255–264.

Costinot, A., Oldenski, L. and Rauch, J., 2011. Adaptation and the boundary of multinational firms, the Review of Economics and Statistics 93(1), 298–308.

Crandall, R., Lehr, W., and Litan R., 2007. The effects of broadband deployment on output and employment: a cross-sectional analysis of U.S. data, Washington: The Brookings Institution 6, 1-35.

Czernich, N., Falck, O., Kretschmer T. and Woessmann L., 2011. Broadband Infrastructure and Economic Growth, the Economic Journal 121(552), 505–532.

Cuñat, A., Melitz, M., 2012. Volatility, labor market flexibility, and the pattern of comparative advantage. Journal of the European Economic Association 10, 225-254.

Debaere, P., 2003. Relative factor abundance and trade. Journal of Political Economy 111, 589-610.

Eaton, J., Kortum, S., 2002. Technology, geography, and trade. Econometrica 70(5), 1741–1779.

Friedrich, R., Sabbagh K., El-Darwiche B., and Singh M., 2009. Digital highways: the role of government in 21st-century Infrastructure. Booz & Company report.

Fink, C., Mattoo, A., Neagu, I. C., 2005. Assessing the impact of communication costs on international trade. Journal of International Economics 67(2), 428-445.

Freund, C.L., Weinhold, D., 2004. The effect of the internet on international trade. Journal of International Economics 62(1), 171-189.

Gwartney, J., Lawson, R., 2004. Economic Freedom of the World: 2004 Annual Report.The Fraser Institute, Vancouver.

Gaulier, G., Zignago, S., 2010. BACI: International Trade Database at the Product-level. The 1994-2007 Version. CEPII Working Paper No. 2010-23.

Goos, M., Manning, A., 2007. Lousy and lovely jobs: the rising polarization of work in Britain. The Review of Economics and Statistics 89(1), 118-133.

Goos, M., Manning, A., and Salomons A., 2011. Explaining Job Polarization: the roles of technology, offshoring and institutions. CES working paper, University of Leuven.

Grossman, G.M., Rossi-Hansberg, E., 2012. Task trade between similar countries. Econometrica 80(2), 593-629, 03.

ITU, 2010. Definitions of World Telecommunication / ICT Indicators. Available from: http://www.itu.int/ITUD/ict/material/TelecomICT_Indicators_Definition_March2010_for_Ib.pdf [Accessed 5/9/2011]

Kaufmann, D., Aart K., and Massimo M., 2006. "Governance matters V: aggregate and individual governance indicators for 1996-2005. World Bank Policy Research Working Paper 4012.

Levchenko, A., 2007. Institutional quality and international trade. Review of Economic Studies 74 (3), 791–819.

Manova, K., Credit Constraints, Heterogeneous Firms, and International Trade. Forthcoming at the Review of Economic Studies.

Mattes, A., Meinen, P., and Pavel, F., 2012. Goods Follow Bytes: The Impact of ICT on EU Trade. DIW Working Paper 1182.

Michaels, G., Natraj, A. and Van Reenen, J., Has ICT polarized skill demand? Evidence from eleven countries over 25 Years. Forthcoming at the Review of Economics and Statistics.

Nunn, N., 2007. Relationship-specificity, incomplete contracts and the pattern of trade. Quarterly Journal of Economics 122 (2), 569–600.

Oldenski, L., 2012. Export versus FDI and the communication of complex information, Journal of International Economics 87, 312–322.

OECD, 2012. The Impact of Internet in OECD Countries, OECD Digital Economy Papers, No.200.

Pierce, W., Schott, P., 2012. A concordance between ten-digit U.S. harmonized system codes and SIC/NAICS product classes and industries. Journal of Economic and Social Measurement 37(1-2): 61-96.

Richard G. Harris, 1995. Trade and communication costs, Paper prepared for the Canadian Journal of Economics Special Memorial Symposium in memory of Douglas D. Purvis, 46-75.

Romalis, J., 2004. Factor proportions and the structure of commodity trade. American Economic Review 94, 67-97.

Santos-Silva, J. M. C., Tenreryo, S., 2006. The log of gravity, the Review of Economics and Statistics 88(4), 641-658.

Stiroh K. J., 2002. Information technology and the U.S. productivity revival: what do the industry data say? The American Economic Review 92(5), 1559-1576

Tang, H., 2012. Labor market institutions, firm-specific skills, and trade patterns, Journal of International Economics 87(2), 337–351.

Tang, L., 2006. Communication costs and trade of differentiated goods, Review of International Economics 14, 54-68.

Timmis, J., 2012. The Internet and International Trade in Goods, Discussion Paper No. 12/03, University of Nottingham.

Van Ark, B., O'Mahony, M., and Timmer, M.P., 2008. The productivity gap between Europe and the United States: trends and causes, Journal of Economic Perspectives 22 (1), 25-44.

Van Reenen, J., 2011. Wage inequality, technology and trade: 21st century evidence. Labour Economics 18 (6), 730–741.

Vemuri, V. K., Siddiqui, S., 2009. Impact of Commercialization of the Internet on International Trade: A Panel Study Using the Extended Gravity Model. The International Trade Journal 23(4), 458-484.

Table 1. The 10 most routine and non-routine tasks

Analytical				Interactive			
Panel A: The 10 most routine tasks (from routine to non-routine)							
No.	**Occ**	**Routine**	**Task**	**No.**	**Occ**	**Routine**	**Task**
1	193093	0.76	Historians	**1**	516021	0.76	Pressers, Textile, Garment, and Related Materials
2	452092	0.75	Farm workers and Laborers, Crop	**2**	519199	0.71	Recycling and Reclamation Workers
3	173024	0.73	Electro Mechanical Technicians	**3**	152091	0.71	Mathematical Technicians
4	452041	0.73	Graders and Sorters, Agricultural Products	**4**	519041	0.70	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders
5	516041	0.69	Shoe and Leather Workers and Repairers	**5**	452091	0.69	Agricultural Equipment Operators
6	419012	0.67	Models	**6**	513022	0.68	Meat, Poultry, and Fish Cutters and Trimmers
7	512041	0.66	Structural Metal Fabricators and Fitters	**7**	519197	0.67	Tire Builders
8	537033	0.64	Loading Machine Operators, Underground Mining	**8**	514071	0.67	Foundry Mold and Coremakers
9	513022	0.63	Meat, Poultry, and Fish Cutters and Trimmers	**9**	499096	0.65	Riggers
10	419011	0.63	Demonstrators and Product Promoters	**10**	514052	0.65	Pourers and Casters, Metal
Panel B: The 10 most non-routine tasks (from non-routine to routine)							
No.	**Occ**	**Routine**	**Task**	**No.**	**Occ**	**Routine**	**Task**
1	131041	0.00	Government Property Inspectors and Investigators	**1**	212011	0.03	Clergy
2	532021	0.01	Air Traffic Controllers	**2**	211013	0.04	Marriage and Family Therapists
3	291069	0.02	Sports Medicine Physicians	**3**	291141	0.05	Advanced Practice Psychiatric Nurses
4	291069	0.02	Neurologists	**4**	411012	0.05	FirstLine Supervisors of NonRetail Sales Workers
5	291069	0.02	Radiologists	**5**	211022	0.05	Healthcare Social Workers
6	291069	0.03	Hospitalists	**6**	131121	0.05	Meeting, Convention, and Event Planners
7	291061	0.05	Anesthesiologists	**7**	211023	0.06	Mental Health and Substance Abuse Social Workers
8	291069	0.05	Ophthalmologists	**8**	112022	0.06	Sales Managers
9	291151	0.05	Nurse Anesthetists	**9**	131151	0.06	Training and Development Specialists
10	291161	0.05	Nurse Midwives	**10**	112031	0.07	Public Relations and Fundraising Managers

Table 2. The 10 most routine and non-routine sectors

Analytical				Interactive			
Panel A: The 10 most routine sectors (from routine to non-routine)							
No.	**Naics4**	**Routine**	**Sector**	**No.**	**Naics4**	**Routine**	**Sector**
1	3116	0.445	Meat Product Manufacturing	**1**	3116	0.478	Meat Product Manufacturing
2	3117	0.431	Seafood Product Preparation and Packaging	**2**	3152	0.450	Cut and Sew Clothing Manufacturing
3	3152	0.430	Cut and Sew Clothing Manufacturing	**3**	3117	0.445	Seafood Product Preparation and Packaging
4	3151	0.419	Clothing Knitting Mills	**4**	3151	0.437	Clothing Knitting Mills
5	3162	0.406	Footlar Manufacturing	**5**	3262	0.434	Rubber Product Manufacturing
6	3132	0.394	Fabric Mills	**6**	3132	0.419	Fabric Mills
7	3159	0.392	Clothing Accessories and Other Clothing Manufacturing	**7**	3211	0.419	Sawmills and Wood Preservation
8	3141	0.391	Textile Furnishings Mills	**8**	3321	0.412	Forging and Stamping
9	3131	0.382	Fibre, Yarn and Thread Mills	**9**	3371	0.412	Household and Institutional Furniture and Kitchen Cabinet Manufacturing
10	3118	0.380	Bakeries and Tortilla Manufacturing	**10**	3131	0.412	Fibre, Yarn and Thread Mills
Panel B: The 10 most non-routine sectors (from non-routine to routine)							
No.	**Naics4**	**Routine**	**Sector**	**No.**	**Naics4**	**Routine**	**Sector**
1	3361	0.126	Motor Vehicle Manufacturing	**1**	5122	0.133	Sound Recording Industries
2	3341	0.167	Computer and Peripheral Equipment Manufacturing	**2**	3361	0.166	Motor Vehicle Manufacturing
3	3343	0.173	Audio and Video Equipment Manufacturing	**3**	5111	0.166	Newspaper, Periodical, Book and Database Publishers
4	5122	0.186	Sound Recording Industries	**4**	3341	0.170	Computer and Peripheral Equipment Manufacturing
5	3346	0.208	Manufacturing and Reproducing Magnetic and Optical Media	**5**	3346	0.188	Manufacturing and Reproducing Magnetic and Optical Media
6	3231	0.212	Printing and Related Support Activities	**6**	3343	0.196	Audio and Video Equipment Manufacturing
7	3122	0.221	Beverage Manufacturing	**7**	3231	0.206	Printing and Related Support Activities
8	3342	0.225	Communications Equipment Manufacturing	**8**	3169	0.225	Other Leather and Allied Product Manufacturing
9	5111	0.226	Newspaper, Periodical, Book and Database Publishers	**9**	3342	0.234	Communications Equipment Manufacturing
10	3352	0.231	Household Appliance Manufacturing	**10**	5142	0.148	Data Processing Services

Table 3. Summary statistics of sector characteristics

Variable	Obs	Mean	Std. Dev.	Min	Max
problem_solving	92	0.304	0.059	0.126	0.445
thinking_creatively	92	0.332	0.069	0.133	0.478
relationship	92	0.455	0.075	0.218	0.622
communication	92	0.241	0.049	0.077	0.377
skill_intensity	86	0.452	0.319	0.110	2.039
capital_ intensity	86	0.182	0.167	0.039	1.104
material_ intensity	86	0.506	0.111	0.134	0.787
volatility	86	0.175	0.035	0.115	0.267
specific_skill_intensity	67	0.134	0.060	-0.004	0.345
contract_intensity	84	0.873	0.157	0.328	0.998
herfindahl	87	0.113	0.079	0.042	0.432
complexity	54	17.070	7.219	2.380	31.840

Table 4. Correlation of sector characteristics

	problem_solving	thinking_creatively	relation-ship	commu-nication	skill	capital	material	volatility	contract_intensity	herfindahl	specific_skill	complexity
problem_solving	1.000											
thinking_creatively	0.938	1.000										
relationship	0.919	0.922	1.000									
communi-cation	0.954	0.870	0.918	1.000								
skill	-0.450	-0.473	-0.453	-0.318	1.000							
capital	-0.563	-0.523	-0.473	-0.561	0.136	1.000						
material	-0.219	-0.126	-0.248	-0.282	-0.247	0.225	1.000					
volatility	-0.085	-0.120	-0.060	-0.043	0.383	0.040	-0.442	1.000				
contract_intensity	-0.250	-0.318	-0.272	-0.225	0.122	0.104	0.103	-0.304	1.000			
herfindahl	-0.265	-0.252	-0.227	-0.240	-0.127	0.366	0.252	-0.372	0.154	1.000		
specific_skill	0.190	0.259	0.304	0.243	-0.252	-0.140	-0.066	-0.258	-0.210	-0.080	1.000	
complexity	-0.429	-0.358	-0.392	-0.328	0.612	0.268	-0.186	0.316	0.135	-0.123	-0.333	1.000

Table 5. Summary statistics of country endowments

Variable	Obs	Mean	Std. Dev.	Min	Max
broadband ranking06	21	10.830	1.851	7.530	15.730
internet user06	21	4.170	0.256	3.637	4.475
broadband penetration06	21	2.958	0.363	2.245	3.447
broadband percentage06	18	0.774	0.167	0.367	1.000
ICT development index07	21	6.541	0.576	5.190	7.500
computer06	19	3.956	0.535	2.670	4.472
fixed phone06	21	3.887	0.185	3.508	4.208
mobile phone06	21	4.588	0.184	4.051	4.913
cable tv96	21	1.844	1.914	-3.507	3.620
ln(H/L)95	20	1.021	0.153	0.591	1.224
ln(K/L)96	19	11.665	0.212	11.172	11.996
resource97	20	9.108	0.958	7.741	10.841
labor law	21	0.555	0.305	0.049	0.985
legal quality	21	8.440	0.997	5.617	9.278
ln(credit/Y)06	21	0.255	0.354	-0.587	0.721
lnY03-05	21	2.732	1.263	25.500	30.220

Note: Missing data include Germany's broadband percentage, human capital and physical capital stock, Hungary's human capital stock and natural resource, Australia's computer density, Japan's broadband percentage and computer density, Finland's broadband percentage.

Table 6. Correlation of country endowments

	brank06	user06	bp06	b%06	idi07	comp06	fixed06	cell06	ct96	ln(H/L)	ln(K/L)	resource	labor law	legal	ln(credit/Y)	lnY
brank06	1.000															
user06	0.450	1.000														
bp06	0.698	0.710	1.000													
b%06	0.538	-0.048	0.525	1.000												
idi07	0.580	0.877	0.752	-0.012	1.000											
comp06	0.266	0.785	0.606	-0.188	0.726	1.000										
fixed06	0.109	0.405	0.475	0.035	0.444	0.675	1.000									
cell06	-0.325	-0.311	-0.257	-0.199	-0.022	-0.387	-0.300	1.000								
ct96	0.426	0.651	0.658	0.351	0.518	0.580	0.513	-0.362	1.000							
ln(H/L)	0.288	0.833	0.449	-0.254	0.695	0.833	0.460	-0.523	0.454	1.000						
ln(K/L)	0.110	0.282	0.461	0.012	0.312	0.486	0.287	-0.127	0.191	0.394	1.000					
resource	-0.254	0.307	-0.189	-0.465	0.045	0.265	-0.008	-0.470	0.032	0.591	0.045	1.000				
labor law	0.178	-0.373	0.077	0.390	-0.096	-0.504	-0.275	0.454	-0.103	-0.557	0.125	-0.418	1.000			
legal	-0.476	0.465	0.056	-0.428	0.193	0.451	0.253	-0.068	0.395	0.427	0.103	0.549	-0.410	1.000		
ln(credit/Y)	-0.367	0.133	-0.040	0.061	-0.150	0.166	0.325	-0.257	0.328	0.052	-0.289	0.110	-0.538	0.501	1.000	
lnY	-0.360	-0.151	-0.410	-0.210	-0.288	-0.019	-0.297	-0.171	-0.269	0.163	-0.055	0.417	-0.412	0.197	0.313	1.000

Table 7. Rank of countries based on different ICT indexes (Source: ITIF, ITU, ECONSTATS and OECD)

Rank	Country	Broadband ranking _itif	Country	internet user _itu	Country	Computer _econstats	Country	Broadband penetration _oecd	Country	IDI07 _itu	Country	Broadband% _itu
1	KOR	15.730	SWE	4.475	CAN	4.472	DNK	3.447	SWE	7.500	KOR	1.000
2	JPN	14.990	DNK	4.462	CHE	4.460	NLD	3.434	KOR	7.260	PRT	0.982
3	FIN	12.110	NLD	4.427	NLD	4.448	KOR	3.368	DNK	7.220	HUN	0.928
4	NLD	11.870	NOR	4.413	SWE	4.427	FIN	3.291	NLD	7.140	USA	0.900
5	SWE	11.540	FIN	4.378	USA	4.356	CHE	3.286	NOR	7.090	ESP	0.898
6	FRA	11.410	KOR	4.358	GBR	4.328	NOR	3.267	CHE	6.940	NLD	0.870
7	DNK	11.370	CHE	4.327	DNK	4.243	SWE	3.264	FIN	6.790	DNK	0.849
8	NOR	11.290	CAN	4.282	AUT	4.106	CAN	3.186	GBR	6.780	CAN	0.848
9	CAN	11.110	DEU	4.279	DEU	4.105	GBR	3.065	JPN	6.640	FRA	0.833
10	USA	10.470	NZL	4.234	NOR	4.084	JPN	3.029	DEU	6.610	NOR	0.823
11	CHE	10.400	USA	4.233	FRA	4.052	FRA	3.001	AUS	6.580	GBR	0.767
12	AUS	10.230	GBR	4.231	KOR	3.977	USA	2.980	USA	6.440	CHE	0.725
13	AUT	10.080	JPN	4.230	IRL	3.967	DEU	2.895	NZL	6.440	ITA	0.721
14	PRT	9.920	AUS	4.190	NZL	3.917	AUS	2.856	IRL	6.370	SWE	0.692
15	GBR	9.920	AUT	4.153	FIN	3.913	AUT	2.797	CAN	6.340	AUT	0.602
16	DEU	9.810	IRL	4.004	ITA	3.602	ESP	2.708	AUT	6.320	AUS	0.586
17	ITA	9.780	ESP	3.919	ESP	3.320	ITA	2.655	ITA	6.180	IRL	0.542
18	ESP	9.480	HUN	3.851	PRT	2.724	PRT	2.596	FRA	6.160	NZL	0.367
19	NZL	9.260	FRA	3.847	HUN	2.670	NZL	2.412	ESP	5.910	FIN	------
20	IRL	9.140	PRT	3.638	JPN	------	IRL	2.329	PRT	5.470	JPN	------
21	HUN	7.530	ITA	3.637	AUS	------	HUN	2.245	HUN	5.190	DEU	------

Figure 1. Bilateral Exports and Countries' Internet Penetration

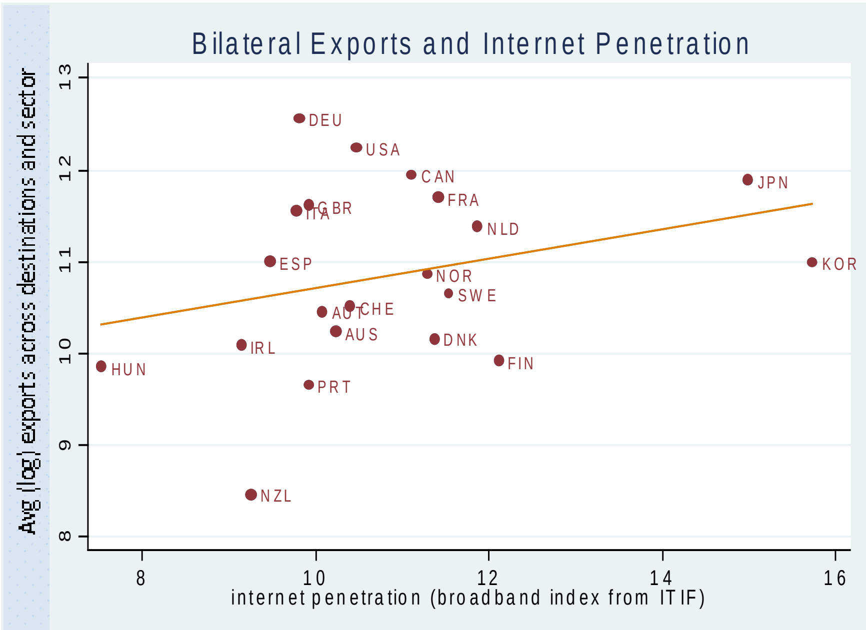

Table 8.1: Aggregate trade volume and unilateral internet penetration

Dependent variable: ln(Xcd)	2002-2007						2006-2007	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Internet penetration_EX	0.331*	0.247*	0.115*	0.105*				
	(11.98)	(21.27)	(4.61)	(5.95)				
Internet penetration_IM	0.147*	0.286*	0.091*	0.255*				
	(5.78)	(19.63)	(4.14)	(12.86)				
%Broadband connections_EX			0.173*	0.235*				
			(5.52)	(6.02)				
%Broadband connections_IM			0.362*	0.401*				
			(6.46)	(13.00)				
Broadband penetration_EX					0.129*	0.314*		
					(7.63)	(38.68)		
Broadband penetration_IM					-0.103*	0.076*		
					(-5.02)	(12.11)		
Broadband ranking_EX							0.329*	0.403*
							(14.08)	(86.06)
Broadband ranking_IM							0.307*	0.564*
							(8.38)	(61.29)
Log distance	-0.415*	-	-0.462*	-	-0.454*	-	-0.549*	-
	(-8.45)		(-8.56)		(-8.40)		(-7.24)	
Colonial ties	0.005	-	0.010	-	0.007	-	0.002	-
	(0.36)		(0.74)		(0.46)		(0.10)	
Common language	0.002	-	0.006	-	0.001	-	0.002	-
	(0.11)		(0.35)		(0.04)		(0.11)	
Common border	0.054*	-	0.059*	-	0.051*	-	0.054*	-
	(3.47)		(3.51)		(3.28)		(2.60)	
Common legal origin	0.057*	-	0.060*	-	0.056*	-	0.083*	-
	(4.97)		(4.71)		(4.64)		(5.10)	
Common currency	0.012	-	0.011	-	0.012	-	0.002	-
	(0.79)		(0.64)		(0.77)		(0.10)	
RTA	0.152*	-	0.140*	-	0.122‡	-	0.136†	-
	(3.58)		(2.93)		(2.50)		(1.95)	
Country pair FE	No	Yes	No	Yes	No	Yes	No	Yes
Exporter-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-square	0.94	0.97	0.93	0.97	0.94	0.97	0.91	0.99
No. of observations	2,400	2,400	1,880	1,880	2,520	2,520	840	840

Note: The regressions are estimates of equation (7) and (8). The dependent variable is the log of bilateral trade from country c to destination d. Only standard beta coefficients are reported. The t-statistics are in the brackets, obtained with the standard errors clustered by country pair. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 8.2: Aggregate trade volume and bilateral internet penetration

Dependent variable: ln(Xcd)	2002-2007						2006-2007	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Internet penetration	0.346*	-0.129†	0.346‡	-0.096				
	(2.70)	(-1.76)	(2.44)	(-1.11)				
%Broadband connections			-0.089	-0.088†				
			(-1.38)	(-1.77)				
Broadband penetration					-0.059†	-0.024		
					(-1.86)	(-1.07)		
Broadband ranking							-0.321†	0.220
							(-1.86)	(1.06)
Log distance	-0.405*	-	-0.445*	-	-0.454*	-	-0.577*	-
	(-8.33)		(-8.35)		(-8.39)		(-8.13)	
Colonial ties	0.006	-	0.012	-	0.007	-	0.009	-
	(0.45)		(0.87)		(0.50)		(0.55)	
Common language	0.006	-	0.010	-	0.000	-	0.001	-
	(0.37)		(0.59)		(0.01)		(0.06)	
Common border	0.053*	-	0.059*	-	0.051*	-	0.049‡	-
	(3.44)		(3.58)		(3.29)		(2.42)	
Common legal origin	0.053*	-	0.057	-	0.056*	-	0.083*	-
	(4.67)		(4.45)		(4.70)		(5.07)	
Common currency	0.008	-	0.005	-	0.012	-	0.002	-
	(0.50)		(0.29)		(0.77)		(0.10)	
RTA	0.160*	-	0.155*	-	0.122‡	-	0.121†	-
	(3.75)		(3.19)		(2.50)		(1.77)	
Country pair FE	No	Yes	No	Yes	No	Yes	No	Yes
Exporter-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-square	0.94	0.97	0.93	0.97	0.94	0.97	0.91	0.99
No. of observations	2,400	2,400	1,880	1,880	2,520	2,520	840	840

Note: The regressions are estimates of equation (10) and (11). The dependent variable is the log of bilateral trade from country c to destination d. Only standard beta coefficients are reported. The t-statistics are in the brackets, obtained with the standard errors clustered by country pair. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 9: Baseline results for countries' task-based comparative advantage in 2006 (analytical)

	OLS(analytical)					
Dependent variable: ln(Xcd_s)	**(1) only routine**	**(2)+ skill/ capital**	**(3)+ material**	**(4)+ more ca**	**(5) cluster by sector**	**(6) cluster by country-pair**
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.510 * (-5.48)	-0.657* (-4.86)	-0.654* (-4.70)	-0.618* (-3.65)	-0.618* (-3.75)	-0.618* (-10.72)
Skill intensity * Human capital: $h^s H_c$		0.429* (4.02)	0.456* (4.53)	0.381* (2.61)	0.381* (2.70)	0.381* (6.95)
Capital intensity * Psychical capital: $k^s K_c$		0.656 (0.91)	0.633 (0.88)	-0.610 (-0.68)	-0.610 (-0.70)	-0.610† (-1.84)
Material intensity * Nature resources: $m^s M_c$			0.217 (1.20)	-0.234 (-1.34)	-0.234 (-1.39)	-0.234* (-3.81)
Capital intensity * ln(credit/Y): $k^s CR_c$				0.143‡ (2.45)	0.143* (2.61)	0.143* (5.37)
Input variety * Legal quality: $(1-hi^s)Legal_c$				-0.066 (-0.20)	-0.066 (-0.20)	-0.066 (-0.82)
Contract intensity * Legal quality: $z^s Legal_c$				-0.168 (-0.75)	-0.168 (-0.74)	-0.168‡ (-2.22)
Complexity*Legal quality: $clx^s Legal_c$				0.345† (1.78)	0.345† (1.79)	0.345* (6.58)
Complexity* Human capital: $clx^s H_c$				0.336* (2.87)	0.336* (3.10)	0.336* (5.88)
Volatility * Labor law rigidity: $v^s LL_c$				-0.133† (-1.75)	-0.133† (-1.82)	-0.133* (-4.25)
Specific skill intensity * Labor law rigidity: $ss^s LL_c$				0.020 (0.46)	0.020 (0.47)	0.020 (1.56)
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of clusters	-----	-----	-----	-----	43	380
Adjusted R-square	0.69	0.70	0.70	0.78	0.78	0.78
Number of observations	36,173	30,861	30,861	16,089	16,089	16,089

Note: The regressions are estimates of equation (1). The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported. The t-statistics are in the brackets, obtained with the standard errors clustered by both the sector and country pair in column (1)-(4), clustered only by sector in column (5), clustered only by country pair in column (6). †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 10: Baseline results for countries' task-based comparative advantage in 2006 (interactive)

Dependent variable: ln(Xcd_s)	OLS(interactive)					
	(1) only routine	(2)+ skill/ capital	(3)+ material	(4)+ more ca	(5) cluster by sector	(6) cluster by country-pair
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.375* (-3.76)	-0.481* (-3.28)	-0.473* (-3.14)	-0.499* (-2.69)	-0.499* (-2.73)	-0.499* (-9.72)
Skill intensity * Human capital: $h^s H_c$		0.444* (4.21)	0.470* (4.70)	0.376* (2.58)	0.376* (2.66)	0.376* (6.86)
Capital intensity * Psychical capital: $k^s K_c$		0.807 (1.11)	0.785 (1.09)	-0.494 (-0.55)	-0.494 (-0.57)	-0.494 (-1.40)
Material intensity * Nature resources: $m^s M_c$			0.205 (1.09)	-0.241 (-1.34)	-0.241 (-1.38)	-0.241* (-3.89)
Capital intensity * ln(credit/Y): $k^s CR_c$				0.136‡ (2.28)	0.136‡ (2.46)	0.136* (4.81)
Input variety * Legal quality: $(1-hi^s)Legal_c$				-0.017 (-0.05)	-0.017 (-0.05)	-0.017 (-0.21)
Contract intensity * Legal quality: $z^s Legal_c$				-0.169 (-0.74)	-0.169 (-0.74)	-0.169‡ (-2.22)
Complexity*Legal quality: $clx^s Legal_c$				0.294 (1.58)	0.294 (1.59)	0.294* (5.84)
Complexity* Human capital: $clx^s H_c$				0.369* (3.10)	0.369* (3.31)	0.369* (6.70)
Volatility * Labor law rigidity: $v^s LL_c$				-0.128† (-1.70)	-0.128† (-1.77)	-0.128* (-4.07)
Specific skill intensity * Labor law rigidity: $ss^s LL_c$				0.024 (0.54)	0.024 (0.54)	0.024† (1.88)
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of clusters	-----	-----	-----	-----	43	380
Adjusted R-square	0.69	0.70	0.70	0.78	0.78	0.78
Number of observations	36,173	30,861	30,861	16,089	16,089	16,089

Note: The regressions are estimates of equation (1). The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported. The t-statistics are in the brackets, obtained with the standard errors clustered by both the sector and country pair in column (1)-(4), clustered only by sector in column (5), clustered only by country pair in column (6). †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 11: Observable bilateral factors instead of country pair fixed effects

Dependent variable: ln(Xcd_s)	OLS(analytical)			OLS(interactive)		
	(1)	(2)	(3)	(4)	(5)	(6)
Log distance	-0.421*	-0.409*	-0.348*	-0.421*	-0.409*	-0.348*
	(-8.77)	(-9.13)	(-7.70)	(-9.05)	(-8.42)	(-7.73)
Colonial ties	0.011	0.011	0.008	0.011	0.011	0.008
	(0.83)	(0.86)	(0.62)	(0.85)	(0.84)	(0.61)
Common language	-0.005	-0.011	-0.006	-0.005	-0.011	-0.006
	(-0.31)	(-0.69)	(-0.37)	(-0.30)	(-0.66)	(-0.36)
Common border	0.059*	0.068*	0.064*	0.059*	0.068*	0.064*
	(3.55)	(4.04)	(3.89)	(3.63)	(3.76)	(3.85)
Common legal origin	0.081*	0.090*	0.097*	0.081*	0.090*	0.097*
	(5.94)	(6.13)	(6.26)	(6.17)	(6.15)	(6.32)
Common currency	0.009	0.017	0.017	0.009	0.017	0.017
	(0.68)	(1.21)	(1.14)	(0.68)	(1.22)	(1.14)
RTA	0.107*	0.117*	0.119*	0.107‡	0.117*	0.119*
	(2.46)	(2.88)	(2.81)	(2.54)	(2.57)	(2.81)
Routine task intensity * Broadband ranking: $r^s IT_c$	-0.502*	-0.645*	-0.615*	-0.510*	-0.466*	-0.497*
	(-5.38)	(-4.59)	(-3.51)	(-3.66)	(-3.06)	(-2.59)
Skill intensity * Human capital: $h^s H_c$		0.462*	0.385‡		0.476*	0.381‡
		(4.56)	(2.53)		(4.72)	(2.50)
Capital intensity * Psychical capital: $k^s K_c$		0.564	-0.712		0.715	-0.598
		(0.77)	(-0.77)		(0.97)	(-0.64)
Material intensity * Nature resources: $m^s M_c$		0.212	-0.232		0.199	-0.239
		(1.15)	(-1.28)		(1.04)	(-1.28)
Capital intensity * ln(credit/Y): $k^s CR_c$			0.140‡			0.133‡
			(2.22)			(2.08)
Input variety * Legal quality: $(1-hi^s)Legal_c$			-0.074			-0.026
			(-0.22)			(-0.07)
Contract intensity * Legal quality: $z^s Legal_c$			-0.162			-0.163
			(-0.68)			(-0.68)
Complexity*Legal quality: $clx^s Legal_c$			0.333			0.282
			(1.61)			(1.42)
Complexity* Human capital: $clx^s H_c$			0.340*			0.373*
			(2.68)			(2.89)
Volatility * Labor law rigidity: $v^s LL_c$			-0.132†			-0.126
			(-1.65)			(-1.60)
Specific skill intensity * Labor law rigidity: $ss^s LL_c$			0.019			0.023
			(0.43)			(0.50)
Importer-sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-square	0.70	0.70	0.77	0.70	0.70	0.77
Number of observations	36,173	30,861	16,089	36,173	30,861	16,089

Note: Here are the estimates of equation (2). The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported. The t-statistics are in the brackets, obtained with the standard errors clustered by both the sector and country pair. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 12: Results controlling for importer-sector FE instead of sector FE

Dependent variable: ln(Xcd_s)	Analytical			Interactive		
	(1)	(2)	(3)	(4)	(5)	(6)
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.503* (-5.33)	-0.646* (-4.54)	-0.613* (-3.42)	-0.367* (-3.64)	-0.466* (-3.02)	-0.495‡ (-2.52)
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
Number of observations	36,173	30,861	16,089	36,173	30,861	16,089

Note: The regressions are estimates of equation (3). The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported, with t-statistics in the brackets, obtained by two-way clustering. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 13: Results controlling for other channels

Dependent variable: ln(Xcd_s)	OLS (analytical)			OLS (interactive)		
	(1)	(2)	(3)	(4)	(5)	(6)
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.657*	-0.545*	-0.533*	-0.475*	-0.431†	-0.387‡
	(-4.23)	(-3.83)	(-3.12)	(-3.16)	(-1.90)	(-2.54)
Skill intensity * Human capital: $h^s H_c$	0.439*	0.433*	0.836*	0.458*	-0.509*	-0.836
Capital intensity * Psychical capital: $k^s K_c$	0.601	0.635	-1.035	0.778	-0.956	-1.037
Material intensity * Nature resources: $m^s M_c$	0.213	-0.135	-0.136	0.202	-0.195	-0.137
Routine task intensity * Fixed-phone density: $r^s FIX_c$	-0.254			-0.150	-0.006	
Routine task intensity * Cell-phone density: $r^s CELL_c$	0.046			0.035	0.735	
Routine task intensity * Human capital: $r^s H_c$		0.079*			0.414	
Routine task intensity * Psychical capital: $r^s K_c$		0.504			0.079	
Routine task intensity * Natural resources: $r^s M_c$		0.056‡			0.137†	
Routine task intensity * Log credit/GDP: $r^s CR_c$		0.009			0.022	
Routine task intensity * Legal quality: $r^s Legal_c$		-0.115			0.013	
Routine task intensity * Labor law rigidity: $r^s LL_c$		0.138†			0.009†	
Routine task intensity * log GDP: $r^s \ln Y_c$		0.049			-0.059	
Skill intensity * Broadband ranking: $h^s IT_c$			-0.429*			-0.420
Capital intensity * Broadband ranking: $k^s IT_c$			0.298‡			0.392
Material intensity * Broadband ranking: $m^s IT_c$			0.205			0.230*
Contract intensity * Broadband ranking: $z^s IT_c$			0.049			0.141
Input variety * Broadband ranking: $(1-hi^s)IT_c$			-0.081			-0.045
Complexity * Broadband ranking: $clx^s IT_c$			-0.134			-0.090
Volatility * Broadband ranking: $v^s IT_c$			0.320			0.374
Specific skill intensity * Broadband ranking: $ss^s IT_c$			-0.096			-0.025
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-square	0.69	0.68	0.77	0.69	0.68	0.77
Number of observations	36,173	32,760	17,778	36,173	32,760	17,778

Note: The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only the standard beta coefficients are reported. The t-statistics of the internet interaction terms are in the brackets, obtained with the standard errors clustered by both the sector and country pair. The t-statistics of other variables are suppressed for the sake of space. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 14: Changing the sample period from 2006 to 2007 or 2002-2006

Dependent variable: ln(Xcd_s)	Analytical			Interactive		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 2007						
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.531* (-4.79)	-0.645* (-4.36)	-0.551* (-4.44)	-0.386* (-3.20)	-0.500* (-2.80)	-0.452‡ (-2.09)
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	36,299	30,948	16,121	36,299	30,948	16,121
Panel B: 2002-2006						
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.485* (-5.04)	-0.603* (-3.94)	-0.740* (-4.16)	-0.391* (-3.64)	-0.472* (-2.81)	-0.610* (-3.03)
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
Country pair-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	148,372	126,749	88,204	148,372	126,749	88,204

Note: The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported, with t-statistics in the brackets, obtained by two-way clustering. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 15: Alternative routine task intensity and ICT measures

Dependent variable: ln(Xcd_s)	OLS (analytical)		OLS (interactive)	
	(1)	(2)	(3)	(4)
Panel A: Alternative routine task intensity (crea for analytical; comm for interactive)				
Routine task intensity * Broadband ranking: $r^{s'}BR_c$	-0.414*	-0.565*	-0.466*	-0.623*
	(-3.54)	(-3.07)	(-5.09)	(-4.71)
Endowment controls	No	Yes	No	Yes
Number of observations	36,173	30,861	36,173	30,861
Panel B: Alternative ICT index (Internet penetration index)				
Routine task intensity * Internet users: $r^{s'}IP_c$	-0.765*	-0.468†	-0.458‡	-0.068
	(-3.07)	(-1.87)	(-2.30)	(-0.37)
Endowment controls	No	Yes	No	Yes
Number of observations	36,173	30,861	36,173	30,861
Panel C: Alternative ICT index (Broadband penetration index)				
Routine task intensity * Broadband users: $r^{s}BP_c$	-0.324*	-0.312‡	-0.146‡	-0.050
	(-2.91)	(-2.35)	(-1.47)	(-0.41)
Endowment controls	No	Yes	No	Yes
Number of observations	36,173	30,861	36,173	30,861
Panel D: Alternative ICT index (ICT development index)				
Routine task intensity * ICT development index: $r^{s'}IDI_c$	-0.455‡	-0.401‡	-0.295‡	-0.111
	(-2.76)	(-2.46)	(-2.16)	(-0.86)
Endowment controls	No	Yes	No	Yes
Number of observations	36,173	30,861	36,173	30,861
Panel E: Alternative ICT index (Computer density)				
Routine task intensity * Computer density: $r^{s}COMP_c$	-0.361‡	-0.349‡	-0.246‡	-0.153
	(-2.29)	(-2.05)	(-1.99)	(-1.21)
Endowment controls	No	Yes	No	Yes
Number of observations	32,822	27,691	32,822	27,691

Note: The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported. The t-statistics of the internet interaction terms are in the brackets, obtained with the standard errors clustered by both the sector and country pair. The t-statistics of other variables are suppressed for the sake of space. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 16: Zeros trade flows

Dependent variable: Xcd_s	PPML (analytical)			PPML (interactive)		
	(1)	(2)	(3)	(4)	(5)	(6)
Routine task intensity * Broadband ranking: $r^s BR_c$	-1.130* (-4.61)	-1.657* (-6.29)	-1.439* (-5.65)	-1.147* (-4.20)	-1.588* (-5.58)	-1.529* (-5.19)
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of clusters	92	85	43	92	85	43
R-square	0.49	0.56	0.59	0.49	0.56	0.59
Number of observations	38,640	32,300	16,340	38,640	32,300	16,340

Note: The dependent variable is the bilateral trade from country c to destination d in sector s. The t-statistics are in the brackets, obtained with the standard errors clustered only by sector. Standard errors are clustered only by sector. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table 17: Endogeneity

	IV(analytical)			IV(interactive)		
Panel A: First-stage estimation						
Dependent variable: Routine task intensity * Broadband ranking $(r^s\_06)*(BR_c\_06)$	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Routine task intensity _ lag * Cable tv _ lag: $(r^s\_02)*(CT_c\_96)$	0.285*	0.339*	0.409*	0.293*	0.345*	0.401*
	(11.47)	(12.78)	(12.86)	(11.05)	(11.91)	(11.10)
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
F-statistics	4785.77	5465.74	3133.91	5054.73	5487.23	3382.14
Number of observations	38,640	32,300	16,340	38,640	32,300	16,340
Panel B: Second-stage estimation						
Dependent variable: ln(Xcd_s)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Routine task intensity * Broadband ranking: $r^S BR_c$	-1.552*	-1.130*	-0.654‡	-1.084*	-0.756*	-0.490‡
	(-4.81)	(-3.81)	(-3.24)	(-3.82)	(-3.06)	(-2.46)
Skill intensity * Human capital: $h^s H_c$		0.397*	0.380*		0.430*	0.378*
		(3.36)	(2.68)		(3.83)	(2.68)
Capital intensity * Psychical capital: $k^s K_c$		0.461	-0.648		0.746	-0.503
		(0.65)	(-0.72)		(1.03)	(-0.56)
Material intensity * Nature resources: $m^s M_c$		0.174	-0.232		0.170	-0.242
		(1.23)	(-1.38)		(1.07)	(-1.42)
The other controls	No	No	Yes	No	No	Yes
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Endogeneity test (p-value)	0.002	0.087	0.902	0.011	0.242	0.960
Number of observations	36,173	30,861	16,089	36,173	30,861	16,089

Note: Panel A reports the results in the first-stage estimation. with the dependent variable as the interaction term composed by routine task intensity in 2006 and broadband ranking index in 2006. Panel B reports the results of the second-stage estimation, with the dependent variable as the log of bilateral trade from country c to destination d in sector s. In both panels, only the standard beta coefficients are presented, and the t-statistics are in the brackets, obtained with the standard errors clustered by both sector and country pair pair. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Appendix

Table A1: Results controlling for both endowment interactions and other channels

Dependent variable: ln(Xcd_s)	OLS (analytical)			OLS (interactive)		
	(1)	(2)	(3)	(4)	(5)	(6)
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.447* (-4.23)	-0.476* (-3.37)	-0.365* (-2.59)	-0.338* (-3.16)	-0.304† (-1.90)	-0.277‡ (-2.17)
Routine task intensity * Fixed-phone density: $r^s FIX_c$	-0.083			-0.107		
Routine task intensity * Cell-phone density: $r^s CELL_c$	0.556			0.318		
Routine task intensity * Human capital: $r^s H_c$		-0.391*			-0.372*	
Routine task intensity * Psychical capital: $r^s K_c$		0.012			0.676	
Routine task intensity * Natural resources: $r^s M_c$		0.489‡			0.537‡	
Routine task intensity * Log credit/GDP: $r^s CR_c$		-0.088			0.022	
Routine task intensity * Legal quality: $r^s Legal_c$		0.136			0.130	
Routine task intensity * Labor law rigidity: $r^s LL_c$		0.056†			0.009†	
Routine task intensity * log GDP: $r^s \ln Y_c$		0.001			-0.014	
Skill intensity * Broadband ranking: $h^s IT_c$			-0.182†			-0.180†
Capital intensity * Broadband ranking: $k^s IT_c$			0.174			0.236‡
Material intensity * Broadband ranking: $m^s IT_c$			0.154			0.167
Input variety * Broadband ranking: $(1-hi^s)IT_c$			-0.024			-0.002
Contract intensity * Broadband ranking: $z^s IT_c$			0.145			0.205
Complexity * Broadband ranking: $clx^s IT_c$			-0.022			0.007
Volatility * Broadband ranking: $v^s IT_c$			0.293			0.330
Specific skill intensity * Broadband ranking: $ss^s IT_c$			-0.034			0.014
Country pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-square	0.69	0.68	0.77	0.69	0.68	0.77
Number of observations	36,173	32,760	17,778	36,173	32,760	17,778

Note: The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported. The t-statistics of the internet interaction terms are in the brackets, obtained with the standard errors clustered by both the sector and country pair. The t-statistics of other variables are suppressed for the sake of space. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.

Table A2: Results using the same sample

Dependent variable: ln(Xcd_s)	Analytical			Interactive		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS						
Routine task intensity * Broadband ranking: $r^s BR_c$	-0.619*	-0.539*	-0.618*	-0.528*	-0.439*	-0.498*
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
Number of observations	16,089	16,089	16,089	16,089	16,089	16,089
Panel B: PPML						
Routine task intensity * Broadband ranking: $r^s BR_c$	-1.164*	-1.294*	-1.513*	-1.304*	-1.413*	-1.604*
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
Number of observations	16,089	16,089	16,089	16,089	16,089	16,089
Panel C: IV (the second stage)						
Routine task intensity * Broadband penetration: $r^s BR_c$	-1.214*	-0.999*	-0.642*	-0.963*	-0.731*	-0.485‡
Endowment controls	No	Yes	Yes	No	Yes	Yes
The other controls	No	No	Yes	No	No	Yes
Number of observations	16,089	16,089	16,089	16,089	16,089	16,089

Note: The dependent variable is the log of bilateral trade from country c to destination d in sector s. Only standard beta coefficients are reported. Country pair fixed effects and sector fixed effects are included in all the above regressions. †, ‡ and * indicate significance at 10%, 5% and 1 % level respectively.