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Market-Creating Effect of the Internet on Food Trade

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Abstract

This paper analyses the impact of the number of the Internet users on food industry trade between developed OECD countries using both panel and cross-sectional data. We find the positive, significant and over time increasing effect of the Internet on food industry exports confirming that the Internet reduces market-specific entry costs for food industry exports. The significant positive effect pertained to the Internet is found in the importing countries. The significant positive effects on food industry exports are found for the country's economic size and bilateral common features and proximities. The Internet mitigates the countries proximities, but increased the distance between the countries.

Keywords: Internet, Distance, International trade, OECD countries

Introduction

So far limited literature aims to explain the association between the dramatic growth in the number of Internet users and globalisation with the rapid growth of international trade in developed and developing countries (Clarke and Wallsten, 2006), for trade in services (Freund and Weinhold, 2002), for merchandise trade (Freund and Weinhold, 2004), and for trade in manufacturing products (Bojnec and Fertő, 2009). So far there is no study to investigate the impact in the growth in the number of Internet users on globalisation of international food industry trade. Food industry trade might be also a subject of globalisation due to the retail chain revolution by the increasing role of hyper- and super-markets (McCullough *et al.*, 2008). Therefore, this paper aims to quantify the effect of the growth in the number of Internet users on bilateral food industry trade between the Organisation for Economic Cooperation and Development (OECD) countries.[1] The research question is whether the Internet has contributed to an increase in rate of growth and in volume of bilateral food industry trade between OECD countries due to the reduction of asymmetric information and entry costs into foreign market. Additionally, we also test whether the Internet has mitigated the effect of distance on international food industry trade.

Following Freund and Weinhold (2002, 2004) and Bojnec and Fertő (2009), this article contributes to the academic literature with the implications of the research for researchers and

[1] List of countries included in the data sample: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, South Korea, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Slovakia, Sweden, Switzerland, Turkey, the United Kingdom and the United States of America.

managers on the effect of the Internet on food industry trade by using the adapted gravity model in three ways. First, we quantify the impact of the number of the Internet users on food industry trade using both panel and cross sectional data for the OECD countries. We expect that the better Internet development and global business-to-business web-based marketplaces have a positive impact on OECD countries international food industry trade volumes and for their bilateral food industry trade as the Internet reduces the information-related trade costs, enhances competition, and trade in food industry products. Second, we quantify the impact of the number of the Internet users on altering the effect of the distance on food industry export. We expect that geographic proximity and effect of distance arising from competition increases with the Internet intensity use on faster food industry trade growth. Third, we quantify the impact of the number of the Internet users on food industry trade reorientation in OECD countries. We expect that the Internet intensity use might affect food industry trade reorientation by its increase in the high Internet intensity use countries.

The rest of the paper is structured as follows. In the next section, we present the literature review. Followed by the sections that explain the methodology and presents the data used. The regression results for alternative specifications of adapted and modified gravity models are described in the next section by the investigation of the impact of the number of Internet users on food industry export growth, the impact of the number of Internet users by altering the effect of distance on food industry export growth, and the impact of the number of Internet users on trade reorientation. The penultimate section provides managerial and policy implications for management, development of e-commerce and e-business market outlets in international food industry trade; whereas the final section derives main conclusions.

Literature review

The previous studies underline the use and management of the Internet as a business tool to gain a competitive advantage (Jemmeson, 1997; Vedder *et al.*, 1997; Kribel and Bojnec, 2007) and the approaches to international marketing using the Internet, adopting marketing decisions to the Internet marketing in a global environment (Palumbo and Herbig, 1998; Yang *et al.*, 2009). The most recently, the Internet has become an important for the e-commerce market and economic competitiveness for enterprises and for purchase products at relatively lower costs worldwide (Tucker, 2008).

Rotchanakitumnuai and Speece (2009) identify five determinants that have a positive impact on perceived usefulness of the Internet channels and services: ease-of-use, information quality, accessibility, trust, and flow control of the securities trading process. The global

availability in e-commerce information is important for international businesses where trade costs as a determinant of global trade competition might play significant role mitigating distances between origin of goods and demands for goods at different locations (e.g. Rauch, 2001; Anderson and van Vincoop, 2004). Freund and Weinhold (2004) argue that the Internet tends to lower the fixed costs of arranging international trade and the entry of new markets, whereas Fink *et al.* (2005) argue that it tends to reduce the marginal effort incurred in arranging the transport of any given shipment.

The adapted gravity model is deemed appropriate to study the issue of a non-decreasing impact of the Internet as a trade augmenting technology on food industry trade. Anderson and van Vincoop (2004) provide strong theoretical base for the use of the gravity model to study international trade. In gravity equation models geographical, historical, language and cultural factors have been often specified as explanatory variables of trade costs. The most recent studies diversify gravity model equations underlining few other factors causing changes towards reduction in different components of trade costs due to the advanced information and communication technologies and improvements in infrastructure leading to decreasing communication and transaction costs (e.g. Tang, 2006).

The idea behind the gravity model is derived from the theory of gravity in physics (Anderson, 1979; Brada and Mendez, 1993; Anderson and van Vincoop, 2003). The larger are the economies of the countries involved, the larger is the volume of their trade, but distance causes a resistance to trade, because of transportation and delivery costs, information and communication costs, time lags between order and delivery, and some other trade resistance factors, which cause trade costs. The most recent studies have begun to diversify adapted and modified gravity model equations, underlining the importance of Internet variables with associated e-commerce and e-business activities that tend to reduce communication, transaction, and other trade costs (Fink *et al.*, 2005; Tang, 2006; Freund and Weinhold, 2002, 2004; Bojnec and Fertő, 2008, 2009).

A competitive advantage in a global economy increasingly depends on accurate responses of organizations and individuals to changing demand and market conditions. The Internet plays an important role in online social networks as a development and distribution channel. Export behaviour and Internet use have been examined only by rare studies (Freund and Weinhold, 2002, 2004; Clarke and Wallsten, 2006; Bojnec and Fertő, 2009). These studies confirm the positive association between export behaviour and Internet use. Exports could be higher in countries with greater Internet development and use. The benefits of Internet access are found to be pronounced for firms in developing countries with greater Internet access and

with exports to developed countries (Clarke, 2008). Freund and Weinhold (2004) and Clarke and Wallsten (2006) argue that Internet development in the exporting country is found to be more important than Internet development in the importing country for trade growth, and vice versa Bojnec and Fertő (2009) for manufacturing trade between the OECD countries.

This paper aims to quantify the effect of the number of Internet users on food industry trade among OECD countries by using an adapted gravity model. First, the Internet intensity use might reduce the role of asymmetric information and the information-related trade costs, enhance competition, and thus encourages bilateral food industry trade patterns in both growth rates and levels between the trading partners (Fink *et al.*, 2005; Freund and Weinhold, 2002, 2004; Tang, 2006). We expect a positive association between the number of Internet users and bilateral food industry trade patterns in both growth rates and trade volumes between the OECD countries.

Second, the Internet intensity use might also reduce distances between the bilateral trading partners (Berthelon and Freund, 2008). We investigate OECD countries' geographic proximity by testing how the number of Internet users might affect the impact of distance on food industry trade that is arising from competition increasing with the Internet intensity use, and its impact on faster food industry trade growth in the OECD countries with higher Internet intensity use.

Third, the Internet intensity use might have an affect on overall increase of food industry trade for the analyzed OECD countries. Following Freund and Weinhold (2004) for merchandise trade and Bojnec and Fertő (2009) for manufacturing trade, we expect a positive impact of the number of Internet users on the aggregate food industry trade of the OECD countries.

Methodology

Traditional gravity trade theory points that bilateral trade is positively associated with their national incomes and negatively associated with their geographical distance (e.g. Frankel and Rose, 2002). The increases in national incomes generate greater demands, and the closest partner's country location, lower are transportation costs. In the imperfectly competitive market with fixed entry cost proximate countries and countries with historical linkages are expected to export relatively more because transport costs are lower.

We apply standard gravity model variables including market size [real gross domestic product (GDP)] of host export *x* and destination import *m* countries, geographical factors such as the distance ($Distance_{xm}$) between the capital cities and common border ($Contingency_{xm}$),

cultural linkage with a common language ($Language_{xm}$), and dummy for Regional Free Trade Agreement ($RFTA_{xm}$) membership as explanatory variables.

More specifically, we are interested in at the role of the Internet for food industry trade. Bilateral food industry export growth is determined by the reduction in trade costs through growth in the Internet intensity use, import-country growth, growth in competition, growth in the average distance of exporters, and the relative proximity of the two countries. In a light of gravity model we expect import-market growth as a main determinant for food industry export growth. The growth in Internet intensity use is expected to reduce trade costs and enhance food industry export growth. As the Internet intensity use strengthens competition, this is likely to increase the effect of distance on trade and thus increase food industry import growth from more proximate countries.

First, we specify the following model for panel data estimation to minimize the possibility of omitted variable bias and to capture some of the dynamic impact of the Internet on food export growth (see also Freund and Weinhold, 2004; Bojnec and Fertő, 2009):

$$\ln(ExportGrowth_{xm})_t=\alpha_0+\alpha_1\ln(InternetGrowth_x)_{t-1}+\alpha_2\ln(InternetGrowth_m)_{t-1}+$$
$$\alpha_3\ln(Internet_x)_{1995}+\alpha_4\ln(Internet_m)_{1995}+\alpha_5\ln(Export_{xm})_{1995}+\alpha_6\ln(GDPGrowth_m)_t+$$
$$\alpha_7\ln(Distance_{xm})+\alpha_8\ln(GDP_x)_{1995}+\alpha_9\ln(GDP_m)_{1995}+\alpha_{10}\ln(POP_x)_{1995}+\alpha_{11}\ln(POP_m)_{1995}+$$
$$\alpha_{12}Growth\ln(Export_{xm})_{t-1}+u_t+\varepsilon_{xm} \quad (1)$$

where the main determinants of annual food industry export growth are import country GDP growth, growth in the level of competition, Internet growth, and proximity to market. We expect that GDP growth in the importing country with a greater market size enhances higher exports from all OECD countries. In addition to the size of GDP, the effect of a country size is also measured by the size of country's population (POP). We also expect positive association for GDP and POP. Growth in the level of competition in the regression framework is controlled by the year-fixed effects. The distance between the exporter *x* and importer *m* countries ($Distance_{xm}$) determine whether food industry trade growth is biased with respect to economic geography. Food industry export growth is controlled for initial log-levels of food industry exports to capture possible faster adjustment in OECD countries with very low food exports. Similar as Freund and Weinhold (2004) and Bojnec and Fertő (2009) the year 1995 is taken to captures time-invariant idiosyncratic features of the food industry trade relationship between two OECD countries. The growth rates of the Internet variable are introduced for the exporting country and the importing OECD country, where there is expected that the introduction of new Internet users affects food industry trade with a time lag and thus the growth rates of the Internet variables are lagged one period. In addition, the

growth of the Internet users is expected to be correlated with the initial level with those starting from a lower level growing faster, which is controlled for the 1995 log-level of the Internet variable for each OECD country. Using the growth rates instead of absolute level data the equation levels-fixed effects with the correlated unobservable (possible correlation of the Internet intensity use with levels of development, education, and high-tech production development) are excluded.

Second, we specify cross-section adapted gravity model across 29 OECD countries to check sensitivity of results:

$$\ln Exports_{xm}=\alpha_0+\alpha_1 \ln(Internet_x*Internet_m)+\alpha_2 \ln(GDP_x*GDP_m)+\alpha_3 \ln(POP_x*POP_m)+ \alpha_4 \ln(Distance_{xm})+\alpha_5 Contigency_{xm}+\alpha_6 Language_{ij}+\alpha_7 RFTA_{ij}+\alpha_8 \ln(Export)_{1995}+\varepsilon_{xm} \quad (2)$$

A cross-country adapted gravity model explains food industry export from country *x* to country *m* as proportional to the product of their economic sizes (GDP and POP, respectively) and inversely related to the Distance between them. A dummy variable $Contigency_{xm}$ reflects whether *x* and *m* OECD countries share a common land border, $Language_{xm}$ is a dummy for countries that speak the same language, and $RFTA_{xm}$ is a dummy for countries that are part of a free trade agreement.

Third, we specify cross-section regression model across 29 OECD countries to estimate the effect of the Internet intensity use on trade openness, as opposed to bilateral food industry trade flows between the OECD countries:

$$\ln(\text{aggregate food trade/GDP})= \alpha_0+\alpha_1 \ln(ROWGDP)+\alpha_2 \ln(POP)+\alpha_3 \ln(REMOTE)+ \alpha_4 \ln(Internet)+u_t \quad (3)$$

A cross-country regression model explains dependent variable, which is expressed by the natural logarithm of total food industry trade relative to GDP of the 29 OECD countries by the natural logarithm of the rest-of-the world GDP (ROWGDP), the natural logarithm of POP, and the natural logarithm of a distance-weighted measure of other countries GDP (REMOTE). According to the empirical results by Freund and Weinhold (2004, p. 187) for merchandise trade and Bojnec and Fertő (2009, p. 131) for manufacturing trade, we expect a positive association for the regression coefficient, which is pertained to the Internet intensity use and negative association for the regression coefficient, which are pertained to the REMOTE and POP variables. The results for the regression coefficient that is pertained to ROWGDP is found positive in significant by Freund and Weinhold (2004) and mixed, but not significant by Bojnec and Fertő (2009).

The similar specification of dependent and explanatory variables as in Freund and Weinhold (2004) for merchandise trade and in Bojnec and Fertő (2009) for trade in

manufacturing products provides opportunities to compare the obtained results with the previous studies.

Data

The data used on the growth of food industry exports are calculated from the OECD Bilateral Trade Database at the two-digit level of the Industrial Standard International Classification (ISIC) in US dollars. The sample for the food industry trade contains 29 OECD countries for the 9 years period between 1995 and 2003 resulting 7,308 observations. Our data span is for the period 1995–2003. After taking growth rates and introducing time lags into the specification our final model is estimated on export growth for the seven-year period from 1997 to 2003 as a reason for the lower number of observations in the reported results.

The data used on the market size variables [real gross domestic product (GDP) in million US dollars and population in millions (POP)] of host export *x* and destination import *m* OECD countries are obtained from the World Bank, World Development Indicators (WDI) database. The data used on the growth of GDP and on the growth in the number of Internet users for both exporter and importer OECD countries are calculated from the WDI database. The variable of the Internet intensity use in the WDI database is defined by the number of Internet users per 1000 persons.

The data used on the geographical factors such as the distance (Distance) between the capital cities and common border ($Contigency_{xm}$), then on cultural linkage with a common language ($Language_{xm}$), and dummy for Regional Free Trade Agreement ($RFTA_{xm}$) membership are obtained from the CEPII (Centre D'Etudes Prospectives Et D'Informations Internationales: http://www.cepii.fr/anglaisgraph/bdd/distances.htm) database.

Empirical results

Summary statistics

Table 1.

Summary statistics for the number of Internet users per 1000 persons in OECD countries

	Mean	Standard deviation	Minimum	Maximum
1995	31.1	34.1	0.8	139.0
1996	52.9	52.1	1.9	182.6
1997	91.7	82.1	4.7	295.2
1998	140.4	108.9	6.9	365.0
1999	208.2	137.2	18.9	540.5
2000	270.6	149.7	37.1	597.9
2001	312.4	153.8	51.1	603.5
2002	360.8	157.2	61.8	647.9
2003	405.9	160.1	84.9	673.5

Source: Own calculations based on WDI database

Both demand-side factors such as the GDP growth and higher levels of economic development, real prices, and an increasing importance of higher education, and supply-side factors such as fast development of high-tech production and technologies and declining using costs have contributed to the rapid increase in the number of Internet users per 1000 persons since the mid-1990s in the OECD countries (Table 1). The considerable variations in the number of Internet users are between the OECD countries as confirmed by standard deviation and particularly by a large differential between the minimum and maximum values (see also Bojnec and Fertő, 2009).

Panel data estimation

The relevant variables are pre-tested for unit roots. We use so-called second-generation panel unit root tests, which are analogous to time-series augmented Dickey–Fuller tests, as proposed by Levin *et al.* (2002) (LLC) and Im *et al.* (2003) (IPS). The LLC and IPS panel unit root test results are presented in Table 2. Results suggest that the relevant variables do not contain unit roots with both specifications, i.e. they are stationary except for GDP variables in the case of the IPS test with the constant and time trend specification.

Table 2.

Panel unit root tests for levels

	intercept and trend		intercept	
	LLC	IPS	LLC	IPS
$\ln(\text{ExportGrowth}_{xm})$	-85.501***	-6.616***	-68.864***	-26.340***
$\ln(\text{InternetGrowth}_{x})$	-102.960***	-10.693***	-105.621***	-14.905***
$\ln(\text{InternetGrowth}_{m})$	-102.960***	-10.693***	-105.621***	-14.905***
$\ln(\text{GDPGrowth}_{m})$	-59.636***	-0.486	-52.599***	-13.512***

Source: Own calculations. Lag length (1) was selected by Schwarz Bayesian Information Criteria.

Notes: Columns LLC and IPS report the Levin *et al.* (2002) and Im *et al.* (2003) unit root tests. Significance levels at the 10 percent, 5 percent, and 1 percent levels for the one-tailed tests are indicated by *, **, and ***, respectively. The null hypothesis of a unit root is rejected if the test statistic is significant.

To ensure that all variables are stationary I(0) and not integrated of a higher order, we apply unit root tests on first differences of all variables. Table 3 presents unit root test results for the first differences of the variables. All tests reject the unit root null hypothesis for the first differences. In sum, we may conclude that panel is likely to be stationary.

Table 3.

Panel unit root tests for first diffences

	intercept and trend		intercept	
	LLC	IPS	LLC	IPS
$\ln(\text{ExportGrowth}_{xm})$	-123.123***	-12.206***	-111.811***	-42.470***
$\ln(\text{InternetGrowth}_{x})$	-143.357***	-13.976***	-135.147	-48.726***
$\ln(\text{InternetGrowth}_{m})$	-143.357***	-13.976***	-135.147	-48.726***
$\ln(\text{GDPGrowth}_{m})$	-79.009***	-4.135***	-73.9772	-24.785***

Source: Own calculations. Lag length (1) was selected by Schwarz Bayesian Information Criteria.

Notes: Columns LLC and IPS report the Levin *et al.* (2002) and Im *et al.* (2003) unit root tests. Significance levels at the 10 percent, 5 percent, and 1 percent levels for the one-tailed tests are indicated by *, **, and ***, respectively. The null hypothesis of a unit root is rejected if the test statistic is significant.

Table 4.

Panel food industry export growth regressions in OECD countries, 1997-2003

Dependent variable: $\ln(\text{ExportGrowth}_{xm})_t$ Growth of food industry exports from OECD country *x* to country *m*	(1)	(2)	(3)	(4)	(5)
$\ln(\text{InternetGrowth}_x)_{t-1}$		0.043	0.020	0.021	0.023
$\ln(\text{InternetGrowth}_m)_{t-1}$		-0.021	-0.014	-0.018	-0.011
$\ln(\text{Internet}_x)_{1995}$		-0.025*	-0.023*	0.011	0.008
$\ln(\text{Internet}_m)_{1995}$		-0.008	-0.017	-0.007	-0.003
$\ln(\text{Export}_{xm})_{1995}$	-0.001	0.000	-0.018**	-0.021**	-0.035***
$\ln(\text{GDPGrowth}_m)$	1.686***	1.703***	1.850***	1.862***	1.800***
$\ln(\text{Distance}_{xm})$	-0.002	-0.002	-0.008**	-0.011***	-0.011***
$\ln(\text{GDP}_x)_{1995}$				0.015	0.019
$\ln(\text{GDP}_m)_{1995}$				0.008	0.014
$\ln(\text{POP}_x)_{1995}$				0.286	0.234
$\ln(\text{POP}_m)_{1995}$				0.117	0.092
$\ln(\text{ExportGrowth}_{xm})_{t-1}$					-0.092***
Constant	0.159***	0.154***	0.197***	0.227***	0.237***
Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes
R^2	0.0155	0.0164	0.0532	0.0521	0.0692
No. observations	5684	5684	5550	5615	5553
F test	11.28	8.53	24.17	17.76	18.46

Note: Significance based on heteroskedasticity and autocorrelation consistent (HAC) standard errors. Regressions (1) and (2) report the results using all available data, and regressions from (3) to (5) report the results without the outliers with an error term more than four standard deviations from zero.

Level of significance: * p<0.1; ** p<0.05; *** p<0.01.

Table 4 presents the panel bilateral food industry export growth regressions in OECD countries, which are estimated from data for the period 1995 to 2003. Due to the use of growth rates and time lags in the model specification, the panel regressions are estimated for food industry export growth for the seven-year period from 1997 to 2003. Den Haan and Levin HAC (Heteroskedasticty and Autocorrelation Consistent) estimation (Den Haan and Levin, 1996) are used to control for heteroskedasticity and to allow for general time dependence between time periods.

Regression (1) in Table 4 is the baseline specification for bilateral food industry export growth from the OECD exporting to the OECD importing country without the Internet variable included in the regression. This regression confirms the importance of the growth of GDP in the OECD importing country on the growth of food industry exports. The regression (1) clearly confirms positive and significant association of the growth of food industry exports that is pertained to the growth of GDP in the importing OECD country. This is consistent with the theoretical expectation and with the previous findings by Freund and Weinhold (2004) for merchandise trade and Bojnec and Fertő (2009) for manufacturing trade. The GDP growth in the greater market size importing OECD country enhances the higher bilateral food industry export growth from the other OECD countries. The negative regression coefficient for the control variable for the initial 1995 log-levels of food industry exports confirms the previous finding by Freund and Weinhold (2004) for merchandise trade. The empirical result confirms the assumption on the faster bilateral food industry export growth adjustment in OECD countries with very low initial food industry exports. The regression coefficient pertained to $Distance_{xm}$ is expectedly negative, but not significant. The latter finding contradicts with the previous finding by Bojnec and Fertő (2009) for manufacturing trade and to a lesser extent by the finding by Freund and Weinhold (2004) for merchandise trade suggesting a specificity of food industry trade, which includes perishable products that are in a greater extent traded locally.

In regression (2) in Table 4 there are introduced Internet variables for the number of Internet users, which are mostly statistically insignificant. These results contradict with the previous findings. Freund and Weinhold (2004) for merchandise trade find positive and significant impact for the one period lagged Internet variable for exporting countries, and for the initial Internet intensity use in both exporting and importing countries. Bojnec and Fertő (2009) for merchandise trade find positive and significant impact for the number of Internet users in exporting countries. This suggests specificity of food industry trade in comparison with merchandise and manufacturing trade. When few outlier observations are omitted from panel data in regression (3) in Table 4, the regression coefficients for the baseline explanatory variables $Distance_{xm}$ and $Export_{1995}$ become significant suggesting that the outliers reflect very high trade growth in OECD country-pairs with initial food industry trade close to zero.

In regressions (4) and (5) in Table 4 from panel data are also omitted outlier observations and among explanatory variables are included variables for the initial market size measured by GDP and POP, respectively, in exporting and importing OECD countries. Similar as in regression (3), the regression coefficients are significant for the growth of GDP in importing

country, $Distance_{xm}$, and the initial food industry $Export_{1995}$ variable. The regression coefficients on the Internet variables remain statistically insignificant. In comparison with Freund and Weinhold (2004) for merchandise trade and Bojnec and Fertő (2009) for trade in manufacturing products the differential in results remain. The former study confirms positive and significant impact for the Internet growth in exporting countries, and for the initial development of Internet in both exporting and importing countries on merchandise trade. The latter study also finds positive and significant impact of growth in the number of Internet users in exporting countries, and for the initial number of Internet users in importing countries on growth of trade in manufacturing products.

Table 5.

Panel food industry export growth regressions in OECD countries: the effect of $Distance_{xm}$, 1997-2003

Dependent variable: $\ln(ExportGrowth_{xm})_t$ Growth of food industry exports from OECD country *x* to country *m*	(6)	(7)
$\ln(InternetGrowth_x)_{t-1}$	0.040	0.020
$\ln(InternetGrowth_m)_{t-1}$	-0.077**	-0.075***
$\ln(Internet_x)_{1995}$	0.014	0.008
$\ln(Internet_m)_{1995}$	-0.008	-0.012
$\ln(Export_{xm})_{1995}$	-0.003	-0.019**
$\ln(GDPGrowth_m)$	1.767***	1.841***
$\ln(Distance_{xm})$	-0.010	-0.008
Longdistance	0.010	-0.057
$\ln(InternetGrowth_x)_{t-1}$*Longdistance	-0.007	-0.000
$\ln(InternetGrowth_m)_{t-1}$*Longdistance	0.111**	0.120***
Constant	0.239***	0.229***
R^2	0.0185	0.0526
No. observations	5684	5616
F test	8.01	16.13

Note: Significance based on heteroskedasticity and autocorrelation consistent (HAC) standard errors. Regression (6) reports the results using all available data, and regression (7) reports the results without the outliers with error term more than four standard deviations from zero. Year fixed effects, log of 1995 exports, logs of 1995 GDP and population (POP) for exporter and importer countries are included in the regression equation, but are not reported.

Level of significance: * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

The relationship between the $Distance_{xm}$ and food industry export growth is negative, implying that the food industry export growth has been biased towards relatively closer countries. This is consistent with the model, which shows that by the intensification of competition the $Distance_{xm}$ vs. food industry export growth locus becomes steeper. However, the regression coefficient changes only slightly when the Internet variables are included, suggesting that the Internet has not had a large effect on the way in which distance affects bilateral food industry trade growth. To examine this question further, we introduce a dummy

variable, $Longdistance_{xm}$, which equals one if the distance between OECD countries *x* and *m* exceeds the average distance between all analyzed OECD countries (Table 5). We then interacts this variable with the growth of the number of Internet user's variable and include the full set of controls as in the regressions from (3) to (5) in Table 4. If the number of the Internet users has reduced (increased) the impact of the $Distance_{xm}$ on the growth of food industry export then the regression coefficient on the interaction term should be positive (negative). The results are presented in Table 5, regressions (6) and (7). We find that the interaction effect between the growth of the number of the Internet users and $Longdistance_{xm}$ is positive and statistically significant for the importing country and close to zero and not significant for the exporting country. Thus, our results offer evidence that the increased number in the Internet users has altered the effect of distance on bilateral food industry trade in the OECD importing countries, but less on food industry trade in the OECD exporting countries. This implies that the OECD food importing countries have adjusted to the advantages that are arising from the potential of the Internet importing of food industry products, but our results do not confirm this for the OECD food industry exporting countries' supply chains that the number of the Internet users lowers entry costs into a new OECD market. For comparisons, Freund and Weinhold (2004) do not confirm significance of the interaction term for the growth of the Internet use and Longdistance, while Bojnec and Fertő (2009) find negative and significant association for importing and to a lesser extent for exporting manufacturing countries. These mixed results suggest that the number of the Internet users has mitigated and reduced the effect of distance particularly for food industry importing countries.

In addition, as statistically significant is find the regression coefficient for the growth rates of the Internet variable lagged for one period for the importing country. The negative sign of this association suggests that the introduction of the new Internet users in the OECD importing countries affects food industry trade with a time lag negatively. This suggests that the increased number of Internet users reduces the importing food industry trade costs for buyers by playing a larger role in determining current trade patterns. As in the previous regressions, the positive and significant association is clearly confirmed for the growth of food exports that is pertained to the growth of GDP in the importing country. Yet, the negative sign of the parameter for the control variable for the initial 1995 log-levels of food industry exports reinforces the previous finding on the faster food industry export growth adjustment in OECD countries with very low initial food industry exports.

Sensitivity of the results by cross section data estimation

Our panel regression specifications have been chosen to minimize the possibility of omitted variable bias and to capture some of the dynamic impact of the Internet. Cross-section estimation is more prone to these problems, as it is impossible to control for country-fixed effects while using country-specific variables. Nevertheless, cross-section estimation eliminates the possibility of co-trending variables over time and thus provides a useful robustness check of our results. Our cross-section adapted gravity regression results for food industry exports in OECD countries are quite consistent with theoretical expectations and the previous findings for merchandise trade by Freund and Weinhold (2004) and for manufacturing trade by Bojnec and Fertő (2009). Food industry exports are proportional to the product of their economic sizes (GDP) and inversely related to the $Distance_{xm}$ between them. Moreover, each of the dummy variables for $Contigency_{xm}$, $Language_{xm}$, and $RFTA_{xm}$ in each of the cross-section adapted gravity regressions has the positive and statistically significant impact on food industry exports. These findings are clearly visible from Table 6, which presents the cross-section adapted gravity regression results in the years 1995 and 2003.

We test the impact of the number of Internet users on food industry exports across the OECD countries at the initial 1995 and final 2003 analyzed years. The adapted gravity regressions (8) and (10) in Table 6 report the empirical results for the 1995 and 2003, respectively, without the Internet variable. Regressions (9) and (11) include the Internet variable, which are highly statistically significant with a coefficient estimate around 0.12. This reveals the significant positive impact of the number of Internet users on the bilateral food industry exports between OECD countries. For comparisons, Freund and Weinhold (2004) estimated the regression coefficient for merchandise trade at 0.10, whereas Bojnec and Fertő (2009) for manufacturing trade at 0.11. These empirical results are rather consistent by studies even for different internationally traded products.

The regression coefficients that are pertained to the GDP variable are positive and statistically significant suggesting that food industry exports are determined by the size of the economies. This is also consistent with the previous studies (Freund and Weinhold, 2004; Bojnec and Fertő, 2009). The regression coefficients that are pertained to the POP variable are close to zero, but statistically insignificant implying that GDP as the measure of the economy size better explains food exports than POP.

Moreover, we test for possible endogeneity bias of the Internet variable with the food industry export variable if growing export spurs increased Internet penetration rather than the

reverse. Similarly as Freund and Weinhold (2004) and Bojnec and Fertő (2009), we lagged the Internet variable by two periods and controlling for initial food industry export patterns from 1995 to minimize these possibilities. By lagging the Internet variable is reduced the possibility of reverse-causality. The lagged dependent food industry export variable captures all of the country- and pair-specific unobservable characteristics that are time invariant (Freund and Weinhold, 2004). Regression (12) in Table 6 reports the empirical results when the food industry export in the initial 1995 year is included in the 2003 regression equation and the Internet variable is twice lagged. The statistical significance of time invariant control variables remain, except for POP. As a striking finding, the regression coefficients for Distance and for proximity variables (Contigency, Language, and RFTA) become smaller suggesting that the Internet has reduced their importance by changing ways how international food industry business are conducted. The Internet variable remains positive and to a lesser extent statistically significant. Not surprisingly, the coefficient on the Internet variable falls when the past trade is included. The coefficient of 0.017 suggest that a 10 percent increase in the number of Internet users led to about 0.2 percent more food industry export in 2003. If this relationship continued to hold over the long run, it would imply that a 10 percent increase in the number of Internet users in one OECD country would lead to 0.4 percent [0.017/(1-0.625)=0.04] higher food industry export (0.9 percent for merchandise trade by Freund and Weinhold, 2004 or 0.5 percent for manufacturing products by Bojnec and Fertő, 2009). These estimates are rather consistent by studies and across analyzed products.

Table 6.

Cross-section gravity regressions for food industry exports in OECD countries

Dependent variable: $\ln(Exports_{xm})_t$					
Food industry exports from OECD country *x* to country *m*					
	1995	1995	2003	2003	2003
	(8)	(9)	(10)	(11)	(12)
$\ln(Internet_x*Internet_m)$		0.126***		0.117***	
$\ln(Internet_x*Internet_m)_{t-2}$					0.017*
$\ln(GDP_x*GDP_m)$	0.033***	0.035***	0.029***	0.029***	0.007***
$\ln(POP_x*POP_m)$	-0.002	-0.001	-0.001	-0.001	0.001
$\ln(Distance_{xm})$	-0.693***	-0.728***	-0.686***	-0.747***	-0.259***
Contigency	0.415**	0.456**	0.550***	0.558***	0.265***
Language	1.701***	1.347***	1.567***	1.233***	0.469***
RFTA	1.649***	1.519***	1.503***	1.370***	0.453***
$\ln(Export_{xm})_{1995}$					0.625***
Constant	-7.272***	-9.572***	-4.885***	-8.676***	-0.405
R^2	0.4879	0.5299	0.5579	0.5912	0.8444
No. observations	812	812	812	812	812
F test	131.64	128.32	187.86	188.26	463.83

Note: Significance based on heteroskedasticity consistent (Huber-White) standard errors.
Level of significance: * p<0.1; ** p<0.05; *** p<0.01.

The cross-section adapted gravity equations provide a sensitivity analysis of the results by allowing for comparison of the effect of $Distance_{xm}$ on food industry export patterns across different years and with the previous studies. The effect of $Distance_{xm}$ on food industry export in regressions (8) and (10) in Table 6 is statistically significant and remains at a similar negative level between 1995 and 2003 (-0.69). Their absolute increases are seen in the individual years 1995 (from -0.69 to -0.73) and 2003 (from -0.69 to -0.75), and between the years from -0.73 in 1995 to -0.75 in 2003, when the Internet variable is included in regressions (9) and (11). These effects for food industry exports are a slightly less than for merchandise trade (Freund and Weinhold, 2004) or for manufacturing trade (Bojnec and Fertő, 2009). The statistically significant and a slight absolute (but of negative sign) increase when the number of Internet users is included in the regression imply that the food industry export has been biased towards relatively closer countries. Similar as in the panel regressions,

this is consistent with the proximity-biased export growth. The regression coefficient pertained to $Distance_{xm}$ increases a slightly when the Internet variables are included, suggesting that the $Distance_{xm}$ remains important over time, but the Internet could be dampening this effect in bilateral food industry export.

Aggregate food industry trade

So far we have investigated bilateral food industry trade between OECD countries by panel and cross-section data analysis. Similar as Freund and Weinhold (2004) for merchandise trade and Bojnec and Fertő (2009) for manufacturing trade we have confirmed evidence of an effect of the number of Internet users on bilateral food industry trade patterns in both panel food industry export growth rates and cross-country food export levels. However, these do not necessarily imply that the number of Internet users has increased food industry trade of OECD countries overall. The impact of the number of Internet users might be in reorientation of food industry trade in a way that high Internet intensity used OECD countries shift some food industry trade to other high-intensity Internet used OECD countries.

To investigate this possible food industry trade reorientation of OECD countries we investigate the impact of the number of Internet users on the aggregate food industry trade of the OECD countries in our data sample. We estimate the effect of the number of Internet users on the aggregate OECD countries food industry trade openness, as opposed to bilateral food industry trade flows between OECD countries. The cross-section regression results for the aggregate OECD countries food industry trade openness by individual years are reported in Table 7. The dependent variable is the natural logarithm of total food industry trade relative to GDP, ROWGDP is the natural logarithm of rest-of-the-world GDP, and REMOTE is a distance-weighted measure of other countries GDP. We fail to find any statistically significant impact of the ROWGDP and POP, respectively, on the aggregate OECD countries food industry trade. This finding contradicts with Freund and Weinhold (2004) for manufacturing trade as they find positive and significant association for the regression coefficient pertained to ROWGDP, but negative and significant association for the regression coefficient pertained to POP. However, unlike Fruend and Weinhold (2004) and similar as Bojnec and Fertő (2009), we do find the statistically significant negative impact of the REMOTE variable on the aggregate OECD countries food industry trade. Similar as Freund and Weinhold (2004) and Bojnec and Fertő (2009), we do find the statistically significant positive impact of the number of Internet users on the aggregate OECD countries food industry trade. The latter results imply that the Internet has led to increased aggregate food industry trade openness.

The regression coefficient pertained to the number of Internet users' variable has increased over time from 0.714 in 1995 to 1.437 in 2003 and that the number of Internet users has increasingly contributed to overall food industry trade growth. Freund and Weinhold (2004) for merchandise trade find the increase from 0.02 in 1995 to 0.05 in 1999 and Bojnec and Fertő (2009) for manufacturing trade from 0.011 in 1995 to 0.023 in 2003. These findings suggest that the number of Internet users has the greatest contribution to overall food industry trade growth than to merchandise or manufacturing trade.

Table 7.

Aggregate cross-section food industry trade regression results by individual years, 1995-2003

Dependent variable: ln(aggregate food trade/GDP)									
	1995	1996	1997	1998	1999	2000	2001	2002	2003
ln(ROWGDP)	6.011	11.456	14.537	12.042	14.264	13.000	14.212	12.465	16.133
ln(POP)	0.470	0.474	0.589	0.555	0.542	0.478	0.417	0.367	0.461
ln(REMOTE)	-28.240*	-25.331*	-29.373**	-31.308**	-31.858**	-33.508**	-33.502**	-33.911**	-33.079**
ln(Internet)	0.714*	0.774**	0.932**	1.018***	1.115**	1.241**	1.286**	1.404**	1.437**
Constant	-171.243	-340.770	-437.515	-360.382	-430.105	-391.007	-428.179	-374.387	-490.481
No. observations	28	28	28	28	28	28	28	28	28
R^2	0.2189	0.2756	0.3412	0.3733	0.3538	0.3765	0.3560	0.3359	0.3323
F test	1.61	2.19	2.98	3.43	3.15	3.47	3.18	2.91	2.86

Note: Significance based on heteroskedasticity consistent (Huber-White) standard errors.

Level of significance: * p<0.1; ** p<0.05; *** p<0.01.

Policy implications

The Internet as a global intermediary facilitates transactions between suppliers/exporters and demanders/importers that contribute to a growing food industry trade. The increase in the number of Internet users better integrates the information and trade flows, creates additional competition and market outlets. Exporters can gain access to more importers, and importers can find more easily multiple exporters. This improves transparency and lowers trade costs for both exporters and importers. The Internet has the potential to stimulate trade as the growth of web hosts and e-marketplaces improves the access and availability of information about new markets for sellers and about goods for buyers everywhere around the world, facilitates logistics and serves as an advertising and marketing channel, which reduces market-specific entry costs on conduction of trade.

The empirical results of the gravity trade model using panel and cross-section adapted gravity regressions revealed the evidence on the positive impact of the number of Internet users on the patterns of bilateral industry exports and overall food industry trade of the OECD countries. The increase in the number of Internet users in organizations, households, and the economy as a whole encourage food industry trade as well as redirect food industry trade. Among limitations of our study is that the definition of Internet users on food industry trade does not include only users, which really influence the international food industry trade, which are mostly institutional and rarely physical users (Bojnec and Fertő, 2009). This suggests that investments into the Internet-based international commerce and e-business are beneficial for food industry trade as Internet access increases customers' and suppliers' market connect and network externalities.

The Internet has changed the ways how international food trade businesses are conducted. It has also changed the competences and managerial skills that are required. This has strengthened additional practical implications toward sustainable Internet management and improved business practices in the trade exchange between the OECD countries. The Internet has strengthened competition and increased the importance of Distance on international food industry trade and thus increased the importance of the country proximity. At the same the Internet has mitigated countries proximities regarding having the common land border, speaking the same Language or having advantages arising from free trade agreements. These striking changes in international food trade management and marketing have important managerial and policy implications for staff capacity building into new required knowledge, skills and competences, and for investments towards the competitive advantages that are arising from the Internet use.

The innovative aspects of the influence of the Internet is on the institutional world policy in the food industry, the industries linked, particularly trade and supply chain management, and in case of natural disasters or other unforeseen occasions, which modify the Internet environment, as consequence of Internet management. The strategy to improve the Internet management in e-international food industry marketing is important at enterprise, country and at cross-country levels due to the specificity of food industry trade that is related to information, food safety standards, and a specific characteristics of food industry products. The globalization of food industry trade has brought changes in international food chain management with the increasing role of multinational companies and international retail hyper and supermarkets, where information and communication costs are important. The rapid technological changes in information and communication technologies and the increase in the number of Internet users reduce the role of asymmetric information and communication costs on international trade (e.g. Fink *et al*., 2005; Freund and Weinhold, 2002, 2004; Tang, 2006). As a result of these processes, trade costs are reduced, whereas both bilateral and overall food industry trade of the OECD countries have increased.

Food safety standards are one of the specificities of international food industry trade vis-à-vis international trade in services or international trade in merchandise products. Food safety standards with specific quality requirements, veterinary, fitosanitary and health standards require specific information and trade arrangements between the countries. The Internet with globalization of food industry trade mitigates the effect of possible non-tariff trade barriers regarding food safety standards in international food industry trade, while the implementation of bilateral and multilateral free trade agreements is one of the reasons that tariff barriers to international food industry trade have been reduced over time or are abolished. Trade liberalization and free trade agreements have been particularly stipulated among the world most developed countries. Most of them are OECD member countries. This is another reason that the Internet with improved information and communication reduces trade costs and induces forces for an increase in international food industry trade.

In addition to food safety standards, the specific characteristic of international food industry trade is its seasonality during the year due to climatic conditions (Bojnec and Latruffe, 2008). Yet, the perishable nature of most of food industry products and their sensitivity to different diseases, which are pertained to food industry trade, make the importance of the Internet to mitigate the proximity variables on international food industry trade. Managers should develop marketing strategies with a greater attention on on-line

international marketing expanding customer based market outlets for exporters and finding suppliers for importers with the improved information availability at lower transaction costs.

We use OECD cross-country annual national aggregates time-series data, which are used in panel and cross-section econometric data analysis to study a business-to-business market. To study the enterprise business levels in order to justify Internet use for enterprises' behaviours and to replicate the research from national aggregates data to the enterprise level, in-depth survey's data is recommended to study the impact of Internet usage in enterprises. For advanced businesses, like international trade enterprises that have been pioneers in the use of Internet technology, focus can be on some other variables such as the spending by enterprises on e-business applications as a factor for enterprises competing in international trade and whether this reduces trade costs.

Conclusion

The academic merit of this paper is in the fact that the impact of the number of Internet users on the patterns and growth of bilateral food industry exports between the OECD countries and on their aggregate food industry trade with the adapted gravity equation using both panel and cross-sectional data and with application of well-established econometric methods has seldom been investigated. As consistent with the adapted gravity model the economic size of country and the countries proximity statistically significantly contributes to food industry export and its growth. As a striking finding, the Internet with the globalization of food industry trade has diminished the importance of the proximity variables on food industry export. This is revealed by the positive and significant, but reduced regression coefficients for Contingency for sharing the common land border, speaking the same language, and belonging to the same free trade agreement, when the Internet variables are included in the cross-section regression.

The contribution and value of the paper with the implications to the research and practitioners' audience is that empirical results confirmed that the number of Internet users has the significant positive impact on bilateral food industry exports level as well as on overall food industry trade for the sample of the OECD countries. The increase in the number of Internet users is likely to improve information and increase competition, reduces trade costs, and thus increases food industry exports. The increasing effect of Distance on food industry trade suggests on the importance of the proximity bias on international trade between the OECD countries in response to an increase in competition. The importance of the findings is for food industry chain management in a global competition. The managerial response is seen in investments at the enterprise level into the increasing role of the e-commerce and e-

business in international food industry trade. The policy response gives a support for removal of tariffs, harmonization of specific non-tariff food industry trade barriers, and more intensive setting-up of different e-commerce food market outlets worldwide.

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References

Anderson, J.E. (1979), "A theoretical foundation of the gravity equation", *American Economic Review*, Vol. 69 No. 1, pp. 106-16.

Anderson, J.E. and van Wincoop, E. (2003), "Gravity with gravitas: a solution to the border problem", *American Economic Review*, Vol. 93 No. 1, pp. 170-92.

Anderson, J. and van Vincoop, E. (2004), "Trade costs", *Journal of Economic Literature*, Vol. 42 No. 3, pp. 691-751.

Berthelon, M. and Freund, C. (2008), "On the conservation of distance in international trade", *Journal of International Economics*, Vol. 75 No. 2, pp. 310-20.

Bojnec, Š. and Fertő; I. (2008), "Agro-food trade sustainability in Central and Eastern Europe", *International Journal of Sustainable Economy*, Vol. 1 No. 1, pp. 100-12.

Bojnec, Š. and Fertő, I. (2009), "Impact of the Internet on manufacturing trade", *Journal of Computer Information Systems*, Vol. 50 No. 1, pp. 124-32.

Bojnec, Š. and Latruffe, L. (2008), "Measures of farm business efficiency", *Industrial Management & Data Systems*, Vol. 108 No. 2, pp. 258-70.

Brada, J. C. and Mendez, J.A. (1993), "Political and economic factors in regional economic integration", *Kyklos,* Vol. 46, No. 2, pp. 183-201.

Clarke, G.R.G. (2008), "Has the internet increased exports for firms from low and middle-income countries?", *Information Economics and Policy*, Vol. 20 No. 1, pp. 16-37.

Clarke, G.R.G. and Wallsten, S.J. (2006), "Has the Internet increased trade? Developed and developing country evidence", *Economic Inquiry*, Vol. 44 No. 3, pp. 465-84.

Den Haan, W. and Levin, A. (1996), *A Practitioners Guide to Robust Covariance Matrix Estimation*, NBER Working Paper No. T0197.

Fink, C., Mattoo, A. and Neagu, I.C. (2005), "Assessing the Impact of Communication Costs on International Trade", *Journal of International Economics*, Vol. 67. pp. 428-445.

Frankel, J. and Rose, A. (2002), "An estimate of the effect of common currencies on trade and income", *Quarterly Journal of Economics*, Vol. 117 No. 2, pp. 437-66.

Freund, C.L. and Weinhold, D. (2002), "The Internet and international trade in services", *American Economic Review*, Vol. 92 No. 2, pp. 236-40.

Freund, C.L. and Weinhold, D. (2004), "The effect of the Internet on international trade", *Journal of International Economics*, Vol. 62 No. 1, pp. 171-89.

Im, K., Pesaran, H. and Shin, Y. (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics,* Vol. 115, pp. 53–74.

Jemmeson, P. (1997), "Using the Internet for competitive advantage", *Industrial Management & Data Systems*, Vol. 97 No. 4, pp. 139-42.

Kribel, Z. and Bojnec, Š. (2007), "Internet and e-commerce service adoption by the Slovenian travel agencies: a comparative view," *International Journal of Services and Standards*, Vol. 3 No. 3, pp. 277-88.

Levin, A., Lin, C. and Chu, C. (2002), "Unit root tests in panel data: asymptotic and finite-sample properties", *Journal of Econometrics,* Vol. 108, pp. 1–24.

McCullough, E.B., Pingali, P.L. and Stamoulis, K.G. (2008), *The Transformation of Agri-Food Systems: Globalization, Supply Chains and Smallholder Farmers*, The Food and Agriculture Organization of the United Nations and Earthscan, Rome and London.

Palumbo, F. and Herbig, P. (1998), "International marketing tool: the Internet", *Industrial Management & Data Systems*, Vol. 98 No. 6, pp. 253-61.

Rauch, J.E. (2001), "Business and social networks in international trade", *Journal of Economic Literature*, Vol. 39 No. 4, pp. 1177-1203.

Rotchanakitumnuai, S. and Speece, M. (2009), "Modeling electronic service acceptance of an e-securities trading system", *Industrial Management & Data Systems*, Vol. 109 No. 8, pp. 1069-84.

Tang, L. (2006), "Communication costs and trade of differentiated goods", *Review of International Economics*, Vol. 14 No. 1, pp. 54-68.

Tucker, S.-P. (2008), "E-commerce standard user interface: an E-menu system", *Industrial Management & Data Systems*, Vol. 108 No. 8, pp. 1009-28.

Yang, M.-H., Chandlrees, N., Lin, B. and Chao, H.-Y. (2009), "The effect of perceived ethical performance of shopping websites on consumer trust", *Journal of Computer Information Systems*, Vol. 50 No. 1, pp. 15-24.

Vedder, R.G., Guynes, C.S. and Vanecek, M.T. (1997), "Electronic commerce on the www/Internet," *Journal of Computer Information Systems*, Vol. 38 No. 1, pp. 20-25.