Information and Communication Technology and the Global Flow of Wine: A Gravity Model of ICT in Wine Trade

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INTRODUCTION

Globalisation results when markets and industries become more integrated because of lower tariffs or reduced trade costs, or both. These costs have fallen over the long term because of sustained advances in transport technology and, even more dramatically, in information and communication technology (ICT) (WDR 2009). Moreover, advances in transport technologies have significantly reduced the time trade good spend in transit (Hummels 2001). Improved transport and information technologies eventually were complemented by the modern global supply chain, an organizational innovation that leverages information and transport technology to better coordinate the activities of geographically dispersed economic agents.

Direct communication costs tend to be a minor component of total transaction costs in international trade, and their share in total trading costs of any one shipment is smaller yet. Indirect communications cost, in particular the opportunity cost of imperfect coordination due to poor communication are unknown but may be significant. Perhaps it is because of reduced loss of coordination that the diffusion of digital ICT is believed to stimulate international trade to an extent that appears to be large in proportion to the share of ICT costs in trading costs (Hummels 2007).

The purpose of our paper is to explore some of the factors that are generally believed to have contributed to the extension and intensification of international trade. In particular, we explore the factors that have an impact on international trade in wine.

ICT AND ITS IMPACT ON INTERNATIONAL TRADE

Digital ICT is the product of the convergence of modern telecommunication technology and digital data processing technology (Economist 2006). The telecommunication technology used by convergent technologies is the internet; the devices themselves are computers which come in various, rapidly evolving guises – PC, notebook, mobile phone, smartphone, pad, etc. The speed at which digital technology has advanced in the past is without precedent (Nordhaus, 2001). Moreover, convergent ICT is spreading much more rapidly than either conventional communication technology or the internet. Fixed-line telephone penetration in the world is nearly flat at just below 20 users per 100 inhabitants. In a much shorter time the internet has grown to about 23 users per 100 inhabitants. Mobile phones, in contrast, have spread much more rapidly than internet use and more than two of every three inhabitants in the world are mobile phone subscribers, of which there are some 4.9 billion in the world at the end of 2009 (ITU 2009), and, as UNCTAD (2006, p. 3) observed, 'Mobile phones are the only ICT in which developing countries have surpassed developed countries in terms of users.' Hence, it is safe to say that advances in convergent ICT, rather than in transportation or in conventional PC plus internet technology, will be the defining technology of the current era of globalization (Hummels 2007).

A small batch of empirical studies has investigated the impact of ICT on international trade (Freund and Weinhold 2004; Clarke and Wallsten 2004; Fink et al. 2005; Wheatley

and Roe 2005; Tang 2006; Clarke 2008; Bojnec and Fertö 2009). In broad terms, the studies found: (i) ICT-diffusion stimulates a country's exports; (ii) the export-stimulating impact is larger for heterogeneous than for homogenous goods; (iii) the internet stimulates exports from developing countries but not from developed countries; (iv) mobile phones stimulate international trade in all countries; (v) there is no consensus among the studies on the differences in impact of ICT on imports and exports.

INTERNATIONAL TRADE IN WINE AND ITS COMMUNICATION REQUIREMENTS

International trade in wine

Global trade in wine has grown rapidly and its structure has changed significantly during the past quarter century. The recent history of the evolution of world wine markets has been recorded by Anderson et al. (2004), Wittwer and Rothfield (2005) and Wittwer (2007). We therefore only highlight some select observations on the current state of world wine markets.

According to OIV (2009), world production of wine amounts to about 270 mio hl of which 89.1 mio hl have been exported in 2008; at this level world wine exports amounted to about 38 per cent of world wine consumption in 2007. Export statistics are highly sensitive to whether intra-EU trade is counted as export.

The dominance of the EU as an exporter of wine has been steadily eroding as 'New World' wines from Australia and New Zealand penetrated markets beginning in the 1980s that 'Old World' suppliers considered as theirs. More recently, new world market entrants, such as Chile, South Africa and Argentina, added to global trade in wine. The new competitors have eroded Europe's dominance in world wine markets. The share in world wine trade of the five leading EU-wine-producers France, Italy, Spain, Germany and Portugal has declined from 75 per cent in 1981/85 to 65 per cent in 2001/05. In the same period, the share in world trade of southern hemisphere wine producers (Argentina, Chile, South Africa, Australia, New Zealand) has increased from 1.6 per cent to 23.3 per cent (OIV 2009). In addition to the southern hemisphere producers, the United States of America have become the world's fourth largest wine exporter after the EU, Australia, and Chile.

The EU is also the major importer of wine with Germany, the United Kingdom and the Netherlands being major importing countries. The USA has remained a major wine importer despite an expanding home production. Moreover, Russia and China have emerged as significant wine importers.

International wine supply chains and information demands

Wine is a heterogeneous product. Wine may be a low-priced alcoholic beverage that is mainly distinguished by the shape and color of its bottle and the design of its label. Wine may also be a complex consumer good that is as much a work of art or an expression of culture as it is a beverage. Such pieces of 'bottled poetry' are usually higher priced than

plain beverage-wine. Finally, there are extremely high-priced superstar wines which are consumed with much ritual, if they are drunk at all.

There are no readily available data on world trade in each of the three wine categories. Consumers' budget constraints assure, however, that, in terms of quantity traded, most of world wine trade is in beverage wines and some is in bottled-poetry wines. Superstar wines, finally, are priced beyond most wine consumers' ability to pay and the quantity traded is minute.

Until the early 1990s the supply chains for wine were largely dominated by wine producers or wine export organizations. This has changed. Most wines are now sold through supermarket chains which apply similar business models to all products that they sell, including wine. Therefore, wine supply chains are first of all geared to meet the exacting and sometimes capricious demands of supermarket chains in the main importing countries. Because of the need to gain access to supermarkets' purchase departments and to be able to react quickly to their demands, most wine producers that are not part of transnational firms with representations in import countries tend to rely on agents in the importing country (Gwynne 2008; Ponte and Ewert 2009). Beyond that, the configuration of the supply chains linking exporting and importing countries seems to depend on historical circumstances. Wine exports from New Zealand, for example, were mostly channeled through only two transnational wine companies that accounted for about two-thirds of her wine exports (Gwynne 2006). Wine from Chile, in contrast, is shipped by a considerable number (> 20) of national wine companies to distributors in the importing countries. In South Africa, in contrast, "the most successful brands of South African wine in the United Kingdom are now owned or co-owned by UK companies (Ponte and Ewert 2009, p. 1645).

Close integration of buyers, sellers, and providers of logistics services in a supply chain together with the need of the whole chain to quickly react to the demands of retailers has certainly intensified the exchange of information along international wine supply chains. Moreover, traceability regulations have added to the information that needs to be passed on along with the wine. Finally, there is a new trend to differentiate wine by information attributes, such as organic or fair trade. The information demands of wine supply chains do not appear to be beyond the capacity of the information infrastructure of the major importing countries and exporting countries as well. This implies that we can expect to see only moderate impacts of the growth of ICT on international wine trade.

MEASURING THE IMPACT OF ICT ON INTERNATIONAL TRADE IN WINE

A gravity model of international trade in wine

We estimated a partial-equilibrium model of bilateral trade in wine, based on a balanced annual data set for the period from 1995 to 2008. The 21 major exporting and 23 major importing countries were selected on the basis of their share in the total value of the global wine trade. They provided a sample size of 6664 observations that accounted for over three-quarters of exports and imports of wine during the study period.

Several country characteristics in both the exporting country and importing country that vary over time are included as normal continuous variables. They include three ICT variables:

- telephone main lines in use per 100 inhabitants, specified in natural logarithms as $LTELX_{it}$ for exporting countries and $LTELM_{jt}$ for importing countries;

- internet users per 100 inhabitants, specified in natural logarithms as $LNETX_{it}$ for exporting countries and $LNETM_{jt}$ for importing countries; and

- mobile phone subscribers per 100 inhabitants, specified in natural logarithms as $LMOBX_{it}$ for exporting countries and $LMOBM_{jt}$ for importing countries.

The first of these variables is included to represent the traditional forms of telecommunication while the other two variables are included to represent modern digital ICT. All variables represent the likelihood that those involved in international wine trade have access to particular forms of ICT. But they are also used as proxies for the geographical spread of ICT within countries, the availability of applications associated with the technology, and the experience users would have had, and the skills they would have developed, in applying it. Finally, they are useful proxies for the costs of information and communication tools because there is a high correlation between prices and the extent of penetration of each ICT category.

Other continuous variables considered for inclusion are common to many previous models of bilateral trade flows. The natural logarithms of GDP per capita in importing country j in year t ($LGDCM_{jt}$) and GDP per capita in exporting country i in year t ($LGDCX_{it}$) were included to reflect the greater effective demand for wine with higher mean incomes per head in the importing country and exporting country, respectively. A positive sign is expected for the estimated coefficient of $LGDCM_{jt}$ and a negative sign for the estimated coefficient of $LGDXC_{it}$. The natural logarithm of the product of populations of trading partners ($LPOP_{ijt}$) was also included to capture the tendency for greater trade to take place between countries with large populations.

We follow Baltagi et al. (2003) who included two main explanatory variables consistent with certain trade theories that feature gross domestic product (GDP) as a component: a similarity index of economic size between the trading partners ($LSIM_{ijt}$); and the absolute difference in relative factor endowments between the trading partners in time t ($LRFAC_{ijt}$). Egger (2000, p. 2) defined $LSIM_{ijt}$ as

$$\ln\left[1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}}\right)^2\right].$$ Countries with similar-sized economies

are expected to trade more with each other, although this relationship is likely to be stronger at the macroeconomic level than for a specific industry such as wine. $LRFAC_{ijt}$ is

defined by Baltagi et al. (2003, p. 393) as $\left|\ln\left(\frac{GDP_{it}}{capita_{it}}\right) - \ln\left(\frac{GDP_{jt}}{capita_{jt}}\right)\right|$ where $capita_{it}$ is

the population in the exporting partner country and *capita$_{jt}$* is the population in the importing partner country in year *t*. Those who believe that the 'new trade theory' models best depict international trade in products where scale economies prevail along with product differentiation would expect a negative sign on this variable (Baltagi et al. 2003). International trade in wine does indeed lend itself to scale economies, and product differentiation is rife, supporting the relevance of these models. Adherents of the classical Heckscher-Ohlin-Samuelson theory, on the other hand, expect a positive sign: the greater the difference between countries in relative factor endowments, the more likely they are to trade with each other. While important at the macroeconomic level, the relevance of the Heckscher-Ohlin-Samuelson theory at the individual industry level is likely to be muted.

Wine outputs in exporting and importing countries were included as explanatory variables in natural logarithms (*LPDNX$_{it}$* and *LPDNM$_{jt}$*). Because grapevines are perennial crops, it is assumed there is little opportunity for producers to vary output in the short run. Therefore, wine producers are assumed to have a fixed volume of wine grapes to make into wine for supply to the domestic and export markets in each year.

Moreover, a sub-set of time-invariant country- and trading partner-specific variables are included: an adjacent country dummy variable (*ADJ$_{ij}$*) for trading partners; a variable for the use of a common language between trading countries (*LANG$_{ij}$*) (Hutchinson 2002); a logged variable for distance between trading partners (discussed below); and a logged logistics performance index that is the product of the individual indices for exporting and importing countries (*LPI$_{ijt}$*).

LPI$_{ijt}$ comprises the seven elements of: efficiency and effectiveness of the clearance process by border control agencies; quality of transport and IT infrastructure for logistics; ease and affordability of arranging international shipments; competence in the local logistics industry; tracking and tracing of shipments; costs of domestic logistics; and timeliness of shipments in reaching their destination (World Bank 2007). This variable may vary over time but, because data are only available for one year of the study period (2007) and probably vary only marginally, the variable is treated as time-invariant for the purpose of this study.

Baltagi et al. (2003) pointed out that many country characteristics cannot be identified with specific data series. They stressed the need to account for interaction effects between pairs of countries in trade flow models, to reflect the heterogeneous relationships between exporting and importing countries not captured by other country-specific variables, and to account for changes in trading relationships over time. We follow their lead by including year effects and trading partner effects in the estimated model to depict various trading partner- and year-specific factors as either fixed or random effects.

We attempt to account for the cost of international shipment of wine by using two proxy variables that are applied to each bilateral trade transaction in each year. First, the importance of distance between two trading partners has been studied for over four decades (Egger 2008). We follow Feenstra (2004) in specifying a distance variable while controlling for the trading partner-specific fixed effects, mentioned above, to obtain a

consistent estimate of the average effect of trade frictions. This variable is used in natural logarithm form ($LDIST_{ij}$). Second, a continuous but trading partner-invariant variable for fuel, also in natural logarithm form ($LFUEL_t$), is included to capture the effects of changes in the real fuel price on freight costs over the study period. A preferred option for transport cost would obviously have been the actual freight cost in shipping wine in real terms, but data on this variable are unavailable.

The model was estimated using *Stata 11.0* as a fixed-effects model and a random-effects model (Greene 2003, pp. 287-298). The two-way effects models were estimated for trading partner and year effects. A Hausman test (Greene 2003, pp. 301-303) was conducted to decide between the fixed-effects and random-effects models.

A Poisson pseudo-maximum likelihood (PPML) estimator, recommended by Santos Silva and Tenreyro (2006), was considered the most appropriate approach among the estimators in estimating a gravity model. Crucial statistical advantages of the PPML estimator are its linear-log linking function that avoids the under-prediction of large values or volumes of trade, and the fact that it provides a natural way to deal with the difficulty of zero-trade flows because of its non-linear form by using an exponential regression function (Linders et al. 2008). A detailed explanation of the Poisson specification of the gravity model trade and its attributes can be found in Santos Silva and Tenreyro (2006, 2010).

Burger et al. (2009) suggested the negative binomial pseudo-maximum likelihood (NBPML) to avoid the problem of non-equidispersion when using a PPML model. An assumption of equidispersion underlying the PPML estimator means that the conditional mean is assumed to equal the conditional variance. If this condition does not hold, under-dispersion or (much more likely) over-dispersion could result. *Stata 11.0* can be used for panel data when applying the PPML and NBPML estimators. A test was conducted for non-equidispersion when using the PPML estimator and the result was found to favor the use of the NBPML estimator because of the presence of over-dispersion.

Data on ICT, international trade in wine and control variables

Data on annual international trade values in wine in nominal US dollars were obtained from Comtrade (2009). The HS code 2204 was used to extract the data, which were translated into real values using the US GDP deflator. Data on wine production were obtained from OIV (2005) for the period from 1995 to 2005, and extrapolated for the years 2006-2008 on the basis of trends prior to 2006.

ITU (2008) was the source of data for the ICT variables included in the estimated model. The specific data sources used were telephone main lines in use per 100 inhabitants (ITU/MDG [code 13130]), internet users per 100 inhabitants (ITU estimates/SYB51, [code 29969]) and mobile phone subscribers per 100 inhabitants (ITU estimates [code 13110]).

The World Bank (2008b) database and UNCTAD (2008) were the sources of data on population and GDP. The GDP data in nominal US dollars were converted to real GDP

estimates using the US GDP deflator. Mayer and Zignago (2006) provided the information from which we compiled the distance, adjacent country and common language data series. The mean annual Brent crude oil price in real terms was used as a proxy for fuel prices. The indices of logistics performance were obtained from the World Bank (2007).

Results

The estimates of most coefficients of the preferred estimated model reported in Table 1 are in line with expectations, but there are exceptions that are detailed below. A series of hypothesis tests were conducted on the merits of various model estimates computed using *Stata 11.0*. Likelihood ratio test results show that a two-way effects model is strongly preferred to a model comprising solely the regressor variables, or either a trading partner effects model or a year effects model. On the merits of the fixed effects and random effects two-way models, the result of the Hausman test strongly favors a fixed effects model for the trading partner and year effects and estimates are reported only for this model in Table 1.

The distance, adjacent countries and language variables are excluded from Table 1 because their coefficients were reported as fixed parameters in the fixed effects model and hence no estimated coefficients were presented for them in the *Stata 11.0* output. The fuel costs variable is also excluded because it is invariant across trading partners.

A likelihood ratio test on the ICT variables confirms that, as a group, they have a significant impact on the value of wine trade. But the individual results differ between the ICT variables, and between exporting and importing countries. The coefficient of the fixed-line telephone variable in exporting countries is significantly positive at less than the 1 per cent level while the coefficients of the digital ICT variables in exporting countries are insignificant. The coefficient of the internet variable is marginally significant and of expected sign, but has an extremely small elasticity. Coefficients on the internet and mobile phone variables in importing countries are both significantly greater than zero at well below the 1 per cent significance level. The coefficient on the fixed telephone line variable in importing countries has an unexpected and significant negative sign.

Coefficients on the economic mass variables present startling differences. GDP per capita variables have highly significant positive coefficients while the coefficients on the population variables are highly insignificant. The coefficient on the variable of absolute difference in relative factor endowments between the trading partners is also highly insignificant while the coefficient on the similarity index of economic size between the trading partners is significantly greater than zero. The coefficients on both the wine production variables are highly significant and greater than zero.

Table 1:   Estimated Model Coefficients for Trade in Wine

Variable	Coefficient	Standard error	t-value
Constant	-7.476	0.964	-7.75
$LGDCX_{it}$	0.229	0.093	2.47
$LGDCM_{jt}$	0.356	0.113	3.16
$LPOPX_{ijt}$	-0.005	0.077	-0.06
$LPOPM_{ijt}$	-0.054	0.113	-0.48
$LRFAC_{ijt}$	0.003	0.094	0.03
$LSIM_{ijt}$	0.205	0.075	2.74
$LPDNX_{it}$	0.218	0.035	6.21
$LPDNM_{jt}$	0.198	0.091	2.18
$LNETX_{it}$	0.031	0.031	1.00
$LNETM_{jt}$	0.074	0.026	2.84
$LMOBX_{it}$	-0.077	0.024	-3.19
$LMOBM_{jt}$	0.098	0.030	3.23
$LTELX_{it}$	0.418	0.132	3.17
$LTELM_{jt}$	-0.235	0.120	-1.97

DISCUSSION OF RESULTS

The penetration of fixed telephone lines remains the dominant positive influence on wine trade among the three ICT variables in exporting countries. Neither of the digital ICT variables in exporting countries has a strongly positive impact on wine trade, suggesting that wine exporters rely on the traditional means of communication. The internet effect in exporting countries is positive but minor, with a 1 per cent increase in internet penetration associated with only a 0.031 per cent increase in wine trade. The internet effect in importing countries is more substantial: a 1 per cent increase in internet penetration is associated with a 0.074 per cent increase in wine trade.

Results for mobile phone usage vary starkly between exporting and importing countries. A 1 per cent increase in usage in importing countries is associated with an increase in the value of trade in wine of 0.09 per cent, suggesting that wine importers are making effective use of mobile phone communication in their trading activities. In contrast, a 1 per cent increase in mobile phone usage in exporting countries is associated with a decrease in the value of trade in wine of 0.077 per cent, a highly unexpected result that is difficult to explain. Clearly, wine producers and exporters are not using their mobile phones to enhance their trade in wines.

These results nevertheless support the proposition that recent developments in the internet and mobile telephony have had a significant impact on the pattern of trade in wine, albeit at small magnitudes. The impact of ICT has been greater for the traditional source of fixed telephone line form of communication than for mobile phone and internet usage. The impact of digital ICT has been felt only in importing countries, suggesting that the most crucial needs for it occur once wine reaches the port in the importing country.

CONCLUSIONS

We employed a gravity trade model of international wine trade that includes the 21 main exporting countries and 23 main importing countries, and covers the period from 1995 – when the World Wide Web and mobile phone technology were in their infancy – until 2008 when both technologies were available globally. The gravity model explains the value of wine trade between two countries in terms of the level of internet, fixed telephone line and mobile phone diffusion, and a broad range of factors that might also affect bilateral trade. A two-way (trading partner and year) fixed effects model using a negative binomial panel estimator was found to be appropriate for estimation purposes.

Results from tests of ICT effects on international trade in wine provide findings, which vary between exporting and importing countries, and between near and distant trading partners. Fixed line telephony remains the most important influence on wine trade in exporting countries while digital ICT has a greater positive effect in importing than in exporting countries. Internet usage in exporting countries was found to have a negligible effect on wine trade while its usage in importing countries had a significant but minor positive effect. Mobile telephony usage was found to have a significant positive but minor effect on wine trade in importing countries but not in exporting countries. The fact that the impact of internet and mobile phone usage has been felt only in importing countries suggests that the most crucial needs for this form of digital ICT occur once wine reaches the port in the importing country.

These results provide modest support for the proposition that recent developments in internet and mobile telephony have had a positive impact on the pattern of trade in wine during the study period. But the fact that the ICT impact was still greater for the traditional communications source of fixed line telephony than for these digital ICT sources in exporting countries raises questions why wine producers and exporters are not making more effective commercial use of digital ICT.

REFERENCES

Anderson, K., Norman, D. and Wittwer, G. 2004, The global picture. Ch. 2 in: Anderson, K. (ed.), *The World's Wine Markets. Globalization at Work,* Cheltenham, Edward Elgar.

Baltagi, B.H., Egger, P. and Pfaffermayr, M. 2003, A generalized design for bilateral trade flow models, *Economics Letters* 80, 391-397.

Bojnec, S. and Fertö, I. 2009, Communication costs and agro-food trade in OECD countries, Paper for presentation at the Annual Conference of the Agricultural Economics Society, Dublin, March 31 - April 1, 2009.

Clarke, G.R.G. 2008, Has the internet increased exports for firms from low and middle-income countries?, *Information Economics and Policy* 20, 16-37.

Clarke, G.R.G. and Wallsten, S.J. 2004, Has the Internet increased trade? Evidence from industrial and developing countries. World Bank Policy Research Working Paper 3215. Washington, DC: World Bank.

Comtrade 2009, United Nations commodity trade statistics database. Accessed 19 June 2009, available at: http://comtrade.un.org/db/dqBasicQuery.aspx

Economist 2006, A survey of telecom convergence. Economist print edition, 12 October 2006.

Egger, P. 2000, A note on the proper specification of the gravity equation, *Economics Letters* 66, 25-31.

Egger, P. 2008, On the role of distance for bilateral trade, *World Economy* 31, 653–662.

Feenstra, R.C. 2004, Advanced International Trade: Theory and Evidence, Princeton University Press, Princeton, NJ.

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

Freund, C. L. and Weinhold, D. 2004, The effect of the Internet on international trade, *Journal of International Economics* 62, 171-189.

Greene, W.E. 2002, LIMDEP Version 8.0: Econometric Modeling Guide, Volume 1, Econometric Software, Plainview, NY.

Greene, W.E. 2003, Econometric Analysis, 5th ed., Prentice Hall, Upper Saddle River, NJ.

Gwynne, R.N. 2008, UK retail concentration, Chilean wine producers and value chains, *Geographical Journal* 174(2), 97-108.

Gwynne, R.N. 2006, Governance and the wine commodity chain: Upstream and downstream strategies in New Zealand and Chilean wine firms, *Asia Pacific Viewpoint* 47(3), 381-395.

Hummels, D. 2007, Transportation costs and international trade in the second era of globalization, *Journal of Economic Perspectives* 21, 131–154.

Hummels, D. 2001, Time as a trade barrier, unpublished paper, Purdue University, West Lafayette, IN.

Hutchinson, W.K. 2002, Does ease of communication increase trade? Commonality of language and bilateral trade, *Scottish Journal of Political Economy* 49, 544-556.

ITU 2008, Yearbook of Statistics: Telecommunications Services 1997-2006 (and previous issues), International Telecommunications Union, Geneva.

ITU 2009, New ITU ICT development index compares 154 countries, Press release 2 March 2009, International Telecommunications Union, Geneva.

Linders, G.-M.J., Burger, M.J. and van Oort, F.G. 2008, A rather empty world: the many faces of distance and the persistent resistance to international trade, *Cambridge Journal of Regions, Economy and Society* 1, 439–458

Mayer, T. and Zignago, S. 2006, Notes on DEPII's distance measures. Accessed 19 June 2009, available at http://www.cepii.fr/distance/noticedist_en.pdf

Nordhaus, W.D. 2001, The Progress of Computing, Cowles Foundation, Yale University, New Haven.

OIV 2009, *State of vitiviniculture world report, March 2009*, Organisation del la Vigne et du Vin, Paris.

OIV 2005, World Vitivinicultural Statistics, Organisation del la Vigne et du Vin, Paris.

Ponte, S. and Ewert, J. 2009, Which way is 'up' in upgrading? Trajectories of change in the value chain of South African wine, *World Development* 37(10), 1637-1650.

Santos Silva, J.M.C. and Tenreyro, S. 2010, On the existence of the maximum likelihood estimates in Poisson regression, *Economic Letters* 107(2), 310-312.

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

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

UNCTAD 2006, Information Economy Report 2006, United Nations, New York and Geneva.

UNCTAD 2008, UNCTAD handbook of statistics online. Accessed 17 June 2008, available at: http://www.unctad.org/

Wheatley, W.P. and Roe, R. 2005, The effects of the Internet on U.S. bilateral trade in agricultural and horticultural commodities, Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, RI, July 24-27, 2005.

Wittwer, G. 2007. The global wine market in the decade to 2015 with a focus on Australia and Chile. General Working Paper No. G-166, Centre for Policy Studies, Monash University, Melbourne, Vic.

Wittwer, G. and Rothfield, J. 2005, Projecting the world wine market from 2003 to 2010. *Australasian Agribusiness Review* 13, Paper 21.

World Bank 2007, Logistics performance index 2008. Accessed 14 September 2009, available at: http://info.worldbank.org/etools/tradesurvey/mode1c.asp

World Bank 2008b, Data and statistics, World Bank, Washington, D.C. Accessed 17 June 2008, available at: http://data.worldbank.org/topic

WDR 2009, World Development Report 2009: Reshaping economic geography. World Bank, Washington, D.C.