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A panel data analysis over the period 1988-2008

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Technological effects of intra-OECD trade in manufacturing: A panel data analysis over the period 1988-2008

by
Javad Abedini*

This article seeks to study how intra-OECD trade in manufacturing goods has affected technological heterogeneity across member states during 1988-2008. To this aim, we derive a panel data version of the Eaton and Kortum (2002) normalised trade model to estimate, annually, the technological heterogeneity of OECD countries. We find a gradual technological convergence across the group as the sensitivity of intra-group trade to price factors increases over time. However, the results diverge when considering European and non-European OECD sub-samples, separately. We find that technological convergence is not an automatic result of intra-group trade but, for that, a more general programme of economic liberalisation, including free movement of capital and labour, is also required.

JEL classification: F13, F15, F33.

Keywords: Regional trade, comparative advantage, technological convergence

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Traditional trade theory treats the state of technology as exogenous. In its most known form, the Ricardian model shows how technological differences across countries give rise to international specialisation and trade. The more countries are (initially) productive in certain industries, the more they should specialise in these. This approach directed many studies which recognise an economic causation from technology to trade (e.g. Markusen and Svenson, 1985; Davis, 1995; Harrigan, 1997).

Since the 1990s, the view has substantially changed. Now theoreticians who endogenise technological heterogeneity across countries are more prominent.

“Models with exogenous differences in technological capabilities have much to offer trade theory. ... Still, they are rather limited in what they can teach us, because they fail to identify the primitive sources of national competitiveness. We turn now to recent developments in the theory that allow us to address issues having to do with the endogenous creation of comparative advantage.” (Grossman and Helpman, 1995.)

Trade would affect the state of technology through multiple channels. These channels may, however, cause technological convergence or divergence across countries.

The literature represents two channels for technological convergence through trade. First, a technological upgrading in the production process would be achieved by the import of intermediate and final goods endowed with high technology and/or human capital (Romer, 1990; Coe and Helpman, 1995; Coe et al., 1997; Jones, 2011). Such imports also stimulate technological and organisational learning (Gereffi, 1999; Acharya, and Keller, 2008). Using a rich database, Madsen (2007) shows that 93% of the worldwide increase in TFP over the past century has been solely due to imports of knowledge.

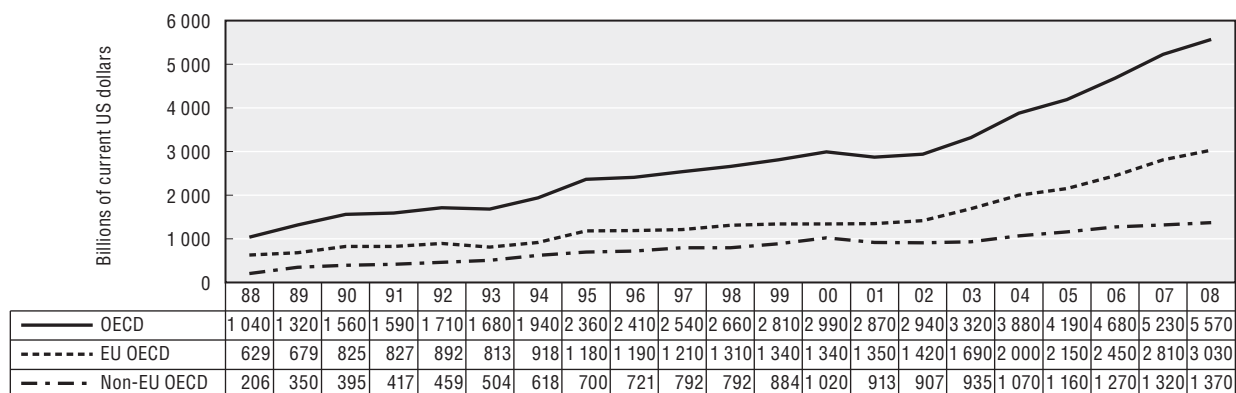
Second, trade in capital goods, even between similarly-endowed countries in technology and capital, motivates international technology diffusion (Xu and Wang, 2000). Examining a sample of 48 countries, Xu and Chiang (2005) indicate that technology spillover, from this last channel, takes place more easily when trade partners belong to high- or middle-income countries.

On the other hand, trade may cause (or reinforce) technological divergence between countries. If countries have, initially, specialised differently in skilled- and unskilled-intensive goods, trade would result in technological divergence by reinforcing the initial relative specialisation in each country. So, trade may strengthen “bad” specialisation in one country and “good” specialisation in another. Baldwin et al. (2001) and O’Rourke et al. (2011) refer the great divergence between the industrialising north and the lagging south during the 18th and 19th centuries to such a phenomenon. Zeira (2010) indicates that the effects may even persist in the long-term if the factors of production (especially, labour force) are immobile across countries.

Including 34 member states, OECD is a forum of countries for international economic co-operation across the globe. It includes many developed countries along with some developing and emerging ones, namely, Chile, Czech Republic, Estonia, Hungary, Mexico,

Poland, Slovakia, Slovenia and Turkey. In addition, a large number of OECD countries are also involved in the European Union or NAFTA which are among the most integrated trade arrangements in the world. The rest of the members are, in part, involved in some multilateral and bilateral trade agreements between themselves such as Japan-Mexico FTA (2005), USA-Chile FTA (2004), PACER¹ (2011), TPP² (2006), EURO-MED³ (1995) and USA-Australia FTA (2005). Indeed, a major part of current OECD countries has been included in free trade zones with other members since the mid-1990s (bilateral.org). Although, these agreements are usually independent of the OECD context of members, they generate a considerable trade dynamic within the sample.

Figure 1. **Total intra-group manufacturing exports, OECD sub-samples**



Note: Author's calculation based on the OECD-STAN Database.

Figure 1 shows the huge increase in intra-OECD manufacturing trade during the 1988-2008 period. The same upward trends are also found for European and non-European sub-samples, separately. On average, the intra-group trade, i.e. trade within each OECD sub-sample, has multiplied by more than six compared with that at the end of the 1980s.

Such an expansion in trade exposes OECD countries to certain sources of technological convergence or divergence. While technology and skill exchanges, trade in capital goods, and intra-FDI flows might facilitate technological convergence, a pattern of trade specialisation based on the capital/labour ratio and economies of scale might cause divergence. Taking into account significant heterogeneity between developed and developing OECD member countries, in terms of technology, the scale of changes may be considerable too.

This article seeks to investigate how intra-OECD trade in manufacturing has affected technological heterogeneity of member states during the period 1988-2008.⁴ Based on the Eaton and Kortum (2002) theoretical trade model, we develop an augmented panel-data version which allows obtaining annual estimates of technological heterogeneity across the group as well as by the European and non-European sub-samples, separately. This method also requires computing, in a more direct way, bilateral iceberg trade costs in the model.

Depicting the series over time shows that OECD countries achieve a slight technological convergence over 1988-2008. The findings are, however, heterogeneous when considering the European and non-European sub-samples, separately. While a significant technological convergence accompanies European OECD intra-group trade, no sign of technological convergence is found following non-European OECD intra-group trade.

Further analyses provide some explanation for these conflicting results. In particular, we find that technological convergence is not an automatic result of intra-group trade but the latter must also be supported by a general programme of economic liberalisation, including free movement of capital and labour across borders. These policies are those which largely distinguish European members from other OECD countries.

The rest of this article is structured as follows: Section 1 introduces the theoretical model and methodology. We also represent an alternative data generating process which replaces bilateral iceberg trade costs in our Eaton and Kortum-based trade model. Section 2 derives the empirical model with corresponding econometric considerations. The estimates are also provided in the same section. Finally, Section 3 concludes.

1. Theoretical model and methodology

In this section we represent the Eaton and Kortum model which allows us to obtain, in a direct relationship with trade, technological heterogeneity measures across countries over time. To this aim, however, we need to augment the model with panel dimensions and alternatively replace bilateral trade cost data.

Eaton and Kortum (2002) built their model on Dornbusch, Fischer, and Samuelson's (1977) model of Ricardian trade with a continuum of goods. They assume that countries have differential access to technology in the way that efficiency varies across commodities and countries. According to Eaton and Kortum (2002), the state of technology within either country is described by a probability distribution including a parameter which specifically stands for the absolute advantage of each country across the continuum of goods, and another parameter which commonly describes the comparative advantage of countries to trade with each other. They assume that the distributions are independent across countries.

For the sake of brevity, we only introduce their final equation here and ignore the intermediate equations which are already developed by Eaton and Kortum (2002). So, our starting point here is an augmented version of the Eaton and Kortum model which relates trade flows to price factors and technological heterogeneity:

$$\frac{X_{nit} / X_{nt}}{X_{iit} / X_{it}} = \left(\frac{P_{it} d_{nit}}{P_{nt}} \right)^{-\theta_t} \quad (1)$$

In equation (1), X_{nt} is country n 's total manufacturing spending in year t , of which X_{nit} is spent (c.i.f.) on goods from country i . P_{nt} is the price index for the CES objective function in country n at time t . d_{nit} stands for trade costs between n and i at time t , assumed as having the iceberg form (i.e. $d_{nit} > 1 \quad \forall n \neq i$, $d_{nit} = 1 \quad \forall n = i$) and respecting the triangle inequality rule for trade costs (i.e. for any three countries i , k , and n , $d_{nit} \leq d_{kit} d_{nkt}$). θ_t measures to which degree typical countries i and n differ from each other at year t in terms of technology across manufacturing goods. It measures the sensitivity of normalised bilateral trade (the left-hand side of equation [1]) to price factors (including trade costs) due to technological heterogeneity across countries. Smaller (greater) θ_t implies more (less) technological heterogeneity between countries. The more (less) two countries are different in technology, the more (less) they benefit from the comparative advantage of trade with each other. So, θ_t reflects the extent of (technological) comparative advantage across countries to trade together.

As noted by Eaton and Kortum, this Ricardian-based model bears a resemblance to the standard gravity equation, according to which bilateral trade is related to importers' and

exporters' total expenditures and to their bilateral geographic barriers. In particular, it is compatible with the Anderson and van Wincoop (2004) model in which bilateral trade is also a function of relative trade costs. Similarly, in equation (1), the normalised share of country i in country n 's national spending is determined by the relative effective country i 's costs for supply to country n . The triangle inequality implies that the normalised share never exceeds one.

It is important to note that the original model of Eaton and Kortum does not contain the time index t . They only rely on cross-sectional data for their empirical investigation. It is, however, possible to add a time index to the model while keeping the same theoretical framework. An additional assumption indicates that the equation is independently extended to either year t . Similarly to Eaton and Kortum, we hold the independency of technology distributions across countries but allow that the common θ changes over time. This interpretation of θ is similar to that in Eaton and Kortum (2002), except for the time variation of the parameter. It is used as a constant in the cross sectional study of Eaton and Kortum, but as a time variable in our panel data context.

As a second contribution to the model, we suggest a different data generating process to replace d_{nit} . The fact that markets are competitive and that any pair of countries has had a non-zero trade flow in any product category j ($j = 1, \dots, 50$) leads Eaton and Kortum to assume that $r_{ni}(j) \equiv \ln P_n(j) - \ln P_i(j)$ is bounded above by $\ln d_{ni}$. That is, the difference between the price index in importing and exporting countries should be sufficiently large to cover bilateral trade costs. Based on this assumption, they later calculate the logarithm of P_i / P_n as the mean across j of $-r_{ni}(j)$, and measure the entire $\ln(P_i d_{ni} / P_n)$ by the term D_{ni} defined as:

$$D_{ni} = \frac{\max_{2j} \{r_{ni}(j)\}}{\sum_{j=1}^{50} [r_{ni}(j)] / 50} \quad (2)$$

where \max_{2j} means second highest of $r_{ni}(j)$.

There are, however, some shortcomings as regards the Eaton and Kortum method of calculating d_{ni} . First, the single measure $\max_{2j} \{r_{ni}(j)\}$ does not take into account the distribution of $r_{ni}(j)$ around D_{ni} . Second, data on the consumer price index are not readily available for a large number of countries, especially, at sector level. Finally, this method would not provide any reliable measure for D_{ni} when $n = i$ resulting in $r_{ni}(j) = 0$. In this last case, domestic trade within each country is treated with the false assumption of zero domestic trade costs.

Instead, we replace d_{nit} using a standard method developed by Anderson and van Wincoop (2004) to directly generate bilateral iceberg trade costs. The method consists of two main steps. First, we specify an empirical gravity model including exporter and importer income variables, as well as a rich trade cost function which represents geographical, official, institutional, and cultural impediments to bilateral trade.⁵ The equation also includes a time trend and fixed-country effects standing, respectively, for non-stationarity and any missing effect in the model. This model is then estimated using OECD bilateral trade data over the period 1988-2008.⁶ Second, we introduce the fitted values of the same trade cost function in an exponential form to generate the corresponding bilateral iceberg trade costs of countries, as methodologically explained by Anderson and van Wincoop (2004). These bilateral measures are directly used to replace

d_{nit} in our study. This method allows us to estimate bilateral iceberg trade costs (including those belonging to domestic markets) in a continuous way and for any country-pair over time.

It is important to note that our method offers several advantages compared with that used in Eaton and Kortum (2002) to proxy bilateral iceberg trade costs. First, it is based on the gravity approach which is now a standard (and empirically successful) way in the literature to estimate trade costs (see for example, Péridy, 2005; Blum and Goldfarb, 2006; Huang, 2007; Ullah Khan and Kalirajan, 2011; Bergstrand et al., 2013; Abedini, 2013). Second, our trade-cost function controls for various geographical, official, institutional, and cultural trade-cost components, which increases in turn the explanatory power of the model. Third, the method allows us to estimate bilateral trade costs in their iceberg form which would conform more to the theoretical notation of d_{nit} in equation (1). Finally, using this approach, we should be able to estimate bilateral iceberg trade costs in a continuous way and for any country-pair (including those belonging to domestic markets) over time.

The data for the left-hand side of equation (1) has been entirely collected from the STAN database. The missing observations, for less than three consecutive years in some series, have been replaced by their trend estimates. X_{iit} , consumption by i 's consumers from domestic production, has been obtained by subtracting manufacturing exports of country i from its manufacturing production at year t . X_{it} , total spending on manufactured goods by country i , is simply the sum of X_{iit} and the import of manufactured goods by country i . The figures are in current US dollars.

Finally, we generate data for the logarithm of the relative price between n and i ($r_{nit} \equiv \ln P_{nt} - \ln P_{it}$) using the EuroStat consumer price index, all items non-food and non-energy 2005 = 100.

2. Empirical model and results

Now, we have all elements in hand to estimate equation (1). Taking a simple logarithm of the latter delivers a regression model with θ_t as a coefficient to be estimated, annually:

$$\ln\left(\frac{X_{ijt}/X_{jt}}{X_{iit}/X_{it}}\right) = -\theta_t \ln\left(\frac{P_{it}d_{ijt}}{P_{jt}}\right). \quad (3)$$

However, the theoretical equation (3) might return inconsistent estimates because of missing variables. A practical solution to this, in the case of panel data, is to control individual (country) effects in the model. These effects stand for any unobserved factor and ensure the good behaviour of the residuals (Baltagi, 2005). As a result, the final empirical model is expressed as:

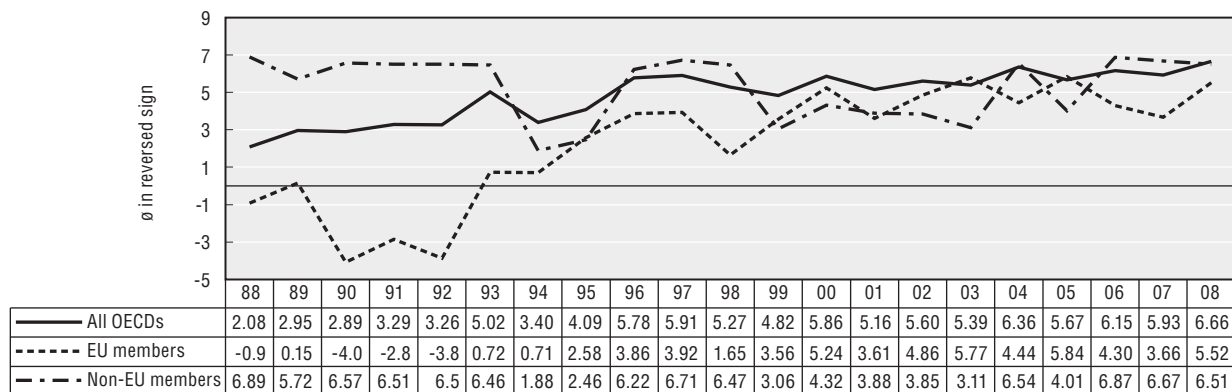
$$\ln\left(\frac{X_{ijt}/X_{jt}}{X_{iit}/X_{it}}\right) = \beta_0 + \theta_t \ln\left(\frac{P_{it}d_{ijt}}{P_{jt}}\right) + \gamma_i + \delta_j + \varepsilon_{ijt}, \quad (4)$$

where β_0 is a constant term ensuring zero-mean for residuals ε_{ijt} , and γ_i and δ_j are, respectively, exporter and importer fixed effects representing unobserved factors at those dimensions.⁷ This is indeed an LSDV model which could be straightforwardly estimated using OLS. Due to the presence of exporter and importer fixed effects, the LSDV model (4) generates the same results as a fixed-effect model (FEM) does. In addition, the Hausman-Taylor test indicates the superiority of the FEM approach versus the alternative REM. We also checked for any collinearity between country-fixed effects and the explanatory

variable of the model. The variance inflation factor for each of them (with an average equal to 1.85) remains largely below the threshold of 5 which indicates no severe problem of multicollinearity.

With a negative expected value, θ_t indicates the sensitivity of i 's normalised import share in country j to the relative price between i and j at t . It corresponds to the relative comparative advantage of the two countries, in terms of technology, to trade with each other. So, any increase (decrease) in θ_t , in absolute value, would reflect a higher (lower) elasticity of trade to price factors due to less (more) technological heterogeneity among countries. In other words, the rise of $|\theta_t|$ implies technological convergence while its fall technological divergence among trading partners over time.

Figure 2. θ variation over time, OECD sub-samples



Note: All estimates are significant at the 1% level (insignificant for EU OECD during 1988-89 and 1993-94).

Figure 2 represents the annual estimates of $-\theta_t$ over the period 1988-2008 using the full OECD dataset and two sub-samples.⁸ The solid line shows the time trend for the OECD group, as a whole. The results have also been provided by European (dotted line) and non-European (dashed line) sub-samples to study any possible heterogeneity across them as regards the impact of their own intra-group trade on intra-technological heterogeneity.

The series for the entire OECD group indicates a general upward trend during the period of study. That is, OECD countries have experienced a significant technological convergence throughout 1988-2008, as long as θ_t increased by three, in absolute value, from 2.08 in 1988 to 6.66 in 2008.⁹

In particular, our estimate for θ_{1999} (= 4.82) is well below what Eaton and Kortum (2002) obtained for a sample of 19 OECD countries in 1999 (= 8.28). The gap can be explained by the fact that we have replaced, in a different way, bilateral trade costs in the model. As described in the previous section, our trade cost function includes a larger variety of trade costs and controls for the non-stationarity of variables. This substantially increases our estimates of trade costs and then reduces the amount estimated for θ_t , *ceteris paribus*.

Figure 2 also shows how technological heterogeneity changes for European and non-European members, separately. EU OECD countries differ by the fact that a larger number of them constitute a much deeper economic integration among themselves which liberalises the flows of goods and services but also those of labour and capital within an economic and monetary union.¹⁰ The EU also predicts a supranational institution to harmonise diverse economic, legal, and even political decisions among member states.

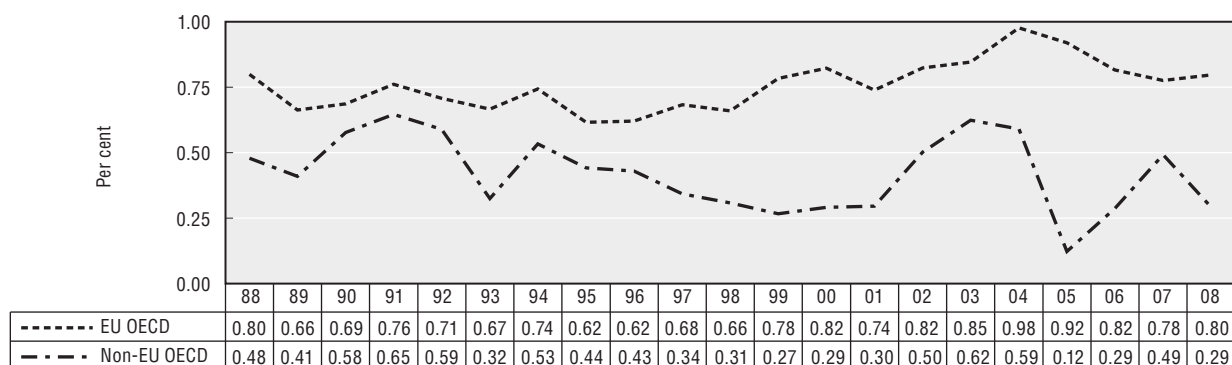
Our findings show that the pattern of technological dynamism for the Europeans substantially differs from that of the non-European members. While EU OECD countries enjoy rapid technological convergence, no evidence of this is found in the case of non-European members. The series of $-\theta_t$ is rapidly increasing for the European set whereas it is rather flat as regards the non-European one. Taking our theoretical background into account, this indicates that intra-group trade has successfully contributed to technological convergence within the European set but not within the rest of the OECD.

This heterogeneity is contrary to the fact that intra-European and intra-non-European OECD trade have increased at nearly the same speed during the period 1988-2008 (Figure 1). As a result, one should look for other sources which might motivate technological convergence within one group while impeding it in another.

According to the literature, FDI and migration (labour) flows are considered as alternative channels for the exchange of technology and expertise across countries (see for example, Borensztein, De Gregorio and Lee, 1998; Sinani and Meyer, 2004; Giroud, 2012; Iranzo and Peri, 2009; Larramona and Sanso, 2006). In addition, the fact that a fraction of trade is carried out outside the group, and is of intra-industry nature, would largely affect the effectiveness of current intra-group trade in causing technological convergence or divergence. As demonstrated below, we find that European and non-European groups of OECD differ significantly from each other as regards these last issues.

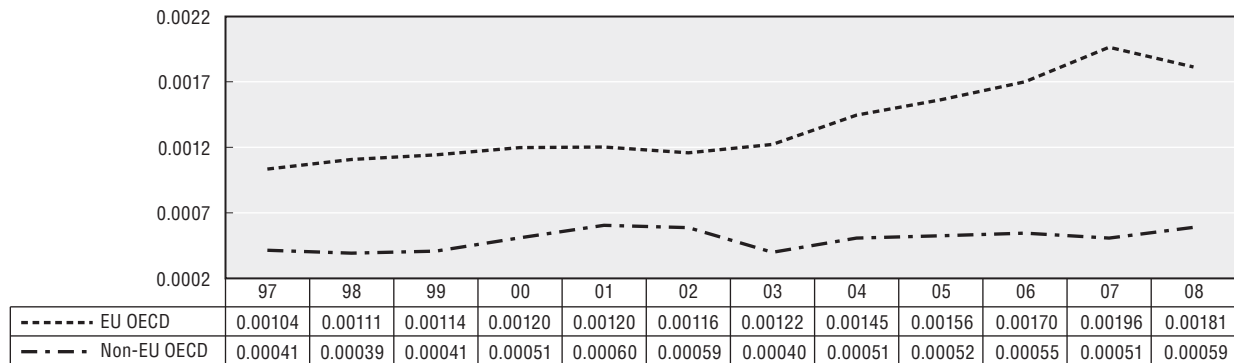
Figures 3 and 4 show that EU OECD countries are better positioned in both intra-FDI and intra-migration flows, normalised, respectively, by total FDI and the population of each group. While the trends are not generally increasing in the case of non-EU OECD countries, European members show their growing preference for EU OECD investments and immigrants. These sources contribute to the sharing of technology and expertise within the European set, while the effects are much more limited in the case of non-EU OECD countries.

Figure 3. Intra-group share in inward FDI, OECD sub-samples



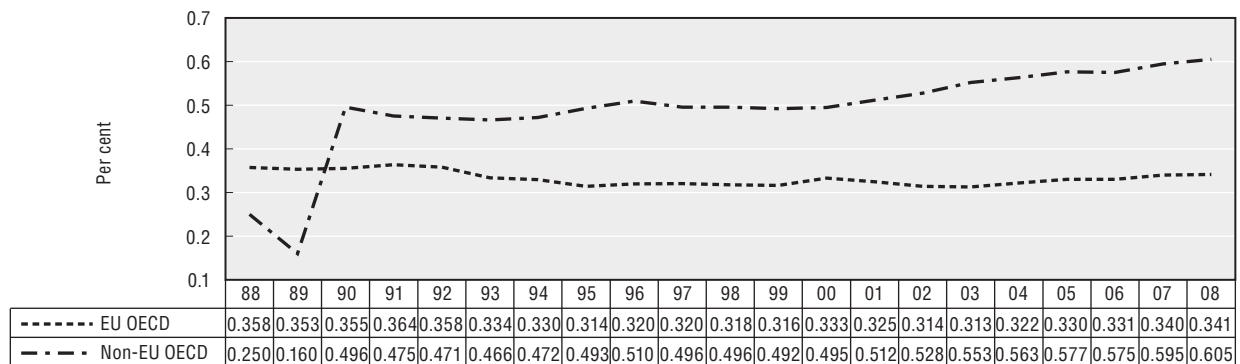
Note: Author's calculations based on the OECD-STAN Database.

Another factor which influences the pattern of technological convergence (or divergence) among a set of countries is the degree to which they trade with countries outside the group. An increasing extra-trade (trade outside the group) exposes the member states to certain sources of technological divergence due to trade with countries differently endowed in technology and expertise.

Figure 4. **Intra-group migration to total population, OECD sub-samples**


Note: Author's calculations based on the OECD-STAN Database.

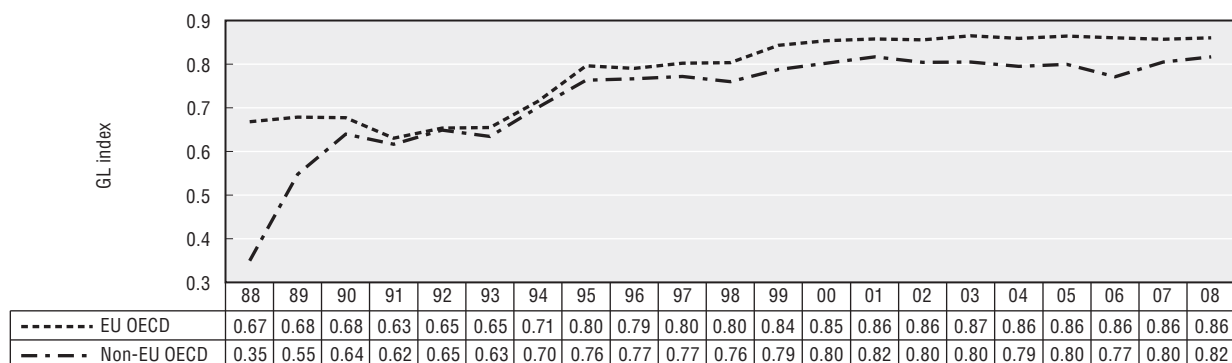
Figure 5 shows how EU and non-EU OECD countries differ in this respect. The extra-trade share is lower and slightly decreasing in the case of European members (indicating a larger and increasing intra-group trade share). In contrast, non-EU OECD countries demonstrate a more important and increasing tendency to trade with countries outside their group. This pattern favours technological convergence in the first group while impeding it in the second group.

 Figure 5. **Share of extra-group imports in manufacturing, OECD sub-samples**


Note: Author's calculations based on the OECD-STAN Database.

Having a large volume of intra-group trade does not suffice, however, to ensure technological convergence. The fact that this trade is of an inter-industry or intra-industry nature also matters. While inter-industry trade reinforces initial specialisation in each country and then results in a sort of technological divergence, intra-industry trade shares knowledge across partners in specific industries and so motivates technological convergence.

As evident from Figure 6, the Grubel-Lloyd index of manufacturing for EU OECD countries is always higher than that for non-European members. That is, intra-industry trade is traditionally more important in the first group than in the second. At other times, this motivates technological convergence within the European sample compared with the non-European one.

Figure 6. **Grubel-Lloyd index of manufacturing, OECD sub-samples**

Note: Author's calculations based on the OECD-STAN Database.

3. Conclusion

Although the Ricardian approach of international trade predicts a causal direction from technology to trade, new approaches treat the state of technology as endogenous. In this article, we seek to study the impact of intra-OECD trade expansion in manufacturing during the period 1988-2008 on technological heterogeneity of member states.

To this aim, we employ the international trade model of Eaton and Kortum which relates bilateral normalised trade to price factors in exporting and importing countries and technological heterogeneity between them. However, we augment the model with panel dimensions in order to obtain annual estimates of technological heterogeneity across countries. We also use an alternative process to generate bilateral iceberg trade cost measures, directly from a trade-cost function.

Our annual estimates of technological heterogeneity indicate that OECD countries have experienced a technological convergence during the period 1988-2008 as the sensitivity of their intra-group trade gradually increases to price factors. In addition, we divide the database into two separate groups of European and non-European members. Our findings show that intra-group trade has affected the distribution of technology differently in each group. While intra-European OECD trade has resulted in a high degree of technological convergence within this group, no sign of convergence is observed following non-European OECD intra-group trade.

European members are distinct in the fact that they share a deeper economic integration which, in parallel, liberalises free movement of capital and labour across borders. Statistical evidence shows that intra-exchanges of goods, capital and labour have been more important and increasing in share for European members while less important and decreasing in share for non-European members. In addition, EU OECD countries benefit from higher intra-industry trade compared with non-European members. These features give EU OECD countries a better possibility of sharing knowledge and technology and so achieving a technological convergence in the sector. In contrast, non-EU OECD countries are far from this pattern as they generally prefer to exchange outside the group. In short, our results indicate that in order for technological convergence to take place, intra-group trade must be supported by a more general programme of economic liberalisation, including free movement of capital and labour. The role of intra-group trade, especially, of an intra-industry nature, is also emphasised.

Notes

1. Pacific Agreement on Closer Economic Relations.
2. Trans-Pacific Strategic Economic Partnership Agreement.
3. European Union-Mediterranean Free Trade Area.
4. Due to the recent world crisis, data for the years after 2008 may not reflect reliable trends. As a result, our analysis in this article is limited to data up to 2008.
5. We employ the same trade cost function used in Abedini (2013) to estimate bilateral iceberg trade costs across the same set of OECD countries. For the sake of brevity, the details are avoided here.
6. The full specification and corresponding estimates of this intermediate model are available upon request.
7. Baldwin and Taglioni (2006) and Magee (2008) suggest using other interaction effects such as country-pair, exporter-year and importer-year effects, instead. However, this method is not practical in our case as it would considerably reduce the degree of freedom in the model due to the increased number of parameters used.
8. The table of estimation with the corresponding standard errors is shown in Appendix A.
9. Please, note that the estimated amounts would vary by using alternative specifications, but the time trend of changes remains stable which indicates the credibility of our results in this sense.
10. Although some European OECD countries do not belong to the EURO zone, they share some of these main features with the EURO members. For example, there is a free circulation of labour and capital between EURO countries and non-EURO EU states such as Poland, United Kingdom, and Switzerland.

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Appendix A

Table of estimation for $-\theta_t$, OECD sub-samples

		88	89	90	91	92	93	94	95	96	97	
OECD	$\hat{\theta}$	2.08 (0.70)	2.95 (0.53)	2.89 (0.49)	3.29 (0.45)	3.26 (0.50)	5.02 (0.39)	3.40 (0.38)	4.09 (0.32)	5.78 (0.24)	5.91 (0.23)	
	R2	0.69	0.77	0.70	0.75	0.70	0.83	0.76	0.78	0.84	0.83	
	F	14.03	18.74	19.87	22.94	19.81	39.42	27.30	36.99	66.60	66.31	
EU OECD	$\hat{\theta}$	-0.9 (1.03)	0.15 (0.80)	-4.0 (1.01)	-2.8 (0.92)	-3.8 (1.04)	0.72 (0.78)	0.71 (0.78)	2.58 (0.64)	3.86 (0.44)	3.92 (0.42)	
	R2	0.52	0.61	0.62	0.60	0.57	0.75	0.74	0.75	0.80	0.76	
	F	3.46	6.03	6.26	6.67	6.41	14.51	13.76	18.02	31.18	25.89	
Non-EU OECD	$\hat{\theta}$	6.59 (1.61)	5.72 (1.08)	6.57 (0.76)	6.51 (0.69)	6.5 (0.73)	6.46 (0.75)	1.88 (0.64)	2.46 (0.53)	6.22 (0.46)	6.71 (0.42)	
	R2	0.87	0.85	0.87	0.88	0.87	0.88	0.78	0.79	0.85	0.87	
	F	12.02	12.88	28.20	31.69	31.10	32.85	18.52	23.14	39.20	46.09	
		98	99	00	01	02	03	04	05	06	07	08
OECD	$\hat{\theta}$	5.27 (0.29)	4.82 (0.28)	5.86 (0.23)	5.16 (0.25)	5.60 (0.24)	5.39 (0.25)	6.36 (0.23)	5.67 (0.25)	6.15 (0.23)	5.93 (0.23)	6.66 (0.21)
	R2	0.76	0.77	0.83	0.80	0.80	0.82	0.84	0.81	0.84	0.83	0.87
	F	43.37	46.11	73.39	57.57	59.55	68.87	79.24	62.67	80.48	73.86	97.80
EU OECD	$\hat{\theta}$	1.65 (0.56)	3.56 (0.42)	5.24 (0.36)	3.61 (0.43)	4.86 (0.36)	5.77 (0.33)	4.44 (0.39)	5.84 (0.35)	4.30 (0.39)	3.66 (0.40)	5.52 (0.32)
	R2	0.62	0.77	0.84	0.77	0.83	0.88	0.81	0.86	0.81	0.80	0.88
	F	14.69	31.09	50.63	31.98	45.71	72.96	40.12	60.48	41.68	38.83	68.44
Non-EU OECD	$\hat{\theta}$	6.47 (0.45)	3.06 (0.56)	4.32 (0.44)	3.88 (0.46)	3.85 (0.48)	3.11 (0.52)	6.54 (0.43)	4.01 (0.53)	6.87 (0.43)	6.67 (0.46)	6.51 (0.44)
	R2	0.87	0.77	0.84	0.81	0.80	0.79	0.87	0.77	0.86	0.85	0.86
	F	48.80	24.11	38.92	32.33	29.35	27.28	49.63	24.79	47.12	41.48	44.65

Note: OECD = All OECD countries, EU OECD = European OECD countries, Non-EU OECD = Non-European OECD countries. The numbers in parentheses represent the standard errors of the estimates. All estimates of θ are significant at the 1% level, except in the EU OECD group over 1988-89 and 1993-1994 which are not significant at all. R2 = R-squared. The F-statistics indicate that all LSDV models are significant at the 1% level.