Technology and international orientation: exploring sectoral differences in home-region orientation

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Introduction

This paper is a partial response to two recent articles in the *Multinational Business Review* that explore key issues related to the extent and nature of MNE internationalization processes and propose original hypotheses on the basis of existing theoretical approaches. First, Wolf, Dunemann, and Egelhoff (2012) proposed a series of hypotheses on the extent of home-region orientation in MNEs, drawing on a multidisciplinary array of theories from economics and the wider social sciences. Second, in a riposte to that paper, Verbeke and Kano (2012) argue that existing international business (IB) theory provides an adequate base for exploring the extent of internationalization of MNEs. Specifically, they hold that internalization theory provides a parsimonious and effective framework for MNE activity, leading them to reformulate the hypotheses of Wolf *et al.* (2012). In some cases, these reformulated hypotheses are very similar; in other cases, the theoretical approaches result in quite different forecasts in terms of the most likely strategy MNEs will adopt in given circumstances.

The hypotheses proposed in the two articles are so extensive and far reaching that a single research project could not prove or disprove them all. This paper seeks to build on these two contributions by providing empirical data which sheds light on two of the hypothesis proposed in the articles:

1. H3a (internalization theory version): "Higher knowledge intensity of an MNE will not result in stronger home-region orientation" (Verbeke and Kano, 2012: 140).
2. H7: "MNEs from different industries vary in terms of their degree of home-region orientation" (Verbeke and Kano, 2012: 146).

Note that H7 is, in fact, identical to that proposed by Wolf *et al.* (2012).

Clearly, these two hypotheses are related, since different industries will often (almost by definition) have different levels of knowledge intensity. The underlying assumption, addressed by both of these hypotheses, is that there are aspects of the sector in which a company operates – including knowledge intensity – which have a direct influence on the extent to which it is feasible and

profitable for companies to expand beyond the borders of their home region. As Verbeke and Kano (2012) assert in their article, each MNE is unique. The firm-specific advantages (FSAs) and location advantages (LAs) of firms in certain sectors coming from specific regions are likely to exhibit similarities which will frame their capacity and motivations for overseas expansion. In addition, they are embedded in the same institutional context, which will tend to bring both advantages and disadvantages for companies. These factors seem likely to result in similar internationalization patterns among MNEs operating within a given sector and a given region.

Literature review

This paper builds upon two articles that integrate a wide array of literature covering a range of theoretical and methodological approaches. In this review, we concentrate on existing literature addressing knowledge intensity and sectoral differences. Drawing from research on the knowledge economy and the difficulty of knowledge transfer, Wolf *et al.* (2012) (WDE) hypothesize that knowledge-intensive MNEs will be more home region oriented (HRO). Verbeke and Kano (2012) (VK) consider that internalization theory implies that knowledge intensity does not result in stronger HRO.

WDE developed their hypothesis in light of the knowledge economy theory, which states knowledge tends to be concentrated in certain knowledge networks, which are geographically grounded. They theorized that knowledge-intensive MNEs will be **more** home region oriented (HRO). However, one could equally argue the opposite. With the concentration of knowledge in a limited number of places around the globe, MNEs seeking knowledge will seek a presence in these key geographical knowledge centers, making them less (not more) oriented towards their home region.

The literature provides empirical evidence for a link between levels of technology and HRO, indicating lower levels of HRO in high tech (HT) companies. Banalieva and Dhanaraj (forthcoming) found in their recent analysis of 625 MNEs that higher technological intensity tends to decrease companies' home-region bias. In his study of Italian companies, Cerrato (2009) found a significantly stronger international orientation among higher technology companies. These findings suggest (1) barriers to international expansion beyond the home region do not impact all firms in the same way, and (2) HT orientation enables firms to overcome these barriers more easily. Moreover, recent work by Curran and Zignago (2012) has found significant differences in the regional orientation of trade flows depending on technological level, with HT trade more globally oriented in the EU and NAFTA than lower-tech sectors. These studies define levels of technology based on either the extent of

embodied technology or spending on research and development as a percentage of sales—both which could be indicative of "knowledge intensity" within a sector.

Current IB literature minimally explores whether and why HT businesses--and the trade they foster--are more global (or HRO) than other businesses. The literature often agglomerates data across MNEs, with the implicit assumption that the difficulties experienced by such companies are similar. Limited research differentiates between or compares company strategies on the basis of sector or technological level. Most survey- or statistics-based works use aggregated data. For example, Enright (2009) included firm-specific variables—such as firm size, international experience, and home country--in his exploration of motivations for different types of FDI, but did not include variables for type of industry or level of technology. However, his study focused only on manufacturing firms, removing one possible source of bias, which is the tendency to include both service-based and manufacturing companies in the same study.

Research by Rugman and Verbeke (2004) and Dunning *et al.* (2007) on the internationalization/regionalization debate includes all types of companies. They thus aggregate the strategies of banks with those of oil companies. Other research, which has differentiated between manufacturing and services companies, has found differences in HRO tendency in that services companies are more likely to be host region oriented than manufacturing companies (Beleska-Spasova and Glaister, 2009).

The hypothesis that technological differences affect the internationalization process is further supported in international trade research. Researchers in International Economics studying trade and its impacts have occasionally differentiated the types of goods traded. Loof and Andersson's (2010) work on the impact of imports on productivity in Swedish firms differentiates between HT firms and others. They find that imports from the richest countries – the G7, where 80 percent of the world's R&D occurs –impact productivity, especially for those firms in HT sectors. They conclude that imports are acting as a means of technology diffusion, which explains, at least in part, the productivity effect of imports. In a sample of Spanish firms, Farinas and Martin-Marcos (2010) identify important differences in the level of foreign sourcing between industries, where HT or Medium Tech (MT) firms (electrical machinery, transport equipment, etc.) exhibit high levels of overseas sourcing.

Keller and Yeaple (2008) have analyzed U.S. company-level data from different sectors in order to explore the motivations for MNEs using local sourcing in the host country (as opposed to sourcing from the MNE home country). Their findings support the idea that technology affects such decisions. In more technologically complex goods, increases in transport costs have less negative effects on the decision to trade. As would be expected, within companies, as transport costs increase, firms are more likely to supplement inputs from the parent with host country goods. However, this tendency is lower for technologically complex goods hence such goods tend to have more global production chains.

Overall, this body of research indicates that more technologically complex goods are important vectors for improvements in productivity and are more concentrated in their production structures within the world economy. Costantini and Massimiliano (2012) have found that distance is not significantly correlated with trade flows in HT goods. Although significant in all other goods, distance has its lowest level of significance in high-medium tech goods. The authors conclude "*…we believe this evidence is coherent with the fact that transport costs are less relevant for exporters' decisions over higher value and technological intense goods" (*Costantini and Massimiliano, 2012*: 141).*

Thus, there is evidence that HT trade is less affected by distance than trade in other goods. Recent research by Ma and Van Assche (2012) suggests this may be due to relatively low trade costs in the sector. Their research examined trends in processed trade in Chinese provinces. They found that geographic closeness to key suppliers and markets was a key indicator for offshoring production. However, for products with a high value to weight ratio—such as those in the electronics and precision instruments sectors--distance was not important. Low-weight products (many of which are HT) are cheap to transport by air, which removes one of the traditional cost-based barriers to trade, making geographic distance a weak predictor of trade flows. Thus, the global nature of HT supply chains may simply be the relatively high value of HT components relative to their weight, which reduces transport costs.

In their analysis of trade flows, with technologies differentiated by key world regions, Curran and Zignago (2012) found that ASEAN+3[1] has (1) a more global trade structure in imports of HT and MT goods than low tech (LT) goods, and (2) the opposite structure in exports. Although HT trade is

[1] This is the grouping of the 10 countries of the Association of South East Asian Nations (ASEAN) with Japan, China and South Korea.

always more global, EU trade in general is strongly regional. NAFTA has a low level of regional sourcing in HT and LT, although its HT sector is significantly more global in exports. In intermediate goods, HRO is often quite different to that of finished goods, reflecting highly integrated or dispersed production structures, with HT inputs being the most globally sourced in the EU and NAFTA (Curran and Zignago, 2011a).

These empirical results from the IB literature, plus wider work on international trade, suggest that knowledge intensity does indeed influence the extent to which companies expand beyond their borders and their home region, but not necessarily in the manner postulated by either WDE or VK. Rather, there is some evidence that it may be easier for HT companies to expand on a truly global, rather than regional, level than it is for those companies operating in lower level technologies. This existing work also indicates that different sectors are likely to have different internationalization patterns, given the different technology intensity of different industrial sectors (OECD, 2011), as hypothesized by both WDE and VK.

WDE provide further theoretical arguments for differences in HRO between sectors using neo-institutional theory, which is where the capacity of MNEs to liaise with host country governments is seen as an important indicator of success. Differences in the institutional environments, though, are more complex in certain industries than in others. WDE consider that neo-institutional theory would indicate that "*MNCs facing strong pressures from the institutional environment will globalize their business activities more slowly than MNCs where technical demands are the main reference points for the formation of strategies and actions*" (Wolf *et al.*, 2012: 82-3). Their paper does not provide any indication of which sectors might be considered technical and which face institutional pressures. However, the notion that there is variation in the extent to which institutions and regulations impact on sectors and that this has important implications for internationalization, is fairly uncontroversial. Indeed, VK accept WDE's hypothesis unchanged, as internalization theory broadly supports such a variation.

Other theoretical traditions also provide support for this hypothesis. For example, research in the area of global value chains has highlighted the importance of institutional factors – including government policy - in location choices made by MNEs in their production activities (Sturgeon, Van Biesebroeck, and Gereffi, 2008; Gereffi and Korzeniewicz, 1994). Government policy in general, especially restrictions on, and incentives for, trade and investment can be seen to influence company

choices in given sectors. However global value chain analyses are almost always focused on understanding the value chain in one particular sector, for example, automobiles (Sturgeon *et al.,* 2008) or clothing (Gereffi, 1999). Although this work provides empirical and theoretical support for the concept that institutions are important in framing sector-level choices, there has been little interest in comparing the impact of these different institutional frameworks across sectors.

In light of this literature review, the two hypotheses which we explore in this article, adapted from WDE and VK, are:

H1: Higher knowledge intensity will result in lower home-region orientation in trade.

This hypothesis is not proposed in either referenced article: WDE proposes the hypothesis of higher HRO for knowledge-intensive MNEs and VK proposes no impact. Neither article provides empirical support of either of their hypotheses. Given the empirical discussion explored above, we believe our hypothesis will withstand further scrutiny.

H2: Trade flows in different industries vary in terms of their degree of home-region orientation.

This is the trade-related equivalent of the hypothesis on MNE activity proposed in both articles. Given that the objective of this work is to look at degrees of HRO, we do not define cut-off points for a classification of HRO, as previous work has tended to do (Rugman and Verbeke, 2004; Curran and Zignago, 2011a), although we do highlight those levels of HRO that are below 50 percent as being low.

Methodology and classifications

This paper uses trade data to explore patterns of internationalization in different industrial sectors at different levels of technology. Trade data is not an ideal proxy for the activities of MNEs, however, it has the advantage of being internationally comparable, available at high levels of aggregation, and very up-to-date. Not all trade flows coming from or going to a given region are linked to the activities of MNEs based in that region, but they give a very accurate indication of the general international orientation of companies operating within the region and differences in their international orientation. In addition, trade flows capture the activities of all companies, not just the largest. They give us a broader picture of the opportunities and difficulties experienced by different types of companies operating in the global economy. In this sense, our research has similarities with work based on FDI flows--such as that by Dunning *et al.* (2007).

The authors believe that trade data can provide interesting insights for the debate, even though they do not capture firm-level activity, which most IB literature is based on. Trade data have been used in previous research, including that by Curran and Zignago (2011a), Beleska-Spasova and Glaister (2009), and Rugman and Hodgetts (2001). Although trade data cannot give us insights into FSAs, it can provide useful information about the existence of location advantages (LAs) in certain regions and the extent to which the institutional context of MNEs within those regions is supportive of internationalization. Although these LAs may be exploited by both regional and/or global MNEs, trade flows provide indicators of their existence and evolution. For this reason, much policy-related work on competitiveness at national or regional levels uses trade data as a proxy for overall firm activity (Curran and Zignago, 2009; CEC, 2012). Inasmuch as trade has been used in the IB debate, the tendency has been to focus on exports (Rugman and Hodgetts, 2001). However, imports also give useful insights into the internationalization of MNEs in upstream activities, particularly in production and the sourcing of intermediates. In light of this, we examine trade in both directions.

This paper expands on the work by Curran and Zignago (2011a) and Curran and Zignago (2012) by exploring trade flows at different technology levels in more detail, in particular looking at different sectors within each technology level. The objective is to shed further light on the extent of orientation differences between and within technology levels. Academic work on technology and trade tends to use either the technology groupings proposed by the OECD (2011) or the categorizations proposed by Lall (2000). In both cases, sectors with quite different production requirements and market structures are aggregated: aeronautics is aggregated with pharmaceuticals, cars with chemicals, etc. As VK have pointed out, both neo-institutional theory and internalization theory support the idea that the institutional context in which firms are embedded has a direct effect on their internationalization capacity. This institutional context is often as much sectoral as it is national or technology-based. This paper explores the structure of trade in goods at different technological levels at a greater level of granularity than ever before. We explore trade across key world regions in order to shed light on these structures (and differences between them) in different regions.

The OECD (2011) categorizes industries in a broad manner between HT, High Medium Tech, Low Medium Tech, and Low Tech (LT) (see Appendix). To look at trade at a more disaggregated level, we selected a variety of industries which are fairly representative of different technological levels, which

don't suffer from strong policy or price related distortions, and which are easily identified in trade data[2].

- For HT goods, we used HS 90–Precision Instruments (which is almost entirely HT) and HS65–Electronics (which includes both HT computers and some flows that would fall into the High Medium Tech OECD category). We chose these because they are easily tradable and identifiable. The other two possibilities–aeronautics and pharmaceuticals -- seemed more likely to be distorted by non-business factors. Aeronautics is highly concentrated in two key companies, strongly impacted by government policy in many countries, and involves goods with such a high inherent value that flows can be very variable from one year to another. The government is the key pharmaceutical customer in many countries, a fact that often impacts prices—creating a problem since our figures are value-based.
- In MT, we used Transport Vehicles (HS87, which is High Medium Tech and includes lorries and cars) and Articles of Iron and Steel (HS73, which is Low Medium Tech). Both are easily identifiable in the trade data and relatively heavily traded.
- In LT, we used both Clothing (the aggregate of HS61 and 62) and Footwear (HS 64), both classic examples of labor intensive industries with long-established and global production networks/markets (Gereffi and Korzeniewicz, 1994; Froebel, Heinrichs, and Kreye, 1980).

We used trade data from the International Trade Centre's (ITC) Trade Map database[3], which uses UN Comtrade figures. ITC seeks to fill the gaps in that database caused by non-declarations by using mirror data from partner countries. It, therefore, has more extensive coverage than Comtrade. However, some data is missing from our analysis. Data from 2008 through 2010 were extracted on dollar values of trade. We did not use figures from a single year since trade flows have been strongly impacted by the international financial crisis; there has been much volatility in trade data in recent years (Curran and Zignago, 2011b). To avoid distortions due to this variability, and in order to give an overall picture of the general situation, we used average figures for market share over the three years for which we have reliable data—2008-2010.

In order to assess home-region orientation, we need to differentiate between the regions of the world. There is no consensus on which country groupings are most representative for academic analysis of regional orientation. Research has used different groupings of countries to represent the

[2] Trade data is categorized by type of good, not by technology; thus, within the Harmonised System (HS) at two-digit level, depending on the product, you may find a combination of HT and MT outputs as well as HT and MT inputs to the same goods.
[3] http://www.trademap.org/

broad Triad. Rugman and Verbeke (2004) and Dunning *et al.* (2007) used "Europe" defined geographically. In the case of the Americas region, there are differing approaches. Dunning *et al.* (2007) used the whole of the Americas, while Rugman and Verbeke (2004) used the more limited NAFTA. Finally, in relation to the Asian region, Rugman and Verbeke (2004) defined the region widely as Asia-Pacific, which includes Australasia but not the Indian sub-continent, while Dunning *et al.* (2007) used only "Asia", which is undefined, although it would be expected to include India. Curran and Zignago (2011a) used EU, NAFTA and ASEAN+3 as they represent politically active efforts to integrate trade and cover the most important world traders.

In this work, we use EU, NAFTA, and a broader grouping than ASEAN+3 for Asia. We label it East Asia, and it includes the economies of ASEAN+3 as well as Hong Kong, Macau, and Taiwan. We include Hong Kong and Taiwan because both have very strong trade and investment links with mainland China. If they were excluded, we would miss important aspects of the picture, especially in certain industries (Jin, 2005; Yeung, 2009). We include Macau for consistency, as it is in a very similar situation to Hong Kong, although trade flows are usually much smaller.

The data on trade from Trade Map relies on declared trade by states. Thus, data from Lao, Myanmar, and Brunei are not included in the East Asia data as they did not declare trade for the years we explore. However, mirror data suggest that these three countries represent only 1.5 percent of ASEAN's imports and exports. Their absence should not distort analysis. Vietnam has not yet declared trade for 2010. As it is a relatively important trader, we felt it could not be excluded. For 2010, we used 2009 Vietnam data adjusted by the average change in trade in the previous two years.

Results

Overall trade trends by value

Table I reports the nominal dollar values of flows in the individual sectors over the time period. The sectors taken together represent a large share of manufactured goods trade from all regions--between 51 percent and 34 percent in 2010, with shares highest in East Asian exports. The very high value of trade in Electronics in Asia in both exports and imports is noteworthy. In spite of East Asia's reputation as a source of low-tech exports, in 2010, 64 percent of the East Asian exports that we examine in this paper were in electronics. The equivalent figures for the EU and NAFTA (often considered HT locations) are only 35 percent and 42 percent, respectively.

Table I. Total trade flows in dollars by sector 2008 and 2010									
	EU27			**NAFTA**			**EAST ASIA**		
Imports ($m)	2008	2010	Change %	2008	2010	Change %	2008	2010	Change %
Electronics	599 756 968	569 819 864	-5,0	361 214 881	375 130 600	3,9	714 069 008	833 659 327	16,7
Precision instruments	150 170 567	143 395 062	-4,5	81 616 603	81 235 098	-0,5	126 641 582	167 579 982	32,3
Transport Vehicles	575 331 987	434 297 460	-24,5	284 722 082	269 410 272	-5,4	75 221 838	119 083 362	58,3
Art. Of Iron and Steel	122 949 122	90 197 438	-26,6	57 180 103	43 998 952	-23,1	33 185 040	37 391 205	12,7
Clothing	164 488 147	152 131 050	-7,5	86 163 325	85 269 126	-1,0	47 145 414	43 799 552	-7,1
Footwear	44 433 263	43 757 146	-1,5	22 906 765	24 500 838	7,0	8 636 964	10 277 040	19,0
All manu products	4 550 099 060	3 924 641 261	-13,7	2 058 769 671	2 002 793 171	-2,7	2 311 330 531	2 820 003 454	22,0
% of all manu products	36,4	36,5		43,4	43,9		43,5	43,0	
Exports ($m)									
Electronics	579 114 180	518 427 158	-10,5	246 247 550	237 353 622	-3,6	1 110 276 700	1 315 118 378	18,4
Precision instruments	170 091 140	167 921 819	-1,3	85 534 654	89 299 537	4,4	151 071 613	176 819 412	17,0
Transport Vehicles	669 391 000	540 211 442	-19,3	205 125 547	199 516 402	-2,7	258 289 507	248 960 579	-3,6
Art. Of Iron and Steel	152 905 433	112 974 895	-26,1	28 587 810	24 371 978	-14,7	76 734 212	80 473 533	4,9
Clothing	110 082 928	95 814 648	-13,0	9 550 546	9 173 191	-4,0	158 784 952	170 770 719	7,5
Footwear	36 772 814	34 709 715	-5,6	1 606 614	1 719 551	7,0	51 991 894	61 773 016	18,8
All manu products	4 901 291 355	4 273 920 091	-12,8	1 545 948 607	1 502 631 127	-2,8	3 560 643 147	4 039 912 246	13,5
% of all manu products	35,1	34,4		37,3	37,4		50,8	50,8	

Source: ITC Trademaps

In terms of the dynamics of trade, we see clear impacts of the financial crisis on imports, most especially on the EU but, also, on NAFTA. These impacts are most evident in Articles of Iron and Steel in both markets and Transport Vehicles and Clothing in the EU. East Asian imports, in contrast, have held up well, most especially in Vehicles and PI. On the export side, the EU and NAFTA have both seen declines in the same two sectors in which imports fell the most: Vehicles and Articles of Iron and Steel. They also show declines in Clothing, with additional declines in Electronics in the EU. Overall, reductions in exports are higher for the EU. Vehicles is the only export sector that has seen a fall in the nominal dollar value of trade in East Asia. However, given that these figures are not adjusted for inflation, Articles of Iron and Steel and Clothing had relatively low growth rates. In the analysis which follows, it should be kept in mind that trade was very dynamic over the period tracked. This particularly applies to the EU, and to a lesser extent to NAFTA, in the MT sectors of Transport Vehicles and Articles of Iron and Steel. This is the reason we use averages over three years, rather than focusing only on one year's figures.

Sector-level analysis

We will now turn to the more detailed analysis. Trade, by definition, is comprised of two way flows. Imports indicate the key sources from which companies seek their final goods and inputs. Exports indicate the key markets where regional production is successful and competitive. Trends can be quite different between the two (Curran and Zignago, 2011a). Therefore we will analyze each in turn.

Structure of Exports

Table II provides an overview of the structure of export trade in the different sectors and regions analyzed in this study as percentages of total value of trade. Exporting regions are in rows while importing regions are in columns. In Electronics, for instance, 57.6 percent of East Asian exports are to the home region while 18.1 percent are to NAFTA and 15.6 percent to the EU. In the case of NAFTA, 54.4 percent of exports are to the home region, 22.4 percent to East Asia, and 10.5 percent to the EU. In the case of the EU, 64.8 percent of its Electronics exports are to the home region, while only 5.6 percent are to NAFTA, and 9.2 percent to East Asia. We will focus on levels of HRO that are presented in bold in the table.

Table II - Structure of export trade by sub sector (Average 2008-10)

	Electronics			Prec inst			Transport Vehicles			Arts. of Iron and Steel			Clothing			Footwear		
	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia
East Asia	15,6	18,1	**57,6**	14,0	15,3	**63,4**	16,1	30,7	**20,0**	16,3	24,4	**35,8**	30,2	30,4	**27,5**	28,2	34,5	**19,8**
NAFTA	10,5	**54,4**	22,4	30,6	**28,2**	24,1	9,0	**72,1**	3,8	7,9	**64,9**	8,7	7,0	**77,5**	5,1	7,4	**57,0**	18,0
EU	**64,8**	5,6	9,2	**53,6**	15,8	11,8	**70,6**	7,3	5,6	**66,1**	5,5	5,1	**76,8**	3,1	3,8	**77,3**	4,6	3,0

Source : ITC Trademaps

It is clear that the EU and NAFTA have relatively high levels of HRO in trade in most sectors. The levels are lowest in Precision Instruments, especially for NAFTA where the HRO is only 28 percent. Electronics, the other HT sector covered, has the next lowest level of HRO. In the EU, the level is very close to the MT sector of Articles of Iron and Steel. In general, for NAFTA and the EU, HT sectors are less HRO than MT sectors, which are less HRO than LT sectors. The curious exception to this latter trend is NAFTA Footwear, which has relatively high levels of exports to East Asia, creating an HRO level that is lower than the two MT sectors[4]. Thus, there is some support in these two regions for our first hypothesis, that HT trade will be less HRO.

However, this is not the case in the East Asia region where the opposite trend is evident: HT exports are more HRO than the others, with the lowest level of HRO seen in Vehicles and Footwear. Thus East Asia trade structure contradicts H1 and supports WDE's hypothesis that knowledge-intensive companies will be more HRO. Why export trade structures are so different across the three Triad regions is an interesting question. Besides the role of FDI (Jongawich, 2011), these structures seem likely to be linked to the role of East Asia in HT production networks, as well as the extensive flows of intermediate goods within each region, between the regions, and elsewhere (Dean, Lovely and Mora, 2009; Ferrantino *et al.*, 2008).

[4] The exports go to Japan, Korea, China, and Hong Kong, which are the most important export markets for NAFTA Footwear after the NAFTA region's own member states.

As for our second hypothesis, that different sectors will exhibit different levels of HRO, it is clearly the case across all regions in export trade. Although there are some similarities between NAFTA and the EU's trade structures across sectors, East Asia's is very different, which suggests that there are not inherent aspects of certain sectors which predefine likely levels of HRO. Rather, it is likely that firms in certain sectors from certain regions are particularly successful at exporting beyond their home region due to (1) different institutional environments, (2) inherent competitive advantages in certain countries/regions, and (3) the FSAs companies have developed over time. Those in different institutional and socio-economic environments may struggle with international expansion.

The very high levels of HRO in the LT sectors in the EU and NAFTA (with the exception of Footwear in NAFTA, as discussed above) seem to imply that firms in these sectors--based in relatively high cost areas of the Triad--have particular difficulty expanding sales outside the home region, whereas these sectors are very global in East Asia. The struggle of LT industries based in Europe and the U.S., especially Clothing, to retain market share against rising competition from low cost Asian sources is well documented and has led to a long history of institutionalized protectionism, much of which has only recently been dismantled (Curran, 2009).

Structure of imports

Table III shows the structure of import trade in the regions and sectors we explored. Importing regions are in rows and exporting regions are in columns. East Asia is HRO in all sectors with levels well above 50 percent across all categories, with the lowest level in Vehicles. In contrast, both the EU and NAFTA have their highest level of HRO in MT sectors, especially Vehicles. Overall, in the latter two regions, there is often a high level of East Asian sourcing across sectors, especially in NAFTA, although there are also important differences between them.

Looking first at LT goods, where patterns are most clear, East Asia is the key source of imports for its home region (90 percent for Clothing and 85 percent for Footwear), and also for NAFTA. In the EU, the share of home-region imports and East Asia imports is almost the same in Clothing, at 34 percent in both cases. For Footwear, we see 45 percent HRO for the EU compared to 42 percent for East Asian sourcing. Thus, in LT trade, where knowledge intensity could be expected to be low, we see high HRO in East Asia, relatively low HRO (lower than any other sector) in the EU, and very low HRO in NAFTA. These low or very low HRO levels in LT mean that HRO in HT goods is higher than in LT, in contradiction of H1.

Table III - Structure of import trade by sub sector (Average 2008-10)																		
	Electronics			Prec inst			Transport Vehicles			Arts. of Iron and Steel			Clothing			Footwear		
	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia	EU	NAFTA	East Asia
East Asia	6,4	6,9	**85,6**	13,3	14,3	**69,9**	31,5	7,7	**57,5**	16,7	5,7	**72,5**	8,4	1,1	**89,5**	10,7	3,0	**85,3**
NAFTA	7,6	**28,2**	60,9	32,5	**26,9**	31,4	15,7	**52,0**	29,5	14,6	**33,9**	43,7	3,0	**6,7**	60,6	7,3	**1,9**	86,3
EU	**51,4**	5,7	34,9	**51,9**	21,9	16,4	**83,1**	3,1	8,9	**73,6**	2,7	14,2	**34,3**	0,5	34,0	**44,5**	0,2	42,2

Source: ITC Trademaps

The lowest HRO for EU and NAFTA, especially the latter, is seen in LT sectors. In fact, levels of HRO in the sectors in our sample are highest in MT sectors, especially Vehicles–the only sector where NAFTA has more than 50 percent home market share. If we view imports as a proxy (albeit imperfect) for sourcing by MNEs, it appears from these figures that their most global sourcing structures are seen in LT industries, with levels of HRO significantly higher in HT and especially MT industries. The most global import structures are in LT trade and the most HRO in MT goods. Thus, the figures:

1. do not support WDE's hypothesis that knowledge-intensive MNEs should be more focused on the home region,
2. do not support our own theory that they will be more global,
3. do support VK's hypothesis that there will be no clear technology based pattern.

Comparing the situation between HT and LT, we see that levels of East Asian sourcing are similar between Clothing and Electronics. Although the EU has just over 50 percent HRO in the latter, it has a level of East Asian sourcing which is almost exactly the same as in Clothing (35 percent and 34 percent respectively), while NAFTA also has almost the same level of East Asian sourcing (over 60 percent) in both sectors, together with low or very low HRO. The similarities in geographical sourcing patterns between industries where knowledge intensity is, ostensibly, so different raises questions about the importance of this latter factor in differentiating MNE decisions on location of production.

In terms of H2, we see large differences in import structures between sectors. The most extreme example is the difference between NAFTA's imports of Footwear–that are heavily sourced in East Asia – and imports of Precision Instruments--that are almost perfectly global. Between these two extremes, there is a variety of structures across regions and sectors, which bear witness to very different FSAs, LAs, and institutional environments in the different region/sector contexts. Again, East Asia exhibits quite different patterns compared to the other two regions, with the lowest level of HRO in the Vehicles sector, where the other two regions have their highest levels. This indicates

that the factors listed, along with other regionally-specific elements, are more important than the inherent qualities of the sector itself.

Discussion

The above data on trade flows provide the framework to present a number of key conclusions. First, findings support the hypothesis proposed by both WDE and VK (our H2) that there will be differences in HRO across varied industrial sectors. These differences are evident across regions and across sectors within the same region. Although there are similarities in structures across sectors in the EU and NAFTA regions, the East Asia region is often very different. These regional differences in structures across the same sector indicate that factors such as institutional structures and locational advantages (or disadvantages) generally, may be more important in framing the internationalization strategies of companies than the sector in which they operate.

For example, MT trade is highly concentrated in the home region in the EU and NAFTA, but not in East Asia. Transport Vehicles and parts/components are relatively heavy so high trade costs may be a factor in the former, but other factors must explain the latter. Institutional factors may be a key issue. Sturgeon *et al.* (2008) have explored the global automotive industry and note strong political pressures on MNEs within the sector to focus production in the region of consumption–as seen in our figures for the EU and NAFTA. These pressures may vary across the globe, leading to different trade structures.

Overall, this observation of high levels of variation between sectors calls into question the wisdom of undertaking studies of MNEs as a group when seeking to elucidate key questions about their operational strategies. It seems likely that sector-focused studies would yield more useful insights, even if such studies would lose their universal appeal. At the very least, firm-level data should be analyzed, not just as a whole but, also, differentiating between key sectors as far as possible before concrete conclusions are drawn.

The structure of trade at different technology levels does not support our hypothesis - H1, which proposes that more HT goods would be less HRO - --at least not universally. The structure of exports from the EU and NAFTA indicates that, indeed, the export of HT goods beyond the home region is less difficult than for lower-level, less-knowledge-intensive technologies. This is not the case in East

Asia where HT goods are the most HRO in all sectors. On the import side, the highest levels of HRO are in MT in both NAFTA and the EU. The highest levels of HRO for East Asia are in LT and Electronics. There are, therefore, no clear or universal patterns in terms of a correlation between technology level and HRO. Much seems to depend on the technology and region in question. In addition, sectors ostensibly at the same technological level, according to the OECD categorizations we use, often exhibit quite different trade structures. Electronics trade is in some ways more similar to trade in Clothing than trade in Precision Instruments, in spite of quite different knowledge intensities between the sectors.

Although the prime objective of this paper was to explore the two sectoral/technology related hypotheses proposed in the WDE and VK articles, the data can also shed light on two other propositions: regions with higher levels of economic integration will favor HRO (proposed by WDE) and the counter proposition by VK that there will be no such pattern. The EU is, objectively, the most integrated of the regions, with a process of economic and political integration which began in the 1950's. NAFTA is probably the next most integrated with a clear and extensive trade liberalization process, which began in the 1990's. In spite of the relatively high levels of integration achieved by ASEAN, East Asia is the least politically integrated, as little progress has been made to expand regional integration beyond that core group. Furthermore, the level of integration remains below that achieved in the other two regions (Katada, 2009; Paczynski and Gasiorek, 2011).

We would expect the EU's HRO to be higher than NAFTA's, and the latter higher than East Asia. This pattern is not evident in the data. Although the EU is more HRO than NAFTA in all sectors except exports of Vehicles and Clothing, East Asia is more HRO than either of the other regions in exports in Electronics and in imports in both HT and LT sectors. Thus, trade data suggest that the presence or absence of strong political efforts to provide institutional support for economic integration is not the only, or even the most important, factor motivating company expansion within or beyond the home region. East Asia has strong HRO in several sectors without having a very strong level of political integration.

The other hypothesis which was proposed by WDE, to which our data is relevant, is the concept that Asian MNEs will be more HRO than others. This hypothesis is based on the fact that psychic distance is higher between Asia and the EU and NAFTA than between the latter two regions. For a variety of reasons, VK consider that no such pattern is likely to hold. As indicated above, Asia is strongly HRO in

imports: all sub-sectors are over 50 percent HRO, although it is less HRO than the EU in MT industries. In exports, however, it is only HRO in HT goods. In the other sectors, especially LT goods, it is rather global. Thus, East Asia is not systematically more HRO than other regions across all sectors and direction of trade. Indeed in some sectors – like Clothing and Footwear – East Asia is simultaneously HRO in imports and global in exports. This contradicts notions of specific difficulties for Asian businesses in accessing markets beyond the home region due to large psychic distance.

Conclusions

Through the analysis of trade structures, this paper has sought to explicitly explore two of the hypotheses proposed in recent articles in the *Multinational Business Review*, and shed light on the debate on MNE regional orientation. It compares trade structures across three key world regions and products of differing knowledge intensity. The results show that there are important differences in these structures within the regions we explore, although the patterns are not universal. Although HT sectors in the EU and NAFTA show more global trade structures than MT trade, East Asian HT sectors are the most home region oriented. Thus, HT trade does not seem to be inherently more global than lower tech trade, in contradiction of our first hypothesis.

Although this initial analysis is not extensive enough to draw firm conclusions, it does indicate that companies operating in different sectors face different challenges in their internationalization process – our second hypothesis. These challenges appear to impact differently depending on the region in question. EU and NAFTA trade structures indicate that companies from the two regions may face rather similar challenges in their internationalization efforts - in MT industry both the EU and NAFTA are more home region oriented than in HT and LT. We have postulated that one of the reasons for this might be higher trade costs of relatively heavy inputs like car chassis, iron pipes, or even final products like cars; however, this is somewhat undermined by the fact that in East Asia, MT industries are the most globally sourced. It is likely that other factors, such as politics, highlighted by Sturgeon *et al.* (2008), also intervene. Clearly, there are differences between sectors, but these differences do not have uniform impacts across regions. There seem to be region-specific strengths and weaknesses in production capacities, competitiveness and wider institutional context that also strongly affect outcomes.

What is evident from this initial analysis is that the way in which MNEs interact with the global economy varies extensively across regions and sectors, complicating efforts to find universal

explanatory factors in their patterns of activity. Many scholars in international business seeking to explain business patterns use aggregate figures of companies' activities to draw conclusions about how they internationalize. However, this risks obscuring important variations between different types of business in their internationalization processes and patterns. In addition, although Asian trade flows do often show different structures to EU and NAFTA, they are not universally more HRO, as postulated by WDE. However, the fact that the structures are so different raises questions about the usefulness of traditional European or North American based IB theory. The way in which Asian businesses are internationalizing, and the trade patterns emerging in the region, are not the same as those seen in more traditional markets. Perhaps existing theories can explain these varying patterns in terms of the very different institutional environments in which businesses operate, but certainly these variations merit greater attention.

This paper has also highlighted the fact that technology level, as such, does not seem to be a useful predictor of likely levels of HRO. Sectors within the same nominal classification–HT, LT, etc.--have different structures, while those with very different technology levels sometimes have very similar structures (Electronics and Clothing are the clearest examples). This observation highlights the mediating effect of sector-specific factors in the process of internationalization. It suggests that approaches based solely on technology level (Curran and Zignago, 2011a) may be too aggregated to provide useful conclusions. The extent to which knowledge can be codified is one factor likely to impact strongly on different levels of internationalization within and between technology levels. Another is the variation in trade costs inherent in different types of goods with different weight-to-value ratios, as suggested by the recent work of Ma and Van Assche (2012). The latter factor can be relatively easily quantified. The former is more difficult to judge. More work needs to be undertaken to understand the complexities of company operations in the world economy, if we are to better understand the impact of technological intensity on business orientation.

In elucidating their thesis that much international business is focused on the home region, Rugman and Verbeke (2007: 201) point out that *"…the 'distance' separating North America, Europe, and Asia remains substantial*". This is certainly the case; however, while that distance is the same in both directions and for all sectors, its impacts on trade are substantially different. Thus, by itself, distance (geographic, psychic, or otherwise) cannot explain differences in the orientation of sales and sourcing between key world regions and sectors. Distance clearly has differential impacts depending on the goods in question and the direction of trade.

Research limitations

Trade flows provide a clear and measurable representation of the choices made by MNEs in relation to the supply chains and markets for specific products which they manage. Although trade data has been used previously in the debate, an evident drawback of macro data is that we cannot link these flows to specific companies. We cannot differentiate between trade within a company–controlled by the MNE –and trade between companies who have no equity relationship. In short, because we cannot define the boundary of the firm through trade data, we cannot provide robust conclusions about the strategies of MNEs on this basis. However, as we have argued above, we believe that the advantages of trade data, in terms of universality and ease of use, are such that they should be more extensively used to inform the debate about how and under what circumstances MNEs internationalize. The macro-level patterns we explore in this paper are the result of a series of micro-level decisions by a myriad of small and large companies operating in the global economy. They give us clues about the difficulties and opportunities which are afforded to them by their location, as well as their own particular FSAs.

A further drawback of trade data is that it combines different types of goods. The figures which we present are from sectors as defined by HS two-digit classification. In many cases, these classifications include both final goods and intermediate products which will be incorporated into final goods. At this level of aggregation, using the HS system, on which Trade Map is based, it is impossible to differentiate between these types of goods. Our figures aggregate trade in goods ready for final consumption and trade in parts and components. Previous work indicates that trade in intermediate products may be more HRO than other types of trade (Curran and Zignago, 2011a). Further work needs to be done at a more disaggregated level if we are to better understand (1) the factors that explain differences in trade flows between sectors and technologies and (2) the extent to which these differences hold across the supply chain. However, the objective of this paper was to explore the extent to which differences between sectors are perceptible and real, in order to elucidate the hypotheses proposed. We believe that our figures do show sectoral variations in the way in which companies trade, which merit further analysis.

Our methodology does not allow us to draw any firm conclusions on the factors driving the trade patterns we observe. To draw any firm conclusions on explanatory factors, an econometric approach would probably be necessary, declining a gravity model by technology or sector, drawing on

methodologies such as those used by Costantini and Massimiliano (2012) and Jongawich (2011), for example. FDI would need to be integrated into such an approach. Analysis at an aggregate level in emerging Asia indicates a strong link between FDI and trade in parts and components (Jongawich, 2011) and final goods (Ferrantino *et al.*, 2008). Thus, investment by MNEs, often beyond their home region, may be motivating much of the trade which we observe. Our methodology does not enable us to pass any judgments on such links. Some of the exporting companies from East Asia to the EU and NAFTA may not be "foreign" in the destination market and, therefore, have no liability of foreignness or psychic distance to overcome. Although this is unlikely to explain all of the differences in Asian trade structures compared to those of the EU and NAFTA, it is probably one component of the picture. Further work is required at a more detailed level to illuminate this question.

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APPENDIX

OECD categorizations of technology level of Industry (OECD, 2011)

High Technology Industries Aircraft and spacecraft Pharmaceuticals Office, accounting, and computing m/cs. Radio, TV, and communications equipment Medical, precision and optical instruments	**Medium High Technology Industries** Electrical machinery and apparatus Motor vehicles, trailers, and semi-trailers Chemicals, excluding pharmaceuticals Railroad equipment and transport equipment Machinery and equipment
Medium Low Technology Industries Building and repairing of s hips and boats Rubber and plastics products Coke, refined petroleum, and nuclear fuel Other non-metallic mineral products Basic metals and fabricated metal products	**Low Technology Industries** Manufacturing, n.e.c. Recycling Wood, paper, printing, and publishing Food products, beverages, and tobacco Textiles, textile products, leather, and footwear