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# Networked FDI: Sales and sourcing patterns of Japanese foreign affiliates

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## Abstract

Using firm-level data on the sales and sourcing patterns of Japanese affiliates, this paper suggests that very little foreign direct investment (FDI) falls neatly into the standard bins of horizontal, vertical and export-platform FDI. Most affiliates import some intermediates and export some output, suggesting a pattern that might be called “networked FDI.” This suggests that the nature of FDI is influenced by “regional comparative advantage,” i.e., the proximity of markets and suppliers.

*Keywords:* Vertical and horizontal FDI, Complex FDI, Networked FDI, Sourcing, Sales, Japanese foreign affiliates

*JEL classification:* F21, F23

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# 1. Introduction

Canonical thinking about FDI distinguishes two main types: horizontal (Markusen 1984) and vertical (Helpman 1984). FDI in the former is said to be ‘market seeking’ and ‘efficiency seeking’ in the latter. Empirical tests (Carr, Markusen and Maskus 2001, Blonigen, Davies and Head 2003) typically search for FDI motives by considering whether FDI activity is greatest between large nations (market seeking), or nations with big endowment and/or factor prices differences (efficiency seeking). The bivariate FDI categories have been synthesised (Markusen and Venables 2000) and enriched to include export platform FDI (Yeaple 2003, Ekholm, Forslid and Markusen 2007, etc.). Grossman, Helpman and Szeidle (2006) generalise these results by allow a richer range of multinational activities that can be called complex FDI.

This paper uses firm-level data on the sales and sourcing patterns of Japanese affiliates in all industries in all nations to suggests that very little FDI falls neatly into any of the standard bins: horizontal, vertical or export platform. As Hanson, Mataloni and Slaughter (2001) show for US MNC data, we find that most affiliates are buying some, but not all, of their intermediates from abroad and selling some, but not all of their output abroad. We refer to this FDI as ‘networked FDI’ since the evidence is that these affiliates are operating as nodes in regional production networks. Moreover, we show that this aspect of the data became much stronger between 1996 and 2005.

The goal of this paper is present features of the dataset that suggests testable hypotheses that are to be addressed in subsequent work. As part of this, we suggest that a very natural way to test FDI theories is to use the sales and sourcing patterns of affiliates.<sup>1</sup> We also argue that the location and nature of FDI activity depends upon third country effects of two types – basically the international equivalent of backward and forward linkages. The first, forward linkages, suggests that FDI production is favoured by locations near many large markets – perhaps measured by some sort of market potential index for the host nation. Such effects have already been found by Baltagi, Egger and Pfaffermayr (2005). The second, backward linkages, suggest that FDI production is favoured by proximity to masses of similar activity in both the host nation and nearby nations. This might be measured by some sort of host-nation-specific price index for intermediates and they have not, to our knowledge, been explored empirically or theoretically.

Taken together, the two third-nation effects suggest that the location and nature of FDI activity is influenced by something that might be called ‘regional comparative advantage’. For example, even if Cambodia and Uganda had identical national policies, endowments, and market size, Cambodia’s proximity to massive manufacturing activity creates backward and forward linkages that make FDI more attractive in Cambodia than in Uganda. The policy implications of these observations are clear. Policies that worked in East Asia must be rethought before applying them to very different regions such as Latin America, Central Asia, and Africa.

The paper begins with a quick and incomplete overview of mainstream FDI theory and proposes a new diagram for organising thinking about FDI categories. This diagram – the sales-sourcing box – plots an affiliate’s share of local sales on the y-axis and its share of local sourcing on the x-axis. We show how the canonical three-way categorisations are

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<sup>1</sup> Sourcing in this paper is defined as the sourcing of raw material, intermediate inputs, and parts and components.

extreme cases, and we add two extreme cases to the list: resource-extraction FDI (100% local sourcing and 100% non-local sales), and tariff-jumping FDI (100% non-local sourcing and 100% local sales). We also show how the diagram can be used to organise thinking about the classic substitute-or-complement view of trade and FDI, and about developing nations' policies towards FDI (e.g. import-substitutions policies, or 'moving up the value chain' policies).

The next section, Section 3, presents some aspects of the data on Japanese affiliates' sales and sourcing patterns using the two-nation perspective (local versus non-local). Section 4 looks at multination sale-sourcing patterns. Here the main result is that most FDI is networked regionally rather than globally. We also see that North America is an outlier compared to Asia and Europe. Specifically North American sales-sourcing patterns are far more akin to horizontal FDI (100% local sourcing and 100% local sales). This suggests caution when interpreting the general validity of empirical results based on US MFN data.

Section 5 discusses one potential line of empirical investigations that are suggested by our informal data work. The testing of FDI theories with trade data, specifically the trade data of affiliates (i.e. their sales-sourcing patterns). Here we can say that even without running any regressions, it is clear that pure horizontal FDI would show up as a rarity while vertical FDI would show up as the rule. This would reverse the conclusion suggested in the empirical survey Blonigen (2005) that states: "It seems clear that vertical motivations are not prevalent in the general FDI patterns. Rather, such motivations for FDI show up as important for only a few particular manufacturing sectors, such as machinery and electronics." The differences in conclusions may be explained in part by the outlier nature of US data, and in part by the indirect approach to testing FDI theories using macroeconomic data such as country sizes and endowments. Section 6 presents our concluding remarks.

## 2. Theoretical frameworks

Foundational thinking about FDI was shaped by two-nation models that excluded the possibility of trade in intermediate goods (Helpman 1984, Markusen 1984).<sup>2</sup> This was natural since the theory arose just before the start of the massive transformation of production known variously as 'production unbundling', 'fragmentation', 'vertical specialisation', 'internationalisation of the supply chain', or 'trade in tasks'. This transformation has changed the motives behind and nature of FDI, but before turning to these new developments, we present a thumbnail sketch of the 1980s FDI theory.

The canonical FDI/MNC model works with two nations, no intermediate goods, and a market structure with no multi-market effects. In this setting, a firm may find it advantageous to produce abroad rather than at home for only two reasons: lower production costs, and/or lower trade costs. These motives correspond to the two canonical types of FDI – horizontal (lower trade costs) and vertical (lower production costs).

Horizontal FDI splits production of the final good geographically and satisfies each nation's demand from a local factory to avoid trade costs. This is market-seeking FDI and it is a substitute for trade. Vertical FDI in its purest form involves final good production with value added in both nations, but goods production in only one. In Helpman (1984), for example, skill-intensive 'headquarter services' is undertaken in the home country while physical production occurs in the host country. This only occurs when such geographical production unbundling reduces costs, so vertical FDI is 'efficiency seeking'. The cost-reducing aspect of vertical FDI typically increases the volume of goods trade (in addition to trade in 'invisible'

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<sup>2</sup> See Helpman and Krugman (1985) Chapter 12 and 13, or Feenstra (2004) Chapter 11.

headquarter services). In short, horizontal FDI is a matter of ‘investment or trade’ while vertical FDI is a matter of ‘investment and trade’.

As trade and investment became increasingly entwined in the late 20<sup>th</sup> century, theory evolved to account for the changes. Analysis of US data by Hanson, Mataloni and Slaughter (2001), for example, showed the canonical distinction between horizontal-FDI and vertical-FDI could not account for the full range of multinationals’ activities. The seminal paper by Yeaple (2003) stepped beyond the horizontal-or-vertical paradigm. In a simple three-nation model, he studied ‘complex’ FDI strategies, i.e. individual firms engaging simultaneously in horizontal and vertical FDI. He elucidates how a firm’s investments in various host nations can be complements or substitutes with each other (what came to be called ‘third country effects’ in the empirical literature), and how trade and FDI may act as complements or substitutes. Ekholm, Forslid and Markusen (2007), and Grossman, Helpman and Szeidle (2006) generalise and confirm Yeaple’s results in richer models.<sup>3</sup> The papers from the 2000’s allow third countries so a new category of FDI logically emerges – export-platform FDI (this may be market-seeking, efficiency seeking, or both). Baltagi, Egger and Pfaffermayr (2005) provide clear empirical evidence that third-country effects are important.

## 2.1. Classifying FDI by trade flows: The sales-sourcing box

As complex international supply chains are a pervasive feature of modern manufacturing (especially in East Asia), it is useful to have a classification of FDI and trade linkages that goes beyond the standard three-fold categorisation (horizontal, vertical and export-platform) but is more concrete than the catch-all ‘complex FDI’.<sup>4</sup>

This suggests a classification of FDI according to each affiliate’s sales and sourcing pattern (Figure 1). In this ‘sales-sourcing box diagram’, the various forms of FDI stressed in the theoretical literature show up as corner solutions.<sup>5</sup>

- Pure horizontal FDI is the northeast corner; affiliates sell all output locally and source all intermediates locally (in the early literature, intermediates were ignored by implicitly bundling them into the production function).
- Pure vertical FDI (Helpman 1984) is the eastern border since all intermediates are sourced locally (again, the early models suppressed intermediate goods but allowed trade in invisibles), but some of the final good output is exported back to the home nation.
- Pure export platform FDI (i.e. outward processing) is the southwest corner; all intermediates are imported and all output is exported.
- Tariff-jumping assembly FDI – where all intermediates are imported and all output is sold locally – is the northwest corner.

The last corner represents pure resource extraction (cash-crop agriculture, mining, fishing, etc.) where all intermediate inputs are sourced locally and all output is exported. In many cases (e.g. oil drilling), some intermediates maybe imported so the point would be somewhere on the interior of the bottom edge of the box.

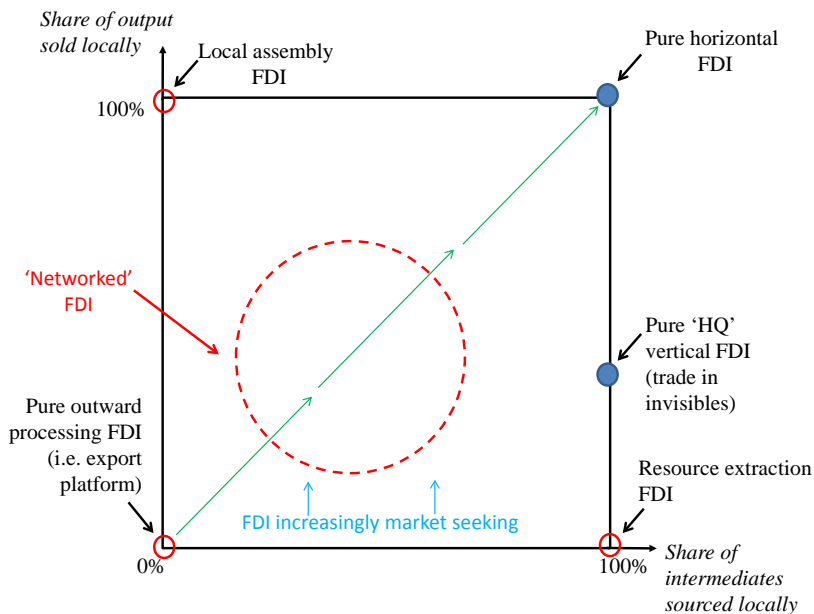
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<sup>3</sup> The first draft of Yeaple (2003) was submitted to the Journal of International Economics in 2001; the first drafts of Ekholm, Forslid and Markusen (2007) and Grossman, Helpman and Szeidle (2006) came in 2003.

<sup>4</sup> A conceptually straightforward generalisation of Yeaple (2003) – for example a many-nation version of Grossman, Helpman and Szeidle (2006) – would permit a much more complex range of FDI and trade outcomes. In such a model, we can envision foreign affiliates engaging in local and export sales as well as local and import sourcing of intermediate inputs.

<sup>5</sup> Also see Ando and Kimura (2005) which suggests a different two-dimensional classification with the axes being physical distance of the affiliate from the headquarters and tightness of corporate control over the affiliate.

FDI marked by low levels of both local sales and local source might be labelled ‘networked FDI’ as these facilities are most naturally viewed as part of international supply chains, or links in global value chains. One interesting aspect of such FDI is its intimate connection with trade. Indeed, trade and investment are simple two observable facets of a single economic activity.



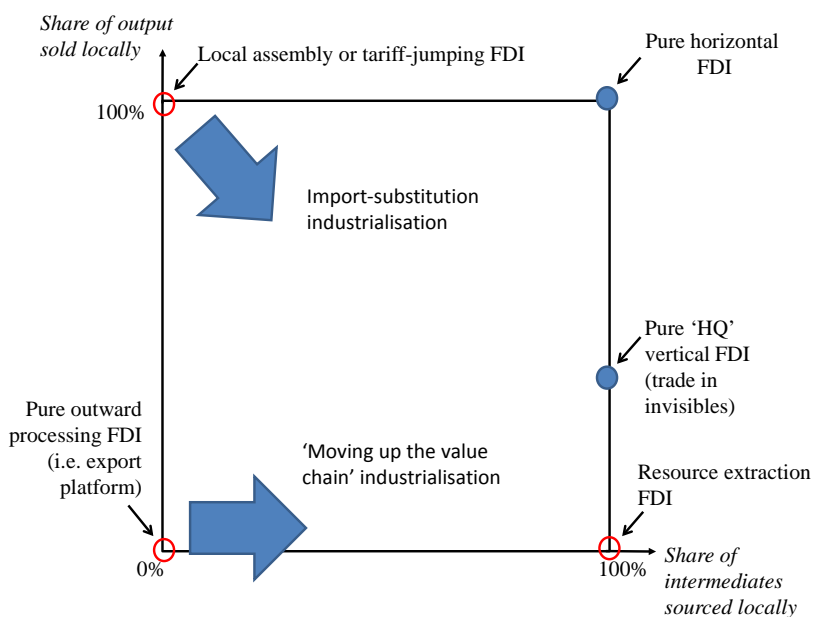
**Figure 1: The sales-sourcing box diagram.**

The substitutability of FDI and trade increases along the southwest to northeast diagonal. At one extreme, pure horizontal FDI extinguishes all trade, while at the other extreme, outward processing FDI maximises trade in both intermediates and final goods. The extent to which FDI is market-seeking (as opposed to efficiency-seeking) increases as we move up the box. For example, on the western edge, outward-processing FDI is purely efficiency seeking while local assembly FDI is purely market-seeking. Likewise, along the eastern edge, resource-extraction and pure-horizontal FDI are, respectively, purely efficiency seeking and purely market-seeking.

Of course, this is a very rough classification and many nuances are hidden by this presentation, but it does serve to illustrate the point – first made by Hanson, Mataloni and Slaughter (2001) – that the standard horizontal or vertical thinking is inadequate for understanding the behaviour of Japanese FDI.

### 2.1.1. FDI and development strategies

The sales-sourcing box can also illustrate typical development strategies involving FDI. The traditional import-substitution strategy, for example, involves starting with local assembly and pushing multinational to produce more intermediates locally; the eventual goal is exporting. This would show up as a move from the northwest corner towards the southeast corner. The 21<sup>st</sup> century version of this – pursued by China and other East Asian nations – starts from the southwest ‘outward processing’ point and seeks to induce multinational to source more intermediates locally. This is a pure ‘eastward’ move from the lower left-hand corner. In some cases, there is also desire to develop the local market for the final good. This would be a push to move affiliates’ position northeastward. These are illustrated in Figure 2.



**Figure 2: FDI and development strategies**

### 3. Japanese affiliates' sales and sourcing: Aggregate data

Our data includes extensive firm-level information on Japan's foreign affiliates called "Kaigai Jigyō Katsudō Kihon Chōsa" or "The Survey on Overseas Business Activities" prepared by the Research and Statistics Department, METI of Japan. The yearly survey is conducted by METI using a questionnaire based on survey forms and covers all Japanese affiliates in all sectors and all nations. The parent firm and each foreign affiliate are surveyed separately. The reply rate of parent firms is almost universal; that of affiliates is about 70% in 2005 and 59% in 1996. 1996 is the first year for which the data is in electronically-accessible form. The data, which is confidential, is prepared and managed by METI.

The survey questions asked cover a very broad range of economic issues including number of employees, assets, purchases, some intellectual property indicators, etc. While the basic questions are constant across years, there is some annual variation in a subset of questions. The trend has been for the survey to be simplified in recent years.

The sector classifications used in the survey do not correspond to international practices (e.g. UNIDO or OECD classifications), but they are broken down into 80 sectors in 2005. In earlier years, the classification scheme involve more sectors but they decomposition was slanted toward 'old' industries.

In this paper, we focus on the sales and sourcing patterns (i.e. the affiliates import and export patterns), but before turning to the data, we present a few summary statistics.<sup>6</sup> As Table 1 shows, the biggest sectors by far are electricity and gas, and machinery. The biggest host regions are Asia, North America and the EU; Asia's total exceeds that of the sum of all other regions combined.

<sup>6</sup> The questionnaire of the data asks about imports or local purchases of intermediate inputs and raw materials (i.e. sourcing) and exports or local sales of final products.

**Table 1: Number of affiliates by region by sector, 2005.**

	Africa	Asia	EU	Middle East	N. America	Oceania	S. America	Sector total
Services	82	3,365	1,570	56	1,511	284	541	7,409
Chemical	4	698	177	2	209	14	26	1,130
Light manuf.	1	580	27		50	11	20	689
Machinery	27	3,425	702	10	968	57	188	5,377
Metal & metal products	7	503	31	1	127	11	18	698
Primary	7	421	94	2	158	133	74	889
Region total	128	8,992	2,601	71	3,023	510	867	16,192

*Note: See appendix for list of sectors under each of the six broad headings.*

Looking across sectors, we see a typical Pareto distribution of the importance of the sectors. Using data for 2005, we see that in terms of assets and workers employed, a handful of sectors account for the lion's share of global totals. The most important in terms of assets are wholesale trade, financial and insurance, auto parts, communication equipment, motor vehicles, electronics, and chemicals. In terms of employment, the ordering is somewhat different, but electronics and financial services are significantly lower while clothing and retail trade are significantly higher. Using either metric, the big FDI sectors are, roughly speaking, in electrical and mechanical machinery, clothing, and certain types of services that involve require local presence. Figures for the total number of nations with at least one affiliate paint a broadly similar picture.

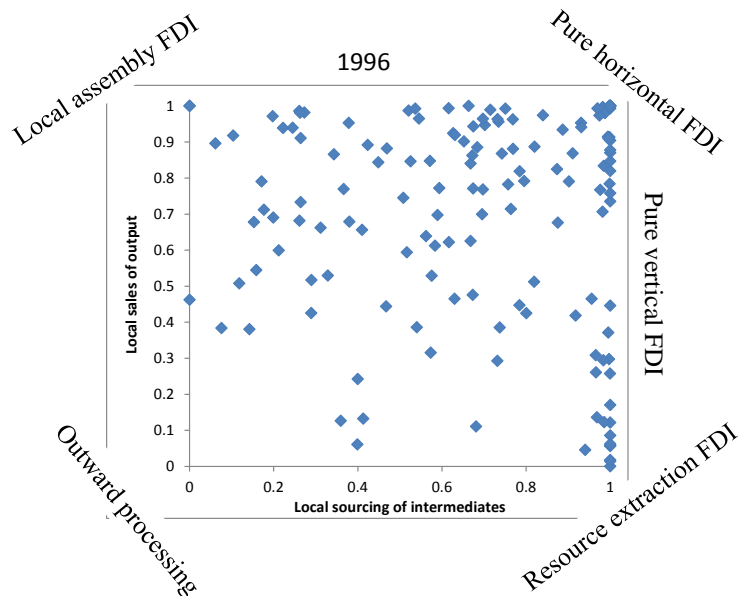
### 3.1. The sales-sourcing patterns: Affiliates' trade patterns

While we have data by nation by sector per affiliate, in this paper we work the figures aggregated across all affiliates within a country or region to reduce the data's dimensionality to a manageable level.

The first task is to see how Japanese affiliates are placed in the sales-sourcing box diagram. That is, we characterise each sector (aggregating over all affiliates in all nations) according to the share of its output sold locally as well as by the share of its intermediate purchases that are acquired locally (these purchases do not concern factors of production like labour, capital and technology). Each sector is plotted as a point in the sales-sourcing box. In keeping with the two-nation worldview, we aggregate the sales and sourcing information into local (i.e. from or to the host nation) and non-local. This gives us 68 data points (one for each two-digit sector), each with two characteristic – the share of local sales and the share of local intermediates. These can be are displayed in a scatter plot.

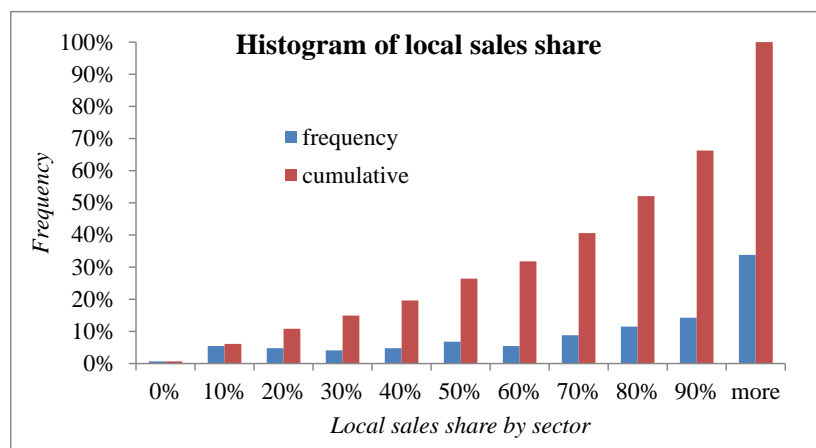
Figure 3, which shows the data for 1996, confirms the Hanson-Mataloni-Slaughter point that the canonical horizontal or vertical distinction is useful but inadequate.





**Figure 3: Sales and sourcing Japanese affiliates, all host nations, 1996.**

In 1996, the horizontal/vertical distinction does cover a large number of sectors as can be seen from the mass of data points along the eastern edge of the box. The mass of data points in the northeast extremity suggests that pure-horizontal FDI was important in 1996. If we interpreted the collapsed data using the prism of canonical FDI theory, the predominance of local sales would tell us that most FDI is market-seeking rather than efficiency-seeking.



**Figure 4: Dominance of local sales, 1996.**

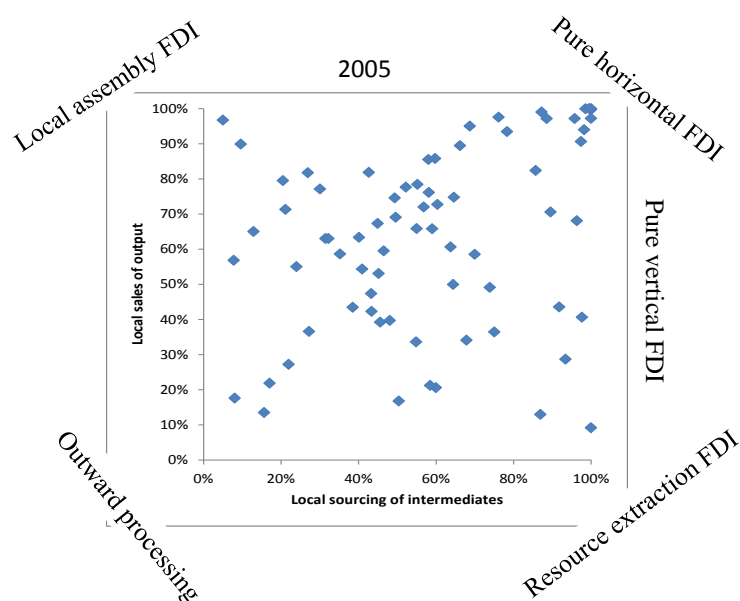
This feature of the data probably explains why early empirical work, such as Brainard (1997), found that horizontal FDI was dominant. Such studies focused only on the sales patterns of affiliates, ignoring the affiliates import behaviour. To understand how this empirical strategy distorts the real behaviour of affiliates, we note that it is like collapsing all points onto the box's eastern edge. When we do this (Figure 4 shows a histogram of local sales shares of the various sectors), we see that a predominant share of sectors sell 90% or more of their output locally. Of course Brainard (1997) and like-minded empirical studies were careful with their econometrics and they typically worked with US data, but our exercise shows that pre-

estimation data manipulation made it almost impossible to arrive at a finding that vertical FDI was important.

Moving away from the box's eastern edge, we see that many data points that display intermediate shares of both local sales and local sourcing. In Yeaple's terms, this is 'complex' FDI. It is also interesting to note that in 1996 there were no sectors in the outward processing corner (remember we have aggregated across all affiliates in all regions so even if many affiliates in, say, IT equipment, were engaged in outward processing, the average need not show up in the southwest corner).

### 3.2. 2005 versus 1996 FDI: Sales and sourcing

As production unbundling advanced, the sales-sourcing pattern of Japanese FDI changes dramatically, as the comparison between 1996 and 2005 in Figure 5 and Figure 3 shows. Although the sector classifications changed between the two years, the broad picture is clear – most sectors saw a decrease in the local sourcing of intermediates. The idea here is that progress in information and communication technology made it increasingly economic to spatially unbundle production, dispersing the production of intermediate goods to locations with attractive production costs (Baldwin 2006). A few sectors remain as classic horizontal sectors but very few correspond to the classical vertical FDI concept.



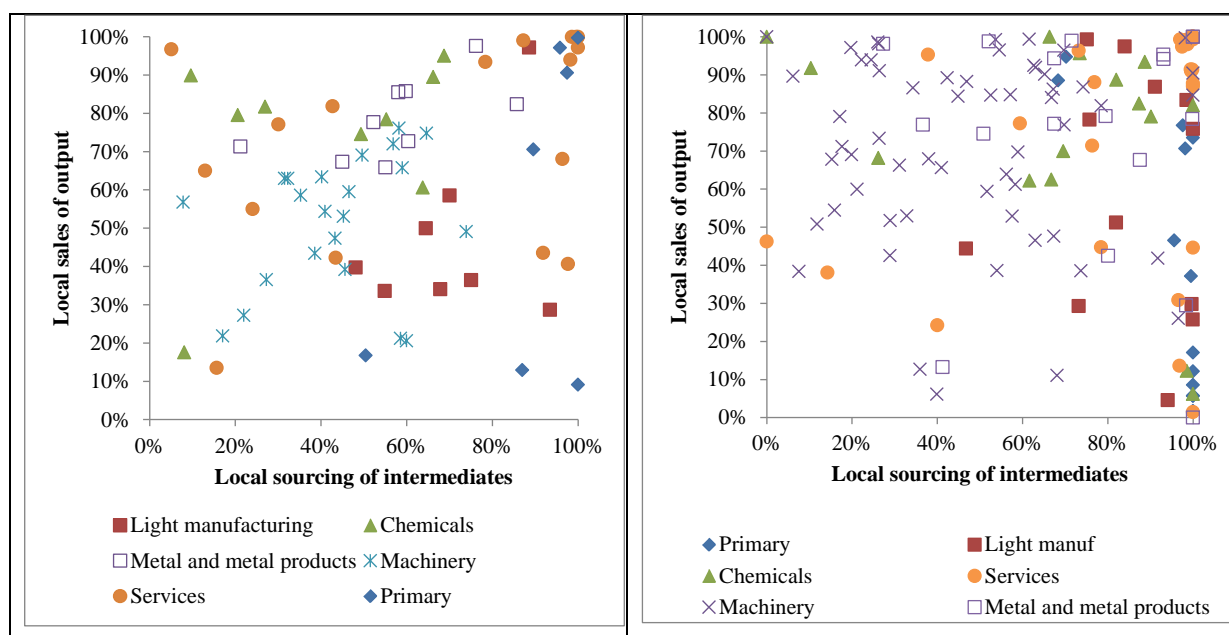
**Figure 5: Sales and sourcing Japanese affiliates, all host nations, 2005.**

In particular, Figure 5 shows the emergence of what we called 'networked FDI' – i.e. FDI where the affiliates import substantial shares of their intermediates and export substantial shares of their output. In this sense, trade and investment became far more entwined between 1996 and 2005.

### 3.3. Focus on sectors

As might be expected, the sales-sourcing pattern varies according to the sector of the affiliate. After all, the key determinant of market-seeking versus efficiency-seeking FDI depends upon sector-varying characteristics such as scale economies, natural and manmade trade frictions, and modularity of the production process. Figure 6 (left panel) shows the facts for 2005 dividing the two-digit sectors into six broad categories: light manufacturing, chemical, metal

and metal products, machinery (electrical including electronics, and mechanical), services and primary. Figure 6 contains some surprising features for readers that generally think of standard manufacturing sectors such as autos and steel when thinking about FDI.



**Figure 6: Sales and sourcing by sector, 2005 (left) and 1996 (right).**

*Note: See appendix for list of sectors under each of the six broad headings.*

Focusing on 2005 data (left panel), the sectors that have trade patterns that correspond most closely to that of pure horizontal or pure vertical FDI are service sectors. For example hotel and restaurant, real estate, and advertising rely almost entirely on local intermediates and sell virtually all output locally. More generally, service sectors tend to have extreme sales-sourcing patterns. The communications industry, for example, sources only 5% of intermediates locally but sells 95% to the local market. The transportation-service sector (for Japan this is mainly air travel and cargo) sources only 16% locally and sells only 14% locally.

Primary sectors are also generally extreme in their trade pattern, generally showing up on the eastern edge of the box. Extractive sectors such as forestry and metal mining have very low local sales but very high local sourcing of intermediates. Note that we are measuring intermediates as total purchases other than those related to labour, capital and technology. There is also a group of primary sectors that closely fit the trade pattern of pure horizontal FDI. Beverage manufacturing, construction, and food manufacturing are examples of sectors with very high local sourcing and sales shares.

The classic FDI sectors – manufacturing of consumer and capital goods, which account for the bulk of FDI by value – tend to have more intermediate sales-source configurations. Interestingly, the machinery sectors tend to be stretched out along the 45 degree line with their sales and sourcing shares tending to rise or fall together. On the high side, Motor vehicles as well as auto parts and accessory manufacturing have sales and sourcing shares around 60-70%. Other transportation equipment, by contrast, has scant local sales and sourcing; the numbers are 17% and 22% respectively. Such low shares suggest that these

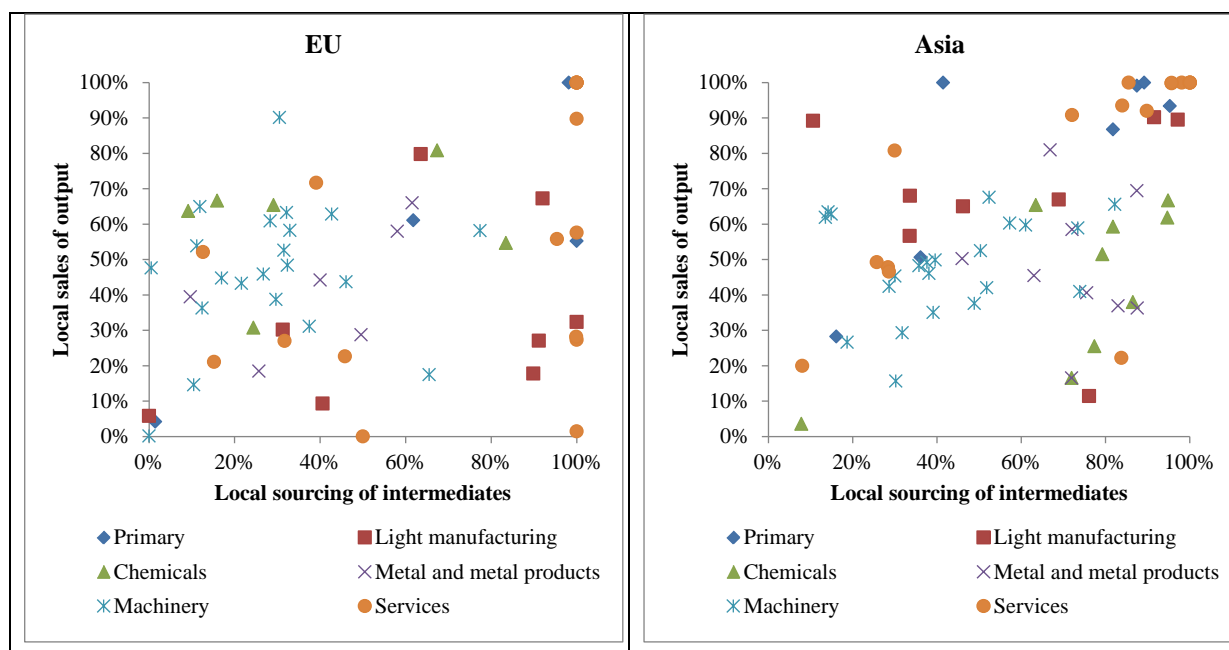
affiliates are adding-value at intermediate production stages and passing their output down the international supply chain.

Chemicals tend to display high local sales shares with variable local sourcing shares. For example, medicines, chemical fertilizers and cosmetics have local sourcing shares under 30% but local sales shares over 80%. Finally, light manufacturing sectors (e.g. textiles, clothes, wood, and paper products) tend to have patterns that are shifted toward the resource extraction corner (100% local sourcing and 0% local sales) compared to heavy-industry sectors.

The pattern for 1996 is difficult to compare exactly to 2005 given the changes in sector definitions, but much of the sector features in 2005 are also found in the 1996 data. For example, services and primary sectors have extreme sales-sourcing patterns, and light manufacturing generally has higher local sourcing shares than machinery. One big change is the truncation of variation in machinery sectors. In 1996, many machinery sectors had local sales and sourcing shares over 80%. By 2005, however, no machinery sectors had more than 80% sales and sourcing shares. This surely reflects the internationalisation of supply chains in the machinery sector.

### 3.4. Regional variations

The patterns depicted hereto reflect an average across all nations. As it turns out, there are important differences among the sales-sourcing configurations of Japanese affiliates in the three major host regions – Asia, North America and the EU. Figure 7 shows the 2005 figures for sectors located in EU nations (left panel) in Asian nations (right panel). Note that here local means sales within the individual host nation, not within the region (e.g. EU or Asia). Both panels show that FDI in both regions is what might be called ‘networked’ FDI (excluding primary and service sectors). That is, the affiliates are very outward oriented in that they import the bulk of their intermediates and export the bulk of their output.

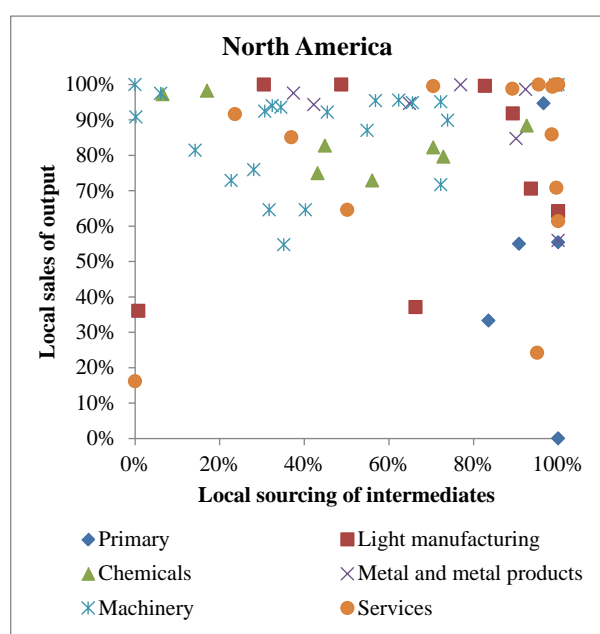


**Figure 7: Sales and sourcing by sector, EU and Asia, 2005.**

*Note: See appendix for list of sectors under each of the six broad headings.*

For the EU, very few sectors have local sales shares over 50% or local sourcing shares over 60%. This is a natural consequence of Japanese firms viewing the EU as a single market; they tend to place a facility in a limited number of EU nations and exporting from these to other EU members. Likewise the local sourcing is limited given the relatively small nature of many EU nations (this limits the range of available intermediates).

The sectoral sales-sourcing patterns in Asia are fairly similar to the EU patterns. Services and primary tend to have extreme patterns. However, the Asian pattern for services seems to reflect the more fragmented nature of Asian national markets for services. That is, many of the services appear to be examples of pure horizontal FDI with mostly local sourcing and sales. In the EU, by contrast, many of the service sectors sell less than 70% locally and about half of them source less than 50% locally. When it comes to the big volume FDI sectors – machinery – the Asia and EU pictures are both marked by the networked features, namely intermediate shares of local intermediate purchases and intermediate shares of local sales.



**Figure 8: Sales and sourcing by sector, North America, 2005.**

*Note: See appendix for list of sectors under each of the six broad headings.*

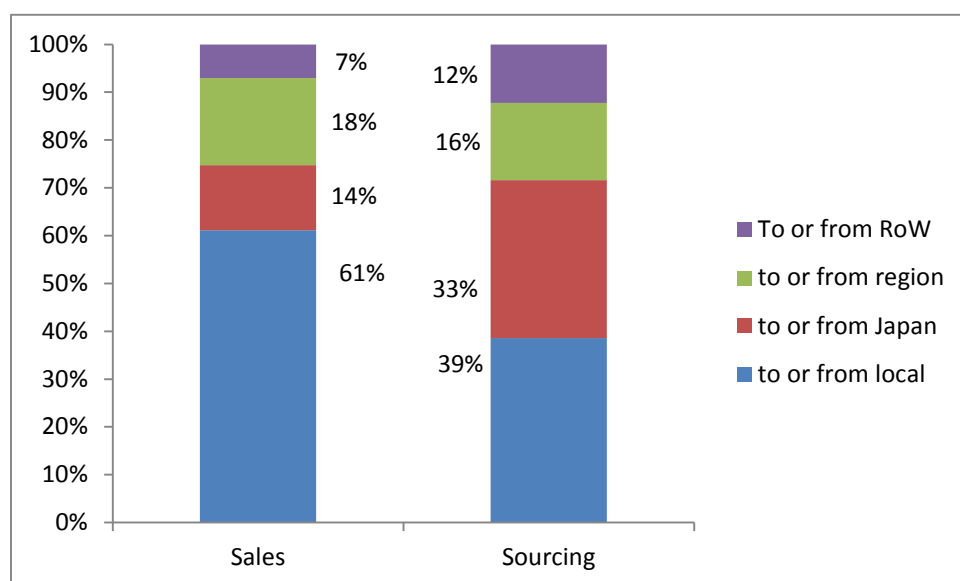
The North American sales-sourcing patterns are strikingly different, especially for manufacturing sectors (chemicals, light manufacturing, and machinery). The most salient feature is the dominance of local sales. Almost every sector sees more than 50% of output sold within the host nation (i.e. within US, Canada or Mexico). This outcome is probably due to the vast size of the US market, which is almost as large as the EU market but made of one nation rather than a couple dozen.

#### 4. The multi-nation sales-sourcing pattern

Hereto we have used the two-world perspective; sales and sourcing is either home or foreign. This was a natural point of departure for our analysis since the canonical theory – which still shapes today’s theory and empirical work – was cast in a two country world. Much of the theory extensions and enrichments have worked with a 3-country setting, but not with 3 full-fledged nations. One of the three is typically not capable of both producing and consuming all goods.

Given the extensive literature on global value chains, the next nature step is to turn to a more refined categorisation of the sales-sourcing pattern. Fortunately, our data allows us to take a step in this direction. In particular, we turn to a four-fold categorisation of the sales and sourcing patterns: to/from local, to/from Japan, to/from other nations in the region, to/from non-regional nations.

To provide a backdrop for our investigation of sector variations, we first consider the aggregate sales-and-sourcing pattern of all Japanese affiliates in all sectors and all nations. The left bar of Figure 9 breaks out the destination of foreign affiliate sales into local sales, sales back to Japan, sales to other nations in the region, and sales to all other nations (RoW). The regions here are North America, Asia, South America, the EU, Oceania, and Africa. The right bar provides the same geographical breakdown for purchased inputs (intermediates).



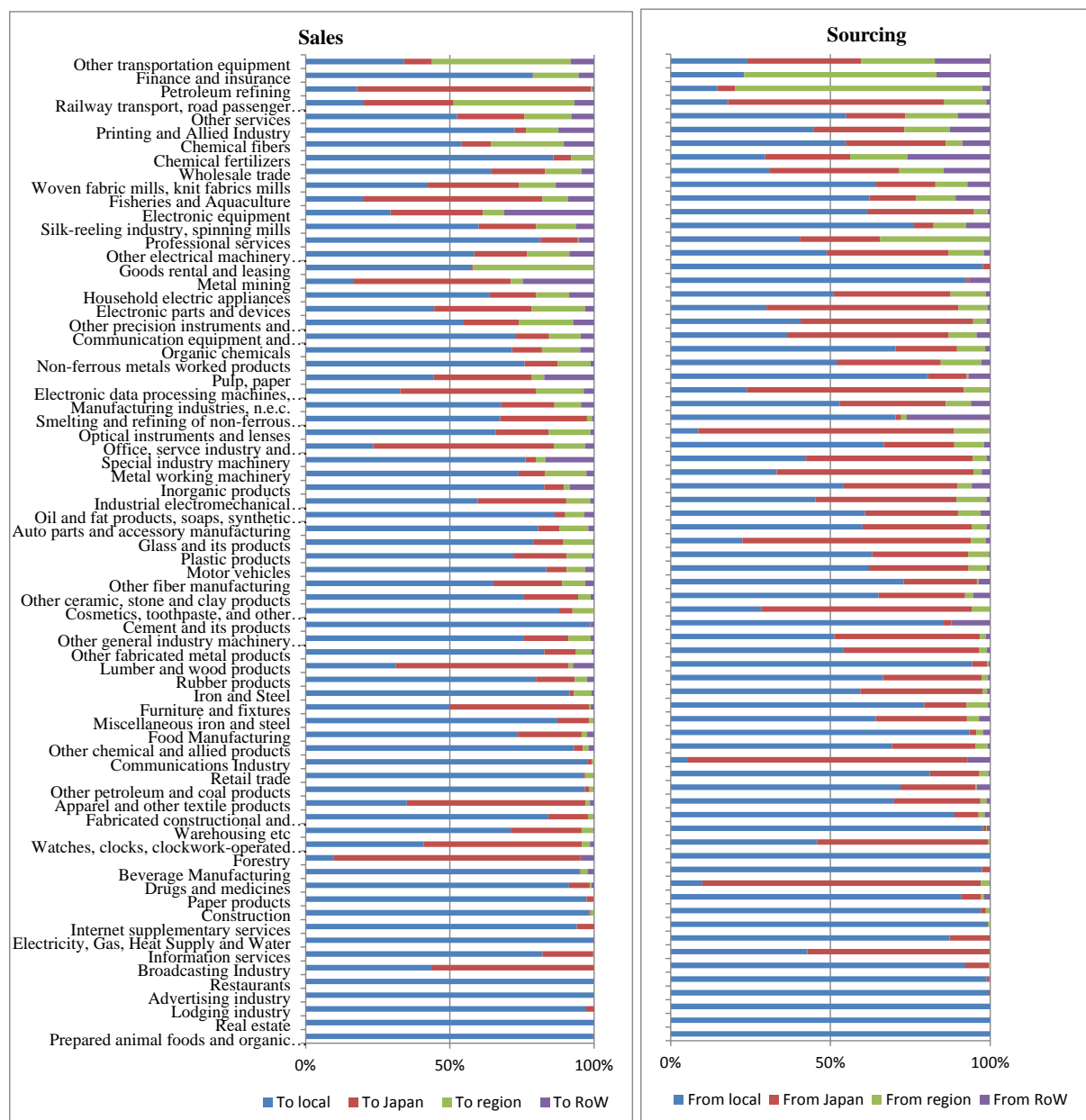
**Figure 9: Sales and source by region, 2005, all sectors and nations**

A key fact shown by Figure 9 is that 25% of sales are to neither the home nation (Japan) nor the host nation. Moreover, 28% of purchased inputs are not from home or host nations. Both facts sit uncomfortably with the two nation thinking and suggest that empirical tests based on this home-or-foreign aggregate will lead to misleading results. For example, looking only at sales, the horizontal FDI story would look good (60% of sales to host market), but looking only sourcing the horizontal FDI story looks bad (only 39% of inputs purchased locally). The two-nation vertical story also struggles to account for the main facts as only 33% are sourced from the home nation. Of course squashing our data to fit the two-nation model, we would add the sourcing from Japan, the region and RoW to get a feeling for the non-local content. The result would be that the vertical story looks much better than the horizontal story as 60% of intermediates are non-local.

The lesson from this first data analysis is that ‘networked FDI’ is important in aggregate. The old twofold distinction – horizontal and vertical – in a two-nation setting is clearly not useful for organizing our thinking about FDI.

## 4.1. Sectoral perspective

The average numbers in Figure 9 hide massive cross-sector variation. The figures for all our sectors (again aggregated across all Japanese affiliates worldwide) are shown in Figure 10.



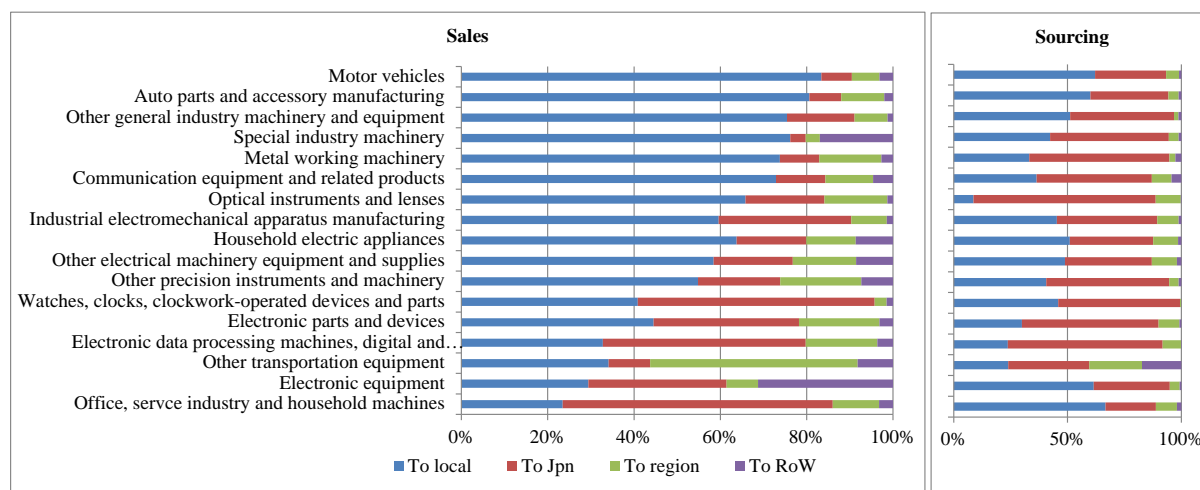
**Figure 10: 4-way sales-source pattern by sector, 2005, all nations**

The sectors have been ordered according to a crude ‘networked FDI index’ which reflects the average share of sales and sourcing from third nations. This a very rough measure of the extent to which production chains are internationalised in complex ways – or what Yeaple (2003) called ‘complex integration strategies’.

Quite a few sectors that are widely viewed as being thoroughly involved in networked production chains – electronic equipment, textiles, chemicals, and machinery sectors. There are also some surprises among the most networked sectors. Finance

### 4.1.1. Focus on machinery

The production unbundling phenomenon (i.e. fragmentation, offshoring, trade in task, etc.) has mostly occurred in the machinery sectors – especially mechanical machines and electronics. Here we focus on the sales and sourcing patterns in these sectors, again aggregating across all firms in all regions. In essence, Figure 11 pulls out and magnifies several of the bars from Figure 10.



**Figure 11: 4-way sales- pattern, machinery sectors, 2005, all sectors and nations.**

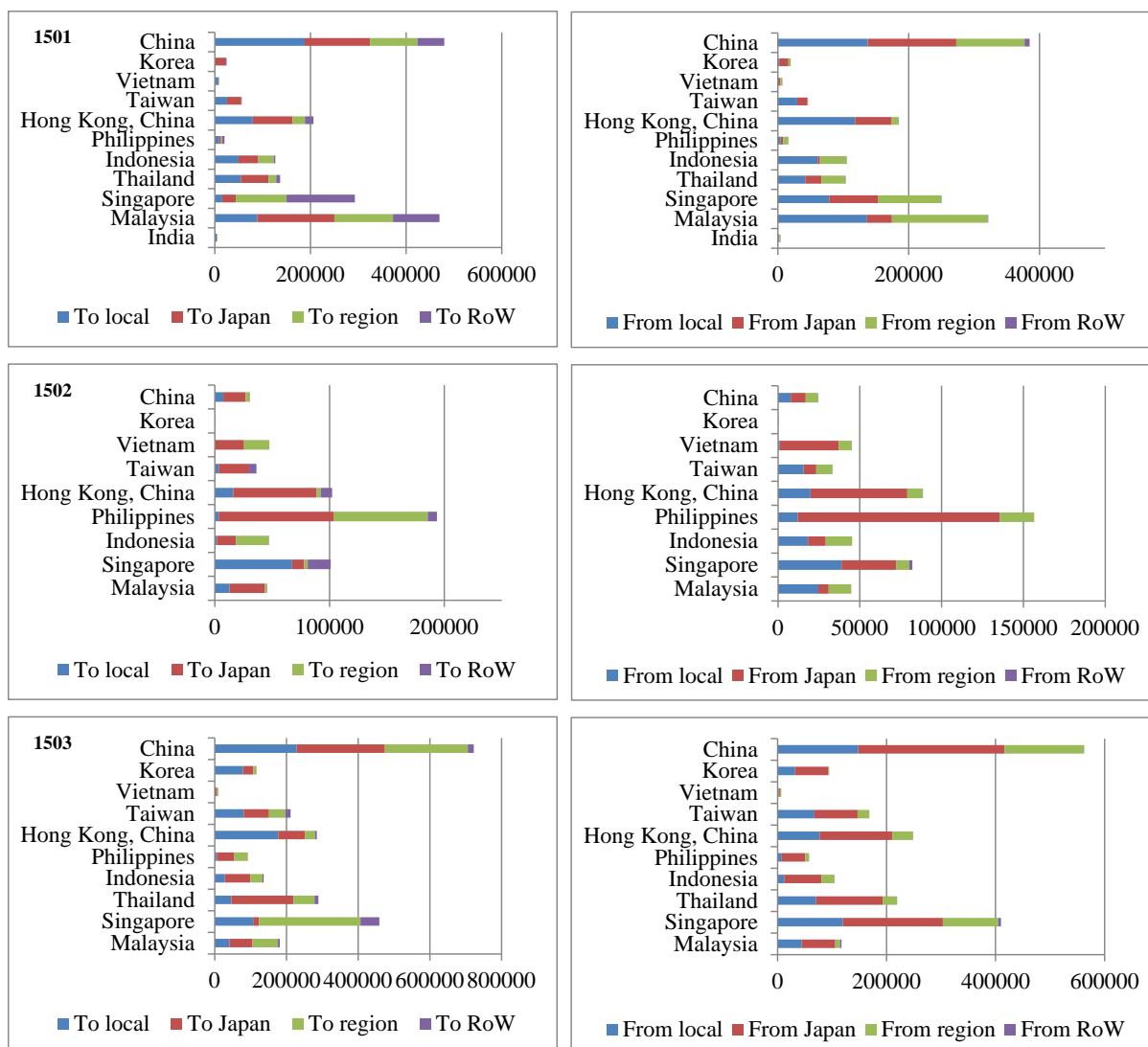
The chart arranges the sectors by order of importance of local sales. The Motor vehicles sector is the top sector on this dimension (largely due to trade, investment and industry policies aimed at promoting local production, or at least local assembly, of autos and small trucks. Averaging across all host nations, over 80% of the output is sold locally, but only 60% of the inputs are purchased locally. At the other end of the scale we have office and household machines where only about a fifth of output is sold locally. A very large share is sold to Japan and about 15% is sold to third markets. The networked feature of FDI in this sector can be seen by noting that about 40% of the inputs are imported. This strongly suggests that affiliates in this sector are involved in an international production network where some parts are imported from Japan or third nations in the region, while the best part of output is sent back to Japan.

Electronic equipment is another sector where FDI seems to be networked. Almost 75% of intermediates are imported by these affiliates (about half of this from Japan) and about 70% of the output is exported – mostly to other nations in the region. Similar patterns can be found in computers (electronic data process machines), electronic parts and devices, other transport equipment, precision instruments (watches and other precision instruments).

### 4.1.2. Focus on electronics in Asia and Europe

To zoom in more closely on a sector where we expect network FDI to feature strongly in the data, we narrow our focus to the three electronics sectors in our data sector and limit the analysis (in this draft) to 2005. As we are only looking at three sectors, we can breakdown sales-sourcing pattern by nation (but aggregating over all affiliates in each host nation). We start with the most networked of all the regions, namely Asia.





**Figure 12: Networked FDI in Asia, electronics sectors, 2005.**

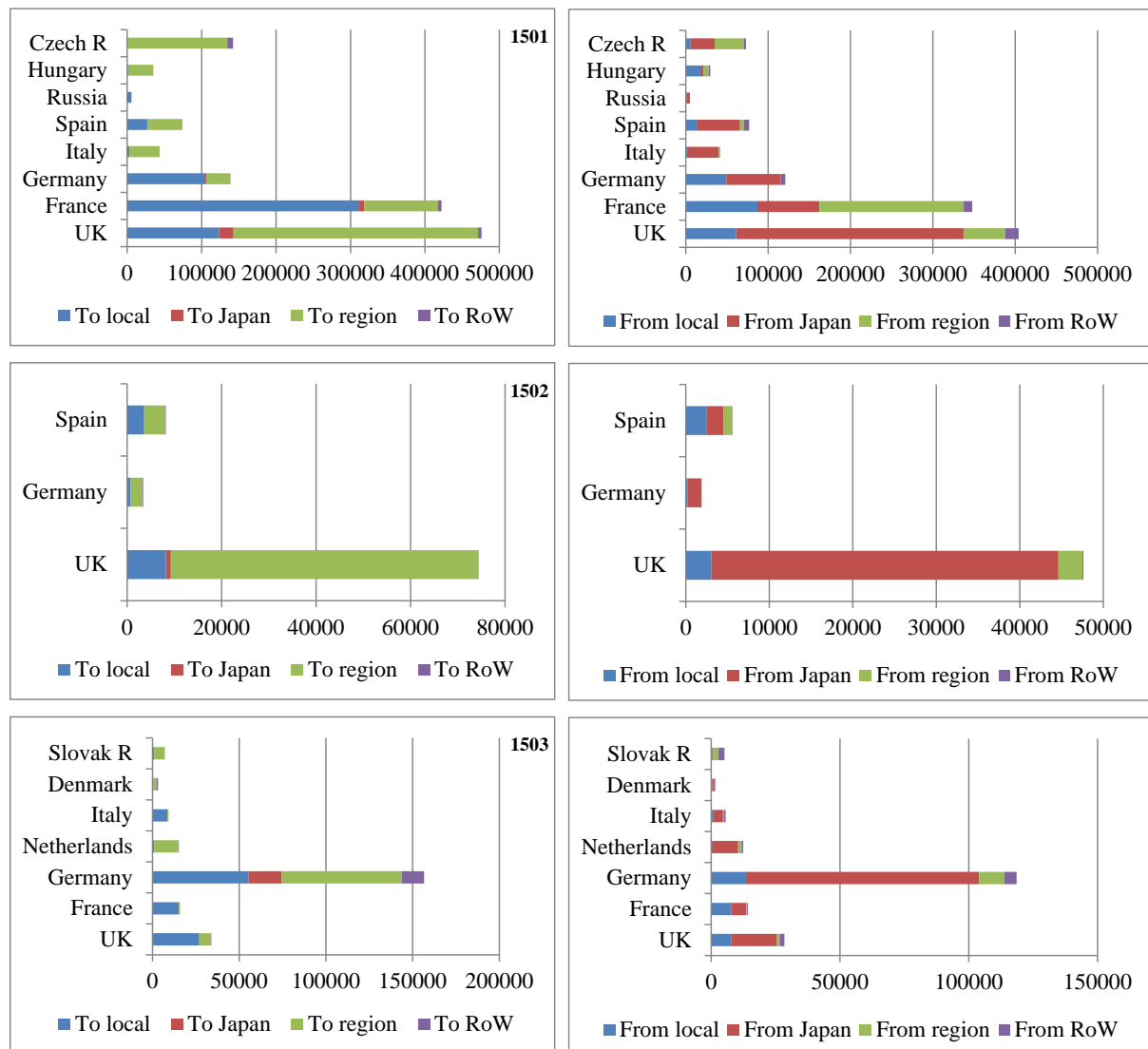
*Note: The left panels show sales; right panels show sourcing; 1501 is ‘Communication equipment and related products’ (final goods including phones, fax, radio, TV, stereo, tape recorders, Karaoke machines, etc.); 1502 ‘Electronic data processing machines, digital and analog computer, equipment and accessories’ (final goods), and 1503 is ‘Electronic parts and devices’ (parts and components such as semiconductors, tuners, transistors, condensers, etc).*

Starting with the sales pattern for phones and related products (top left panel marked 1501), we see that except for China, most of Japanese affiliates’ sales are not local. Much is exported back to Japan, to other Asian nations, or to the EU or the US. The export to non-Asian markets however is quite marginal; the vast majority of sales are regional. An even more extreme regionalization of the supply chain shows up on the sourcing side (top right panel). Virtually all the inputs purchased by affiliates located in an Asian nation are from Asia itself. Local purchases are small; except in Hong Kong.

This is clear evidence that ‘global value chains’ is a misnomer; value chains in Asia are regional, not global. The regionalization of sales-and-sourcing in computers (two charts in the middle panel) is even more marked. With the exception of Singapore, very little of the computer production is sold locally – almost all of it is exported to other Asian nations with Japan been a very large importer. When we compare the sales pattern with the sourcing

pattern, we see that Japan is also a very large supplier on intermediate inputs into computers. Taken together this suggests that computers is a classic case where Japanese computer makers offshored some aspects of their production line to nearby, low-cost Asia locations but maintain substantial production of intermediates at home.

The bottom panels, marked 1503 (the code for the electronic parts and devices sector) displays a somewhat higher local sales share but the same very high import shares of inputs from other Asian nations, especially Japan. As these are parts, the local sales must be feeding into a supply chain.



**Figure 13: Networked FDI in the EU, electronics sectors, 2005.**

Note: see note to Figure 12 for category definitions.

The networked FDI features we saw in Asia are partly present in the EU, as Figure 13 shows. When it comes to parts (bottom panel marked 1503), most of the output is exported and most of this to other EU nations. The UK is an exception with local parts sales dominating. The sales of phones (top panel) and computers (middle panel) shows are remarkable emphasis on local and regional sales. Apart from small slivers of sales back to Japan, virtually all of the

output of these sectors is sold in the EU. Among the EU nations, however, there are important differences. Some nations, like the Italy, Czech Republic and Hungary, are classic export platforms with basically all their output exported to other EU nations. Others, however, such as Germany, France and the UK show a mix of local and export sales.

The pattern for computers (middle panel) is quite stark. The UK is the dominant host nation and it imports almost all of its intermediates from Japan while exporting almost all of its output to other EU nations. This suggests that the manufacturing of Japanese computers in the UK is basically an assembly operation.

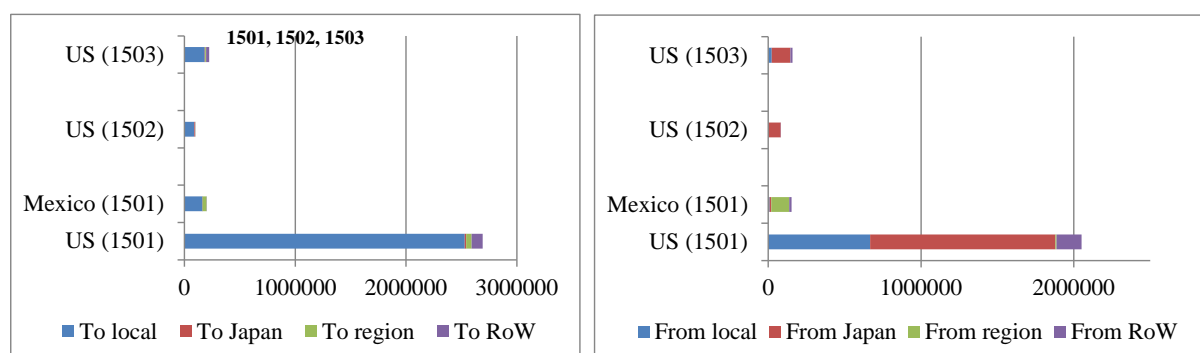
#### 4.1.3. Focus on electronics in the US: The odd man out

The broad similarity of sales-sourcing patterns in Asia and the EU stands in stark contrast to the US pattern.<sup>7</sup> In short, Japanese affiliates in the US do not seem to be engaging in international production chains. The pattern is much more reminiscent of import-substitution assembly. Figure 14 shows the facts.

Since the FDI pattern in North America is so simple (it is mostly in the US), we can show all three electronics sectors in one figure. In the parts sector (1503) and computers (1502), the US-based affiliates buy almost 100% of their intermediates from Japan and they sell almost 100% of the output in the US. In essence, the US-based FDI is basically assembling parts from Japan into final goods – presumably to avoid importing the final goods directly. This is not pure horizontal FDI, since there is almost no local purchasing of intermediates. In the phone sector (1501), however, the US-based Japanese affiliates buy about a third of inputs locally with the rest imported from Asia, with Japan playing the dominant role. On the sales side, the pattern is almost 100% local sales.

The only hint of networked FDI in North America is found in Mexico, where the affiliates import 100% of their inputs from the region (which must mean from the US given the lack of Canadian production).

Once again, we see that FDI in the US is quite different than in other regions. This suggests caution when interpreting empirical studies that rely on inward and outward US FDI.



**Figure 14: Electronics FDI in the US, electronics sectors, 2005.**

Note: see note to Figure 12 for category definitions.

<sup>7</sup> We note that this discussion hinges on the boundary of nations and regions. The US is a large economy and composed of 50 states. If the data is disaggregated at the state level, results might change and be closer to EU case. Likewise, if EU (or Euro) member countries are aggregated as one country, our results in the European case might change.

#### 4.1.4. Focus on auto sectors

To give a flavor of the vast range of multinational activity – and thus strengthen our warning against taking seriously the broad generalizations that often emerge in the empirical literature – we look more closely at the auto sector nation by nation (grouped by the three main FDI hosting regions, Asia, the EU and the US).

Figure 15 shows the facts for motor vehicles and auto parts for the eight Asia nations with significant FDI production by Japanese affiliates. Looking at the right panels we see that sales in the auto sectors are dominated by the local market. This is the polar opposite of the electronics industry where exports were the main business of the affiliates. The local market emphasis is stronger in final vehicles than it is in parts, but in both sectors the lion's share of sales is made inside the host nation. Thailand is an exception with about a third of its sales exported, much of it the US and the EU. The sales pattern in autos is more international on the whole and some Asian nations, such as Vietnam and the Philippines, export their entire output. Another key difference is the importance of the Japanese market as a destination for auto parts. While this is always a moderate share (except for Vietnam), it is significant in most host nations. Vietnam is perhaps the classic example of what seems to be offshoring of one segment of the Japanese auto production line. Japanese affiliates in the country import basically 100% of intermediates from Japan and sell basically 100% of their output back to Japan.

The source side (right panels) shows more elements of production networks, with Japan playing the largest role. However, with some exceptions (Philippines, Pakistan), a very large share of intermediates are sourced locally; the share is usually over 50%.

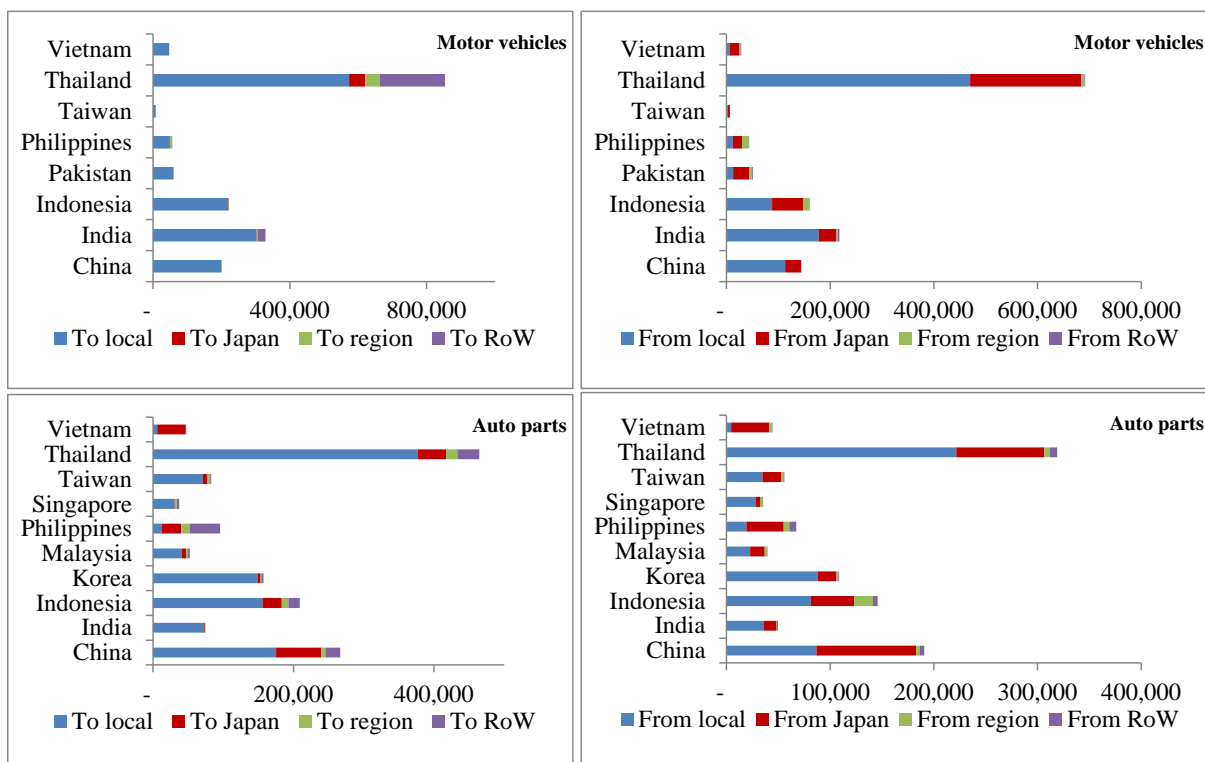


Figure 15: Sales & sourcing, auto sectors, Asia, 2005.

Corresponding numbers for the EU are shown in Figure 16. On the sales side (the left panels), we see a dominance of local and regional markets as in Asia, but in Europe it is even stronger. There are only negligible sales of autos or auto parts beyond the region. On the sourcing side, the pattern difference sharply between the final goods and parts. In several of the nations, especially the Netherlands, Hungary and Turkey, an import fraction of intermediates in the auto sector come from local or region sources. This suggests that there is something of a regional production network going in the EU when it comes to final autos. Auto parts, however, is marked by more of a local assembly pattern. With the exception of affiliates located in France, all of the host nations import the bulk of their intermediates from Japan or the rest of the world (mostly Asian nations).

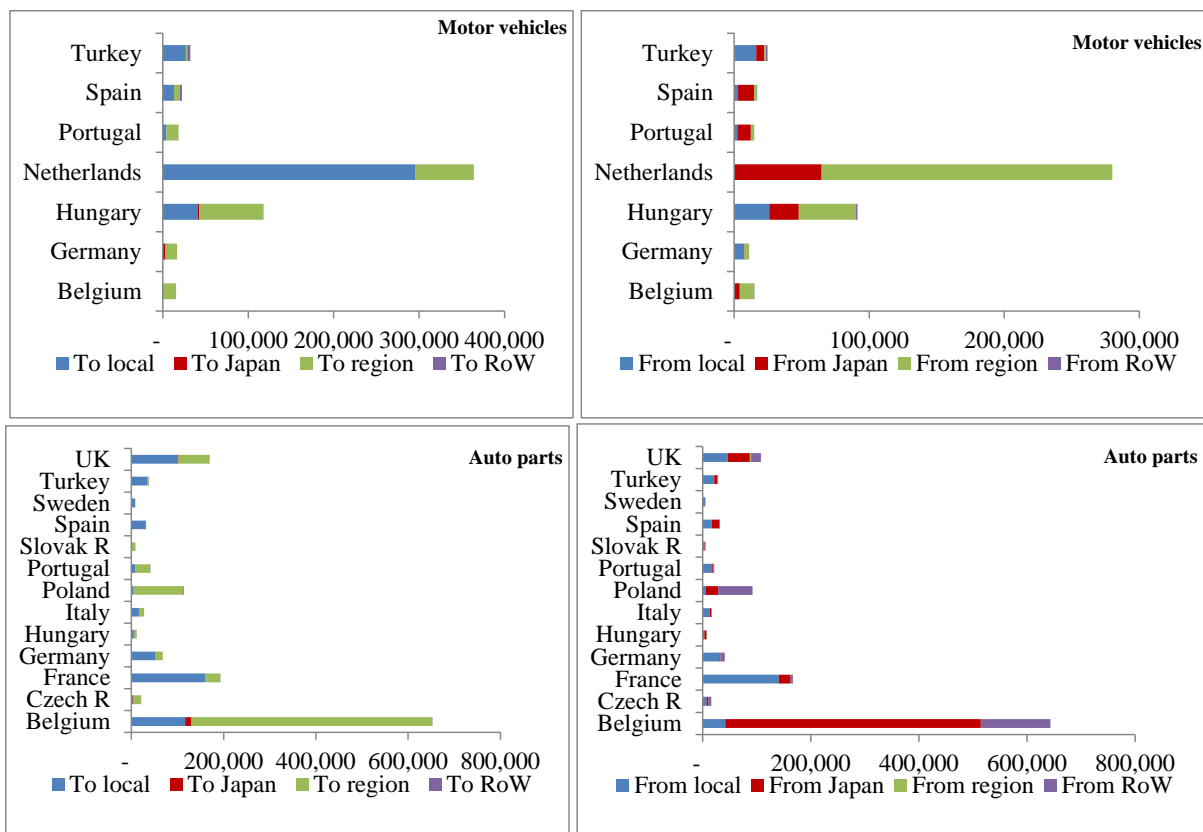
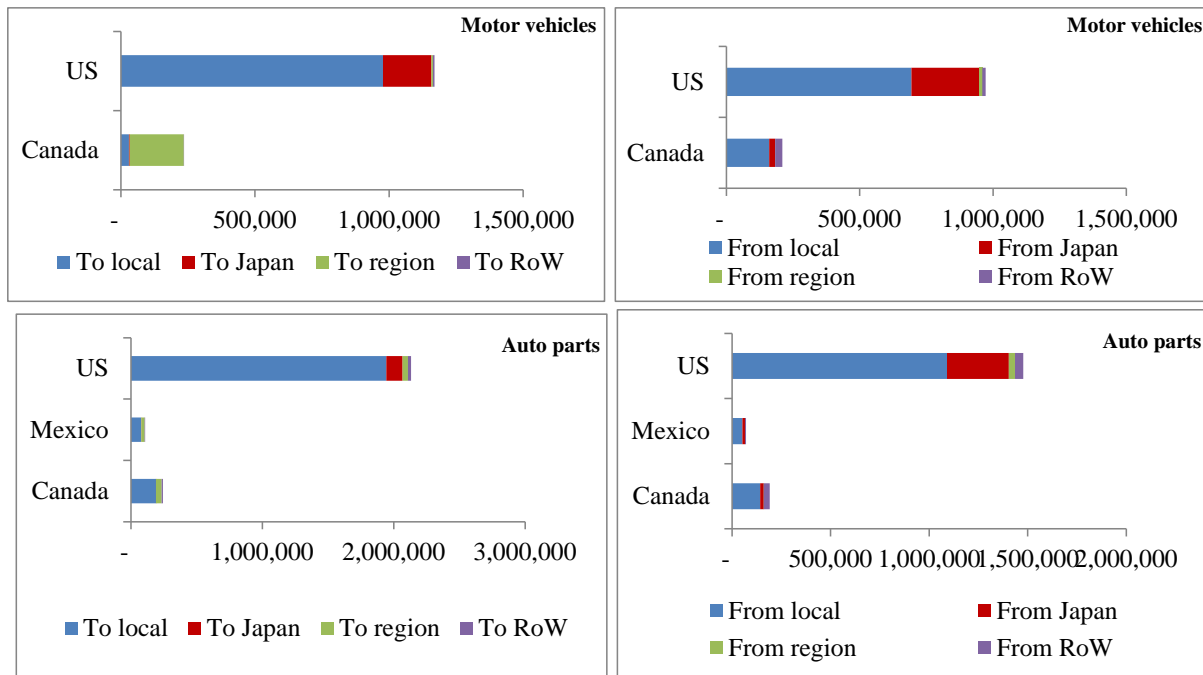


Figure 16: Sales & sourcing, auto sectors, EU, 2005.



**Figure 17: Sales & sourcing, auto sectors, US, 2005.**

Finally we turn to North America, where auto FDI looks very much like a rather pure form of horizontal FDI, at least from the regional perspective. As the right panels reveal, that vast majority of auto sector output, both parts and final vehicles, is sold inside North America. Japanese affiliates in final autos are clearly acting as export platform for the US market. On the input side, local purchases dominate parts and final goods production in Canada, Mexico and the US, although something like 20% of the intermediates from Japan.

Overall, we see that auto sector FDI sales are highly regionalised on the sales side. Most of the vehicles and parts made in a region are purchased in the same region. On the sourcing side, Asia and North America are quite regionalised, i.e. most of the purchased inputs are from the region itself. In autos, Europe is the outlier, on the sourcing side; most of its purchased inputs come from outside the region.

## 5. Theory and testable hypotheses

Most recent testing of FDI theory is indirect. The empirical strategies embraced in the seminal Carr, Markusen and Maskus (2001) article and its critique by Blonigen, Davies and Head (2003) and several follow-on studies seek to identify the 'motives' for FDI. The two contenders are 'market seeking' or 'efficiency seeking' (i.e. horizontal or vertical FDI respectively).

Using a hybrid model that allows horizontal and vertical FDI, Carr, Markusen and Maskus (2001) regress multinational activity by host-country against macroeconomic indicators of host-versus-home country features. For horizontal FDI the basic indicator is economic mass – basically the size of the host and home GDP. The idea here is that if FDI activity in a particular host country is boosted by the size of that nation, it must be that the affiliates are seeking markets. That is, they must be in that host nation are there to sell to the local market. For vertical FDI the indicators relate to endowment differences between the home and host nations. The thinking here is that FDI activity that is encouraged by such differences must be

seeking efficiency, i.e. a production locale with different comparative costs. Davies (2008) is a more recent entrant in this line of attack.

This indirect estimation strategy was a brilliant advance on earlier studies that were flawed by massive problems of measurement of FDI flows or stocks, and a lack of direct connection to FDI theory. Given our discussion in the theory section above, it would seem that there is a far more direct way of testing FDI theories. To give a couple of extreme examples, consider the case of Vietnam in the auto parts sectors. Japanese affiliates in that nation import 100% of their intermediates and re-export 100% of their output back to Japan. Given this pattern, and the nature of the sector (intermediate goods), it is absolute obvious that this FDI is efficiency-seeking rather than market-seeking. The key clue, however, was not in Vietnam's factor endowment – it was in the sales-sourcing pattern of the affiliates.

At the other extreme, Japanese affiliates in the auto parts sector buy only 24% of intermediates from outside NAFTA and sell 93% of their output inside NAFTA. Again this is plainly a case of market-seeking FDI, but the telltale lies not in macro indicators – it lies in the trade behaviour of affiliates. More generally, under pure horizontal FDI, production is placed abroad to economize on trade costs – not to take advantage of the host-nation's comparative advantage. Under pure vertical FDI, production is placed abroad only to lower production costs. The most obvious empirical lever to separate the two motives is the existence of trade in intermediates between the home and the host nation. In the knowledge capital model, it would be simple to prove a theorem that states that even minor trade costs mean that no intrafirm trade arises unless the FDI is motivated in part by efficiency-seeking. If the foreign affiliate buys any intermediates at all from the home nation, we know that the multinational has found it advantageous to divide the production process between the home and host nation. Straightforward revealed preference arguments then tell us that the production cost of the divided production process must be below that of producing the product all in the home, or all in the host nation. Since this exploitation of multi-nation comparative advantages is the hallmark of vertical FDI, we know that the presence and any sourcing of intermediates from the home nation indicates that the FDI is at least in part vertical FDI.

### **5.1. Testing FDI theories with affiliate trade data**

This line of reasoning needs to be developed more fully, but it seems that using affiliates sourcing and sales behaviour will provide a more refined test of FDI theories. Here are some testable hypotheses related to the trade-data approach to testing FDI.

- Affiliates' sourcing of intermediates should be increasing in indicators of the comparative advantage difference between the home and host nations.
- The location of affiliates should be subject to 'multi-nation effects' (a generalisation of third-nation effects) on the sales side – something like a market-potential index could pick this up – and on the sourcing side – something like a price index of imported intermediates could pick this up. Alternatively, one might use a distance weighted measure of the endowment differences (with the home nation) of the candidate nation's neighbours, or a distance weighted measure of the related-parts exports of neighbouring nations.

In short, in the world of networked FDI, affiliate location should be driven by backward and forward linkages; modelling this could be done with a new economic geography model with vertical linkages.

## 6. Concluding remarks

The dominance on the theory side of North-American inspired modelling (horizontal versus vertical FDI) and on the empirical side by US MNC data has resulted in a belief that FDI is mostly motivated by ‘horizontal’ or market-seeking goals. This paper suggests that this is almost exactly wrong in the Japanese MNC data – we see evidence of pervasive vertical, or efficiency-seeking FDI, and very rare evidence of pure horizontal FDI.

Our divergence conclusions stem from two key differences. First, we note that the standard view is based on a rather indirect empirical strategy when it comes to testing FDI theories. Most papers seek to determine whether FDI activity (typically affiliate sales) are stimulated by market-seeking motives (horizontal) or efficiency-seeking motives (vertical), or a combination of the two (complex FDI) using macro data (GDP, endowments, etc) not micro data. We suggest that a very literal reading of the theory points to a very different empirical levers for distinguishing horizontal and vertical FDI, namely the sales and sourcing patterns of affiliates. We argue that affiliates’ purchases of non-local intermediate goods (despite positive trade costs) indicates that it is cheaper to undertake some but not all production stages in the host nation. Likewise, exports back to the home country despite trade costs suggest that separating manufacturing stages lowers the cost of production. Likewise, the share of affiliate sales to the local market are perhaps the most natural indicator of horizontal FDI, with pure horizontal FDI requiring 100% local sales.

Using these levers, we find three key findings. First, FDI in almost all sectors and almost all nations involves some ‘vertical-ness’, and some ‘horizontal-ness’, i.e. the sales-sourcing patterns involve share midway between 0% and 100%. Second, in many nations and many sectors, the Japanese affiliates have sales and sourcing patterns that suggest that individual affiliates are part of a production network. This ‘networked FDI’ may be a very interesting phenomenon to study from a theory, empirical and policy point of view since it suggests that ‘regional comparative advantage’ (basically third-nation effects on the supply and demand sides) may be an important consideration in crafting and evaluating national FDI policies. Third, our data systematically show affiliates in North American have quite different sales-sourcing patterns compared to those in Asia and Europe. Specifically affiliates in North American have sales-sourcing patterns that are far more in line with horizontal FDI than those in Asia and Europe. This suggests that strong conclusions from US MNC data may have to be tempered before they are applied to the rest of the world – especially developing nations.

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## Appendix: Classification of sectors

**Table 2: 6-way classification of sectors**

### **Primary**

Forestry  
Fisheries and Aquaculture  
Metal mining  
Construction  
Food Manufacturing  
Beverage Manufacturing  
Prepared animal foods and organic fertilizers  
Light manufacturing  
Silk-reeling industry, spinning mills  
  
Woven fabric mills, knit fabrics mills  
Other fiber manufacturing  
Apparel and other textile products  
Chemical fibers  
Lumber and wood products  
Pulp, paper  
Paper products  
Chemicals  
Chemical fertilizers  
Inorganic products  
Organic chemicals  
Oil and fat products, soaps, synthetic detergents, surface-active agents and paints  
Drugs and medicines  
Cosmetics, toothpaste, and other make-up goods  
Other chemical and allied products  
Petroleum refining  
Other petroleum and coal products  
Metal and metal products  
Glass and its products  
  
Cement and its products  
  
Other ceramic, stone and clay products  
Iron and Steel  
Miscellaneous iron and steel  
Smelting and refining of non-ferrous metals  
Non-ferrous metals worked products  
Fabricated constructional and architectural metal products, including fabricated plate work and sheet metal work  
Other fabricated metal products

### **Machinery**

Metal working machinery  
Special industry machinery  
Office, service industry and household machines  
Other general industry machinery and equipment  
Industrial electromechanical apparatus manufacturing  
Household electric appliances  
Electronic equipment  
Other electrical machinery equipment and supplies  
Communication equipment and related products  
Electronic data processing machines, digital and analog computer, equipment and accessories  
Electronic parts and devices  
Motor vehicles  
Auto parts and accessory manufacturing  
Other transportation equipment  
Optical instruments and lenses  
Watches, clocks, clockwork-operated devices and parts  
Other precision instruments and machinery  
Furniture and fixtures  
Printing and Allied Industry  
Plastic products  
  
Rubber products  
Manufacturing industries, n.e.c.

### **Services**

Electricity, Gas, Heat Supply and Water  
Communications Industry  
Broadcasting Industry  
Information services  
Internet supplementary services  
Railway transport, road passenger transport, road freight transport, water transport, air transport  
Warehousing, services incidental to transport  
Wholesale trade  
Retail trade  
Finance and insurance  
Real estate  
  
Restaurants  
Lodging industry  
Professional services  
Goods rental and leasing  
Advertising industry  
Other services