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Where is the Value Created and Captured in Manufacturing Firms? Case Precision Machinery Product

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Manufacturing still matters and continues to be of importance to nations and to firms' strategies even in contemporary unbundled world (Skinner, 1969; Cohen & Zysman, 1987; Zysman et. al. 2012). Furthermore, manufacturing is considered critical for economic growth, national productivity, and international trade in goods, services, and other intangible assets such as knowledge. The importance of manufacturing and its link to corporate strategy is complex and appears to vary by firm, industry, technology, and product. Moreover, the role of the manufacturing in firm strategy is evolving.

Introduction

One of the greatest changes in firms' manufacturing strategies has been the manufacturing unbundling that began in the 1980s (Fukao et. al., 2003; Baldwin, 2006). Accompanying the manufacturing unbundling was the movement of an increasing proportion of the physical manufacturing to lower income nations. Firms use differing combinations of captive and independent suppliers organized into global value chains. Another outcome of this globalization is that the internal supply chains cross international borders. Manufacturing of each component, subassembly, final product and respective service bundle can potentially be opened for global competition, (see, for example, Tan et al, 2002; Kenney and Florida 2003; Buckley & Ghauri, 2004, Everatt & Baldwin, 2012). Each stage is increasingly capable of being undertaken in a number of geographies. The corporate siting decision is made according to a complex set of decision variables, including labor, transportation and inventory costs, quality considerations, the appropriate geographical location of inimitable knowledge, proximity to appropriate suppliers and end customers, and government subsidies and tax breaks. the result has been a dispersion of job tasks, value-adding activities, and their resultant profits internationally and across firm boundaries (Kenney and Florida 2003; Mudambi, 2008; Seppälä, 2013). Finally, this cross-border distribution of internal productive activity provides firms with transfer pricing opportunities or, put, more provocatively, makes transfer pricing almost impossible to avoid.

This case illustrates the unbundling of manufacturing stages in terms of the global distribution of value added. We examine the of the input costs and profits for a single precision machinery product in European firm and suggest that the generation of value added is crucial for understanding contemporary globalization. This case is based upon invoice-level internal data, and it is the granular level of our data that allow us to contribute to greater understanding of transfer pricing and the location of profits in global supply chains. Our particu-

lar product the firm has final assembly facilities in North America, Europe, and Asia. It is from these facilities that the final regional market is supplied. The final product is composed of six sub-assemblies, with five of these made in China and one made in Europe (see Figure 1 for global value chain).

Case – Final assembly in Europe and Asia

In Table 1, the total sum of the value added equals the product sales price for another the firm (e.g., 10.000€ (indexed) = 100% of value added). The final product sales price is without taxes. The sales price of the product is then divided between the different participants in a global supply chain according to the data received from the focal firm and data inferred regarding suppliers (see value added column in Table 2). As Table 1 indicates, when the product is assembled in Europe and distributed to the European market, the inputs are 65% (6.500€ indexed) of the total cost of the finished product, while profits comprise 35% (3.500€ indexed) of the total cost, and respectively 42% (4.200€ indexed), and 58% (5.800€) when final assembly in Asia. The actual cost of inputs and profits is then distributed between the global supply chain participants according to the data received from the case companies (see input costs and profits columns in Table 1). The profits equal earnings before interest and taxes (i.e., EBIT). In the accounting system, assembly accounts for the largest portion of the value added. Because this firm has chosen to treat final assembly as the profit center, it appears to pro-

Figure 1 Value chain with final assembly in Europe and Asia

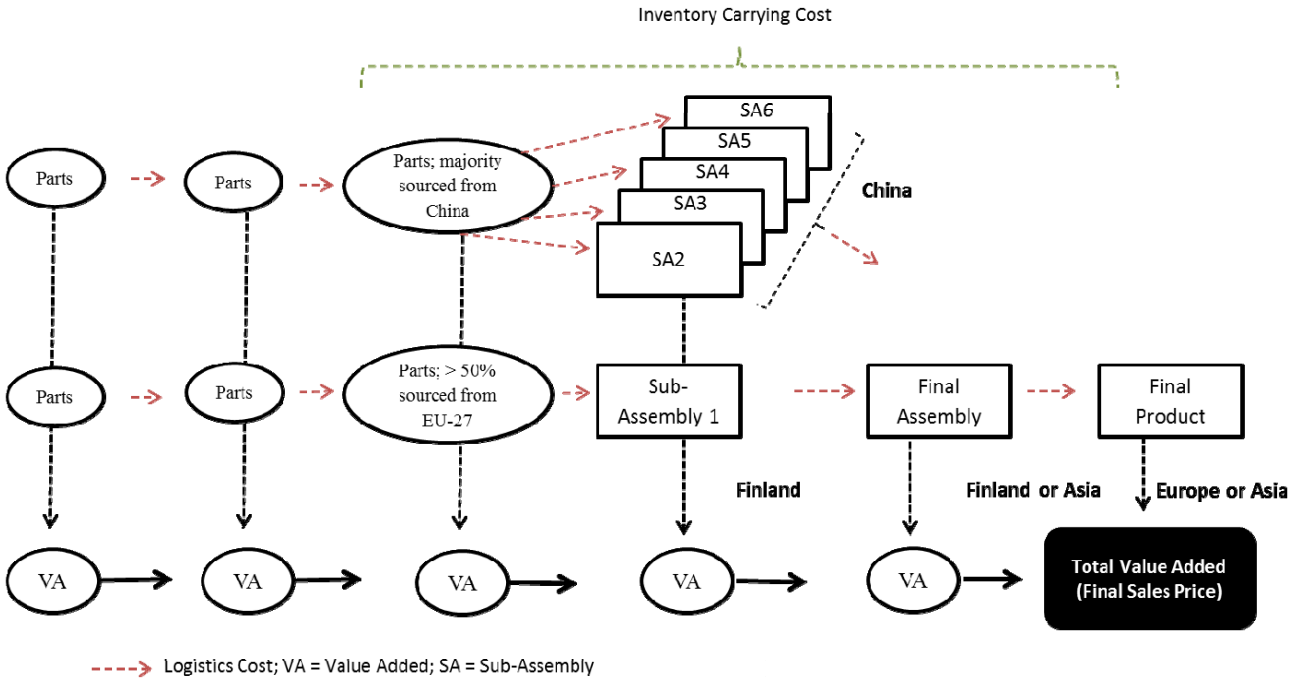

Table 1 Distribution of value added, cost of resource, and operating profit in Europe and Asia

	Total Cost (in percent)		Input Costs (in percent)		Profits (in percent)	
	Europe (10.000€)	Asia (10.000€)	Europe (6.500€)	Asia (4.200€)	Europe (3.500€)	Asia (5.800€)
Sales and Distribution	10	14	16	8	-1	19
Outbound Logistics	4	3	6	7	1	0
Headquarters	3	3	5	6	0	0
Manufacturing (excl. HQ)	49	54	26	23	90	77
Inventory Carrying Cost	1	3	1	7	0	0
Inbound Logistics	7	2	9	5	1	0
1-tier Suppliers	9	7	12	16	5	2
Other tiers	17	12	24	28	4	2

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duce the bulk of the profits. Furthermore, because all of these operations are internal, even though we have access to the invoices, we cannot identify the location of the greatest value added. Moreover, because there is no market for the various sub-assemblies, there is no external market comparison.

In the case of the firm, when the final product is assembled in Europe and Asia, and distributed to either of those markets, manufacturing is the largest contributor of value added. In case of Europe, the five other sub-assemblies are imported from the firm's Asian factories, as are the parts necessary for the final assembly. Nearly all of the Asian-sourced components are low-technology standard inputs.

Geographical distribution of value added, inputs of cost, and profits

When we shift our perspective from that of the firm to that of the nation, a different pattern can be observed (see Table 2). If final assembly is undertaken in Europe, then 64% of the total value added occurs there. In the case of final assembly in Asia, 77% of the total value added occurs there. Because suppliers are small and, for the most part, provide standardized parts and because profits are allocated to the assembly factory, the location of final assembly has a significant impact on the location of the value added. To illustrate, the European share of value added drops from 64% to 15% if the location of the final assembly is Asia. Because of the large number of modules and other components sourced from Asia, Europe and Asia have a similar share of the total value added, 18%. This is paradoxical, because the assembly process is extremely simple and requires fewer trained personnel particularly when compared to the European sub-assembly factory.

The high value-added exhibited by the Asian operations can be explained by what has been a steady transfer of various lower value-added sub-assembly manufacturing operations and the presence of an assembly facility in Asia. An important factor in lowering the value-added of the European operations is the logistics and inventory costs. In summation, if the product is assembled in Europe the product value added is 65% of its total inputs and 35% of its value capture. When the product is manufactured in Asia the product value added is 42% of its total cost of resources and 58% of its value capture.

Table 3 shows the differences between three final assembly locations and how the input costs are in distributed internationally. If final assembly is located in Europe, then 48% of total input costs are derived from Europe. In the case of Asia, 48% of the value added is national. Hence the indexed sums that are being divided vary from final assembly location to another. The location of a final assembly has a significant impact on input of costs particularly in the case of Europe. This is due to inventory and logistics costs.

Ultimately, the geographical distribution of the profits reflects the decision by the firm to have its final assembly operations capture the profits. This illustrated in Table 4. For example, if final assembly is in Europe, then it is the location for 92% of total profits. When assembly is undertaken in Asia it appears as though 98% of the total profits are generated in Asia, despite the fact that the single most valuable module is produced in Europe. The details of the geographical distribution of the profits are illustrated in Table 4. Thus profitability is an artifact and, almost certainly, does not reflect reality.

Table 2 Geographical distribution of value added (Europe versus Asia)

	Value added – Europe (in percent) (10.000€)	Value added – Asia (in percent) (10.000€)
Europe	64	15
Asia	11	77
Americas	2	0
EU-27	19	6
Other	4	3

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Table 3 Geographical distribution of input costs (Europe versus Asia)

	Cost of European inputs (in percent) (6.500€)	Cost of Asian inputs (in percent) (4.200€)
Europe	48	32
Asia	14	48
Americas	3	0
EU-27	28	13
Other	6	6

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Table 4 Geographical distribution of profits (Europe versus Asia)

	Profits – Europe (in percent) (3.500€)	Profits – Asia (in percent) (3.800€)
Europe	92	2
Asia	5	98
Americas	0	0
EU-27	2	1
Other	1	0

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Discussion

Manufacturing and its link to firms' value creation and profits continue to be stronger in industries, like precision machinery, where the technology and product life cycles are longer than in industries like electronics gadgets with shorter technology and product life cycles and existing regimes of appropriability. In the case of this precision machinery manufacturer, manufacturing and, in particular, assembly is treated as the locus of profit appropriability. From our analysis, it could just have easily been shifted to the sub-assembly operations or, probably, more realistically, to the sub-assembly produced in Finland. We turn to the learnings from this case study below:

The first notable result is how, almost counter-intuitively, the profits are concentrated in the assembly facilities, despite the fact that they are simply kit assembly operations. The invoice-level component data shows that the module produced in Europe has the highest value-added components and software and is the focus of nearly all of the corporate R&D. The decision to allocate "profits" to the assembly facilities provides an unrealistic impression of where the greatest value is added and the firm's profits are generated. It disguises the true role of European module not only in generating the overall profit, but also in ensuring that the firm retains control over the value chain. This is of vital importance, because the European sub-assembly factory understakes the most IP and trade secrets-rich production. The other interesting observation is that the retention of production of the key module in Europe ensures that European suppliers can continue to operate in Europe.

The Asian operations are limited in their ability to upgrade their production, because of the centralization of the value-added in the European module. Oddly, as an artifact the transfer pricing scheme, the Asian operations appear to be the most profitable because the five modules (which are quite bulky) are made domestically, there are minimal inventory and logistics costs, and the local assembly operation gets allocated the profits. From this accounting perspective, Asia would appear to be the most successful and important operation. However, this perception is a function of the accounting system; more than the reality of the firm's operations.

This odd situation may also be explained because our firm has globalized relatively recently, so its accounting systems may misrepresent where value is created and where it is recognized. This was not a significant issue when both final assembly and module production were centralized in Europe, but with globalization, the distortion becomes more obvious. There is a possibility that firm may rework its accounting system to more accurately reflect the location of the greatest value creation and thus profitability.

This precision machinery firm has organized its value chain quite differently than those in the personal computer and cell phone industries where most assembly activities have been offshored and/or outsourced (see, for comparisons, Mudambi, 2008; Dedrick et. al. 2009, 2011; Ali-Yrkkö et. al., 2011). It is possible that our firm could also contract out the production of the five simple and low value-added assembly operations, but thus far it has chosen to keep them internalized to guarantee quality and control access to knowledge about its production activities. This contrasts with electronics "gadget" assembly that many firms have decided offer little competitive advantage and are not part of the core competencies. Our precision machinery firm has not chosen this strategy.

This case study suggests that while much of the recent literature has criticized the more integrated Chandlerian firm model as being inefficient and that firms would become more profitable by focusing on their core competencies our firm has chosen to retain module production in-house. Further, in contrast to many firms particularly in the U.S that have engaged in tax reduction strategies that include striking efforts to relocate profits to low tax rate regime nations, this firm has not adopted this strategy

It is remarkable that the literature on "value" chains has not explicitly studied transfer pricing, as it is critical for understanding the contours of global trade.

Our final observation is that the focus on the electronics and apparel industries, while providing much welcome information and insight, overlooks the manufacturing industries that developed nations with high-quality, high-wage workforces may have the greatest advantage in retaining. Moreover, these industries, with their high wages, can help address the increasing wage inequality that plagues a number of developed nations. Whereas, before many precision machinery products had very long life spans and minimal innovation, today these products are information- and design-rich true high-technology products with shorter life cycles thereby providing attractive business prospects.

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