

Slicing Up Global Value Chains: a Micro View

Jyrki Ali-Yrkkö · Petri Rouvinen

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Abstract Global value chains, GVCs, have had a transformative impact on the world economy since the early 1990s. We study 45 specific GVCs with company-confidential invoice-level data. We find that the case companies' headquartering functions capture a large share of the overall value added, 27 % on average. The value added shares of other functions are as follows: distribution 21 %, final assembly 16 %, and logistics 5 %. The remaining 30 % of the value added goes to vendors. Upon considering value added by country, we find that the home economy's share is 47 % on average. This share is reduced with offshored—as opposed to Finnish—final assembly: 2 percentage points for a high-end smartphone, over ten percentage points for a low-end feature phone, and 27 percentage points for machinery and metal products. We attribute the latter large drop to co-location of non-assembly functions, intellectual property issues, transfer pricing, and profit allocation. We conclude that GVCs are complex and heterogeneous; value chains of basic products and services are not nearly as global as those of advanced ones; and the value added share of wholesaling and retail is large in consumer products. We nevertheless argue that value added is less tied to assembly—and other tangible aspects of GVCs—than conventional wisdom suggests; the intangible aspects—market and internal services, and creation and appropriation of intellectual property—are more important. The increasing presence of GVCs brings about several thorny policy issues that are yet to be addressed.

Keywords Global value chains · Case studies · Finland · Transfer pricing · Economic policy

JEL Classification D23 · F23 · L14 · M11

1 Introduction

On 22 September 1996, the *Los Angeles Times* provided a shocking piece of news: only 3.5 % of the \$10 overall value added of a “Tea Party” *Barbie doll* (Mattel Inc.) remained in the location suggested by the “*made in...*” label of mainland China (Tempest 1996). Subsequently,

J. Ali-Yrkkö · P. Rouvinen (✉)

ETLA, The Research Institute of the Finnish Economy, Lönnrotinkatu 4 B, 00120 Helsinki, Finland
e-mail: Petri.Rouvinen@ETLA.fi

J. Ali-Yrkkö
e-mail: Jyrki.Ali-Yrkkö@ETLA.fi

this line of inquiry has largely concentrated on high-end electronics (see, e.g., Ali-Yrkkö et al. 2011; Dedrick et al. 2010; Linden et al. 2011, 2009), although other products have been analyzed as well (for reviews, see Kenney 2012; Sturgeon et al. 2013).

Since the Barbie incident, scholarly discussions have been significant in disciplines ranging from economics and business studies to geography and sociology. The impact of *global value chains* (GVCs) has been transformative. Cattaneo et al. (2010, p. 7) note that "... GVCs have become the world economy's backbone and central nervous system." Backer and Miroudot (2013) note that over half of global trade currently consists of transactions in the context of GVCs and yet, this perspective has not been fully recognized in the public debates about labor market and trade policy, as many politicians and even experts still presume that goods and services are produced in one well-defined location. In reality, however, all but the most basic products are an assemblage of inputs sourced from around the world.

Timmer et al. (2014) provided a macro-view of the "made in the world" phenomenon and used the World Input–Output Tables (Dietzenbacher et al. 2013) to document the rapid fragmentation of production and increasing value-added share being captured by the owners of capital and highly skilled labor since the early 1990s. In addition, these researchers also noted that the developed countries increasingly specialize in functions carried out by highly skilled workers and that the developing countries have increased their specialization in capital-intensive functions. Our current work is a micro-equivalent of the empirical work performed by Timmer et al. (2014); whereas they observed the aggregate outcomes of GVCs operations over time, we observe the operation of specific GVCs for individual products with actual internal firm data; a feature that none of the other "bottom-up" studies has. These macro and micro approaches are complementary and yield similar conclusions. However, many important features—e.g., the role of transfer pricing—are lost with the macro approach.

The increasing geographic and organizational dispersion of production raises the question of where the value added is created and by whom. Our approach can provide insight into this question. We derive the value added by the companies within GVCs, by the various business functions involved (e.g., assembly and logistics), and the geographical locations of the functions (for example, the value added share of distribution largely resides in the country of final sale).

Our analysis is informed by 45 case studies of GVCs, each of which uses company-confidential invoice-level data with respect to specific products and services. This is the largest, most rigorous (in terms of using actual data), and most diverse (in terms of the industries covered) set of GVC case studies conducted to date. To highlight the rigorosity of the data, we are able to see not only where profits are taken in the internal trade of these firms, but also logistics and inventory costs—a significant advantage over other studies that simply tear down a product, estimate its component costs and allocate profit to the firm's headquarters. Obviously, for a GVC of a physical product, logistics and inventory are serious issues and costs.

Our GVC cases show considerable variation across dimensions within and especially between industries. Thus, current discussions, which are largely based on generalizations, often do not appreciate the subtleties of the real world. Moreover, most of these generalizations are based on a few iconic case studies and do not capture the realities in understudied sectors such as services and raw material intense process industries. While all of the attention has gone to GVCs, many value chains are still best characterized as regional or even local. With these caveats, we nevertheless conclude that value added is dominated by the intangible aspects of GVCs, i.e., market and internal services, as well as the creation and appropriation of intellectual property. Value added shows a tendency to migrate to either the earlier or later stages of the value chain at the expense of assembly/processing or service provision toward the middle

(akin to Shih's smiling curve, <http://v.gd/g3EJcd>). The high value-added functions still tend to be performed by highly skilled labor located in the developed countries, even though the role of the developing countries is on the rise in this respect.

Although the GVC-induced shift in policy thinking is rather profound, many previously cherished principles of good policy conduct remain intact. However, in this work as well, the devil is in the details, and micro-level and practical considerations reveal thorny issues. For example, although *laissez-faire* is the applicable rule-of-thumb and although there appears to be little scope for active or targeted enterprise policies (in the developed countries), we identify situations in which a nation-state might seek to apply more hands-on policies. Furthermore, the prevailing principles of good conduct are at times directly in doubt, e.g., with respect to competition policy. On a few occasions, we observed an increased need for certain policy measures, i.e., social transfers, but less scope with which to implement them.

2 Context

The rise of GVCs has been fueled by technological progress, labor cost arbitrage, access to resources and markets, trade policy reforms (Backer and Miroudot 2013), and—more recently—a relocation of important parts of the supplier base in industries such as electronics since the mid-1980s. The GVCs may be viewed as real-time flows of information, material, capital, and labor inputs. These flows require instantaneous transfer of instructions, quick and cheap movement of intermediate inputs and final outputs, and a modularity of functions that do not occur within one organizational structure in a specific location (Grossman and Rossi-Hansberg 2008). The operation of GVCs benefits from reasonably coherent contractual, governance, and legal principles, which are shaped by national policies, in the home and host locations of multinational enterprises (MNEs). Neilson et al. (2014, p. 3) note that, while "... explicit theorization of the state's role has been somewhat lacking in the GVC [literature]...", it is nevertheless central: "... state action and inaction creates the enabling conditions that shape whether and how firms, regions and nations are able to engage with global markets, and their capacities to upgrade these engagements."

The organization of GVCs is primarily driven by the MNEs' expected net present value of corporate profits, which involves operational efficiency, cost arbitrage, and the ability to repatriate returns. On one hand, MNEs are forced to address often conflicting demands from the national authorities in different countries; on the other hand, they often play countries or localities against one another to obtain lower tax rates, higher investment subsidies, or other benefits.

The GVCs enable deepening specialization, which (in principle) leads to global welfare gains. However, it remains unclear how these gains are distributed across countries, among businesses, and between individuals within countries.

3 Data

Our empirical material consists of 45 in-depth case studies conducted in 2008–2014. All of the cases involve a specific product or a service offered by a particular company, i.e., the brand holder (or the coordinator of the GVC), at a certain point in time. The brand holder companies are headquartered in Finland—with three exceptions, in which cases the headquarters are located in other high-income countries. Each value chain spans multiple countries. In 15 cases, we observe the same company coordinating multiple but functionally overlapping GVCs that

churn identical products or services typically for geographically distinct markets. The names of these four case companies are declassified—Helkama, a bicycle manufacturer; Nokia, still manufacturing mobile phones at the time; Ponsse, a provider of forest harvesting equipment; and WhiteVector, social media intelligence services—but for the most part, the case companies must remain anonymous and we discuss the particular product/service in rather general terms.

Data are collected from both primary and secondary sources. Primary sources consist of semi-structured workshops with executives of the case companies (typically involving the chief financial officer, the senior vice president of supply chain management, a business unit controller, a purchasing director, and/or a product designer/engineer; 3–8 workshops per case, each lasting 2–4 h) as well as interviews with various GVC stakeholders (six interviews per case on average, each lasting 1–2 h). The process was iterative because face-to-face meetings invariably required elaborations via email and telephone. Most of the work was carried out in (or from) Finland, but extensive field work was also conducted in China. Typically, the management of each brand holder company contributed 40–80 h of its time to provide sufficient data.

Secondary sources were used in all cases, but they were of particular importance in the case of mobile phones as well as in tracing cost structures and other information on higher-tier vendor companies. Secondary sources involve the following (cf. Ali-Yrkkö et al. 2011): physical reverse engineering of the product; publicly and privately (personal contacts) available information on, e.g., industry profit margins; commercial “teardown” reports in the case of electronics (e.g., Portelligent 2007); interviews with industry experts; and financial reports and press releases from the companies involved and those of their direct competitors (differences in reporting in various geographies and officially required further information, e.g., 20-F reports in the United States, are particularly useful).

4 Definitions

In our terminology, a *value chain* is composed of the entire range of activities involved in providing a product or a service. *Global value chains* (GVCs) span multiple countries. These activities include both arm’s-length relationships and exchanges within an enterprise and begin with conceptualization and design, evolve to provision and distribution, and end only when the product or service in question is completely consumed and disposed (although, for the most part, our analysis ends with the final delivery of the product or service). Although the discussion on value chains is somewhat more concerned with immediate flows of information, variable inputs, and goods, we also account for equally important tangible and intangible capital and fixed inputs.

Each function or link in the value chain—performed either in-house by the brand holder or purchased from an outside vendor—conducts its own value-added activities and forwards its output to the next phase. The starting point of the analysis is to identify each of these links in the value chain. We follow through by defining the value added of each link with an eye on performing companies (profits, ownership of and compensation for tangible and intangible capital), individuals (labor income) as well as host locations (to determine national outcomes). We observe all the relevant details within the case company but are mostly forced to extrapolate product-specific profit margins of vendor companies.

We employ the conventional measure of value added, although we are forced to define it at a fine level of aggregation. *Value added* is the difference between gross

output and intermediate consumption *at each link*. Thus, value added is equal to the net output of each link and reflects the amounts that employed labor and capital inputs jointly contribute. We *proxy* the value added with the sum of the following three elements: wages and other labor income, operating profits (if unobserved at a given link, we would apply a typical industry rate of profit that accounts for the type and the risk profile of the function), and costs attributable to the employed capital inputs (the depreciations of the performing companies' own tangible and intangible capital stocks as well as costs of other capital inputs, e.g., rents of capital equipment and licensing fees).

Throughout our analysis, we record the actions that actually take place in the GVC. Thus, our calculations reflect the transfer pricing practices employed by the involved corporate entities and also reflect other complexities, e.g., inability to repatriate profits from China in certain cases—despite its legitimacy in light of the internationally accepted guidelines (OECD 2010).

Because we employ the conventional measure of value added and are able to re-aggregate the value added in the context of each product/service by country, our measures correspond directly to *gross domestic product* because GDP may be understood as the sum of value added within national borders.¹ Thus, our calculations directly indicate what goes into the actual measurement of GDP (by country/year) for each product/service.

5 Analysis

Throughout this section, the tables summarize certain standard aspects of our case studies, and in the text, we highlight some dimensions. Although the 45 cases extend over five tables, we assign a running number to each case (the numbers of the cases with more than one geographic incarnation are followed by an identifying letter).

In Tables 1, 2, 3 and 4, the case company's value-added share is on average 41 % (for services in Table 5, the corresponding share is 60 %).² If we exclude the value added shares of any in-house assembly, logistics, and distribution, the case company's broadly understood headquartering functions capture 27 % of the value added. Vendors of raw materials and intermediate inputs—including all goods and certain services (other than any outsourced assembly, logistics, and distribution)—capture 30 % of the value added (obviously the vendors' value added has its own functional structure). The remaining value added shares are: distribution 21 %, final assembly 16 %, and logistics 5 %. As we will show, however, these averages conceal huge variation.

In Tables 1, 2, 3, 4 and 5 Finland, the dominant host country, captures on average 47 % of the value added generated globally. In several cases, the location of final assembly changes from Finland to a lower cost location—mostly China—while other aspects of the GVCs remain intact. For a high-end smartphone (Table 1, Case 1a vs 1b), such a change reduced Finnish value added by two percentage points; for a low-end feature phone, the difference is over ten percentage points (Table 1, Case 2a vs

¹ Plus taxes, minus subsidies; ignoring several complexities, e.g., computational rents in housing and illegal activity.

² Note that the sum of *all* value-added activities is equal to the final sale price of the product/service. We consider pre-tax prices without subsidies.

Table 1 GVC case studies: electronics

No	Description	Year	By company/function						By location											
			Case		Vend.		Assembly		Logistics		Distrib.		Fi		EU*		Asia		Oth.	
			%	%	%	%	Loc.	Org.	%	Org.	%	Org.	%	%	%	%	%	%	%	%
1a	Nokia N95	2007	49	36	Fi	In	2	Ex	0.0	Ex	15	41	27	14	14	5				
1b	Nokia N95	2007	49	36	Lo	In	2	Ex	0.0	Ex	15	39	12	28	16	5				
2a	Nokia 3310	2000	43	40	Fi	In	9	Ex	2.5	Ex	15	39	33	8	14	6				
2b	Nokia 3310	2000	43	40	Hi	In	9	Ex	2.5	Ex	15	26	46	8	14	6				
2c	Nokia 3310	2000	43	40	Lo	In	9	Ex	2.5	Ex	15	26	33	8	27	6				
3a	Nokia 1100	2003	43	38	Fi	In	9	Ex	4.9	Ex	15	41	33	7	13	6				
3b	Nokia 1100	2003	43	38	Hi	In	9	Ex	4.9	Ex	15	21	49	7	17	6				
3c	Nokia 1100	2003	43	38	Lo	In	9	Ex	4.9	Ex	15	21	33	7	34	6				
4a	Nokia 1200	2007	21	54	Lo	In	5	Ex	6.4	Ex	18	8	46	10	26	9				
4b	Nokia 1200	2007	21	54	Lo	In	5	Ex	6.4	Ex	18	8	37	10	36	9				
5	Device, low	2011	62	15	Fi	In	15	Ex	0.3	In	23	17	4	4	3	3				
6	Device, mid l.	2011	67	10	Fi	In	14	Ex	0.1	In	23	16	3	1	1	2				
7	Device, mid h.	2011	61	12	Lo	Ex	6	Ex	0.2	In	23	6	2	6	6	2				
8	Device, high	2011	52	8	Fi	In	4	Ex	0.1	In	40	5	1	4	1	1				
Average			46	33			8		2.6		19	22	26	9	16	5				
Average, Ass. Fi			53	24	Fi		9		1.3		22	26	17	6	8	4				
Average, Ass. Lo			40	39	Lo		6		3.4		17	18	27	12	24	6				

Notes: The case company's value-added share ("Case") includes in-house assembly/logistics/distribution; accounting for these categories, the shares under "By company/function" add up to 100% (save for rounding). The column "Vend." includes all vendors and vendors of vendors, which is composed of all purchased parts and components as well as services (excluding assembly/logistics/distribution). Assembly reflects its direct costs, but the geographical breakdown also reflects the remainder of the value added (profits, etc.) attributable to it. The alternative locations ("Loc.") are: Finland ("Fi"), another high cost country ("Hi", e.g., Germany), and certain low cost locations ("Lo", mostly China). The method of organizing a specific function ("Org.") refers to either in-house provision ("In") or provision by another company either through outsourcing or via a market transaction ("Ex"). Logistics consists of inbound and outbound transportation. Distribution refers to wholesaling and retailing (or comparable functions). In the "By location" geographical breakdown, "EU*" refers to the EU-27 excluding Finland, "US*" refers to North America (here dominated by the United States), "Asia" to the continent, and "Oth." to the rest of the world; the columns under "By location" add up to 100% (save for rounding). The "Average" below the horizontal line refer to the arithmetic mean of the numbers above it; the "Average, Ass. Fi" refers to the cases in which the final assembly is located in Finland and to the "Average, Ass. Lo" to the cases in which the final assembly is in a low-cost country. *Case notes*: 2a–4b: Sale in EU-27 outside Finland (logistics include warranty costs); 2a–3c: Year of market introduction (the Nokia 3310 was analyzed in 2003 and the Nokia 1100 in 2004 (these GVCs were not significantly adjusted in the course of the respective models' life cycles); 5–8: Logistics excludes inbound; 5–7: Wholesaling by the case company, external retailing

Sources: Case 1a–b, Ali-Yrkkö et al. (2011); Cases 2a–4b, Seppälä and Ali-Yrkkö (2014); Cases 5–8 Ali-Yrkkö (2013)

Table 2 GVC case studies: machinery and metal products

No	Description	Year	By company/function						By location											
			Case		Vend.		Assembly		Logistics		Distrib.		EU*		US*		Asia		Oth.	
			%	%	Loc.	Org.	%	%	Org.	%	Org.	%	%	Fi	%	%	%	%	%	%
9a	Bicycle	2011	36	33	Fi	In	16	Ex	5.0	Ex	25	Ex	67	13	5	11	5			
9b	Bicycle	2011	28	42	Lo	Ex	2	Ex	3.0	Ex	25	Ex	58	21	5	11	5			
9c	Bicycle	2011	27	37	Lo	Ex	2	Ex	9.0	Ex	25	Ex	59	9	5	21	5			
10a	Drilling equip.	2011	44	51	Fi	In	23	Ex	4.0	In	0	In	54	14	19	2	11			
10b	Drilling equip.	2011	47	46	Lo	In	17	Ex	7.6	In	0	In	26	15	2	42	14			
11a	Filter system, hi	2011	27	65	Fi	In	6	Ex	4.0	Ex	5	Ex	32	51	6	6	6			
11b	Filter system, hi	2011	21	70	Lo	In	1	Ex	4.0	Ex	5	Ex	22	53	6	14	6			
12a	Filter system, lo	2011	34	56	Fi	In	14	Ex	5.0	Ex	5	Ex	40	44	5	6	5			
12b	Filter system, lo	2011	22	67	Lo	In	2	Ex	6.0	Ex	5	Ex	22	50	6	16	6			
13a	Handling equip.	2011	64	26	Fi	In	50	Ex	10.0	In	0	In	64	19	2	11	4			
13b	Handling equip.	2011	50	34	Hi	In	38	Ex	16.0	In	0	In	19	8	50	18	5			
13c	Handling equip.	2011	75	20	Lo	In	58	Ex	5.0	In	0	In	15	6	0	76	3			
14a	Heating eq., hi	2011	37	21	Fi	In	12	Ex	28.0	Ex	14	Ex	35	8	10	3	44			
14b	Heating eq., hi	2011	42	15	Lo	In	12	Ex	30.0	Ex	13	Ex	2	2	46	2	48			
15a	Heating eq., lo	2011	43	16	Fi	In	6	Ex	28.0	Ex	14	Ex	40	7	7	2	44			
15b	Heating eq., lo	2011	45	12	Lo	In	6	Ex	30.0	Ex	13	Ex	1	2	47	2	48			
16a	Special vehicle	2011	56	41	Fi	In	39	Ex	2.0	Ex	0	In	61	9	24	2	4			
16b	Special vehicle	2011	57	39	Lo	In	40	Ex	3.9	In	0	In	45	10	22	14	9			
17a	Steel structure	2011	48	46	Fi	In	22	Ex	6.0	In	0	In	46	33	7	7	7			
17b	Steel structure	2011	48	38	Lo	In	19	Ex	6.4	In	0	In	5	73	7	7	7			
18a	Paper mach. part	2010	54	37	Fi	Ex	1	Ex	1.0	Ex	7	Ex	75	19	1	3	1			
18b	Paper mach. part	2010	54	37	Hi	Ex	1	Ex	1.0	Ex	7	Ex	55	15	4	22	4			
19a	Tool tip	2011	52	45	Fi	In	6	Ex	3.0	In	0	In	90	5	0	5	0			

Table 2 (continued)

No	Description	Year	By company/function						By location									
			Vend.		Assembly		Logistics		Distrib.		EU*		US*		Asia		Oth.	
			%	%	Loc.	Org.	%	%	Org.	%	%	Fi	%	%	%	%	%	%
19b	Tool tip	2011	57	41	Hi	In	6	Ex	2.0	In	0	51	0	0	17	32		
20	Forest tractor	2011	38	60	Fi	In	10	Ex	2.0	In	7	48	–	–	–	–		
	Average		44				16		8.9		7	41	20	12	13	13		
	Average, Ass. Fi		44		Fi		17		8.2		6	54	20	8	5	12		
	Average, Ass. Lo		41		Lo		16		10.5		9	26	24	15	20	15		

Notes: For definitions of the column headings, see Table 1. *Case notes.* 10a–b, 17a–b and 18a–b: The headquartering country is not Finland but rather another high-income country; 15a: Logistics includes customs and tariffs; 17a–b: Assembly consists of only direct labor costs (i.e., excludes depreciation etc.); 20: Due to the confidentiality agreement with Ponsse, the value-added share by location is only reported for Finland

Sources: Case 9a–b, Kalm et al. (2013); Case 18a–b, García (2011); all others, Ali-Yrkkö (2013)

Table 3 GVC case studies: foodstuffs and textiles

No	Description	Year	By company/function									By location				
			Case %	Vend. %	Assembly		Logistics		Distrib.		Fi %	EU* %	US* %	Asia %	Oth. %	
					Loc.	Org.	Org.	Org.	Org.	Org.						
21	Bread, dark	2011	57	12	Fi	In	36	Ex	6.8	Ex	24	95	4	0	0	0
22	Bread, white	2011	54	11	Fi	In	25	Ex	4.4	Ex	32	97	1	1	1	1
23	Chicken, proc.	2011	37	29	Fi	In	38	Ex	3.2	Ex	30	98	2	0	0	0
24	Cold cut	2011	38	14	Fi	In	18	Ex	1.5	Ex	47	94	6	0	0	0
25	Packaged meal	2011	34	16	Fi	In	15	Ex	2.6	Ex	47	96	4	0	0	0
26	Bag of candy	2011	50	17	Fi	In	18	Ex	1.4	Ex	32	0	0	0	0	0
27	Jar of jam	2011	26	29	Fi	In	16	Ex	0.7	Ex	44	84	16	0	0	0
28a	Chocolate bar	2011	33	20	Fi	In	9	Ex	0.6	Ex	46	88	1	4	4	4
28b	Chocolate bar	2011	19	12	Fi	In	6	Ex	1.1	Ex	66	27	66	2	2	2
29a	Textile, tiny	2011	40	4	Lo	Ex	7	Ex	0.0	Ex	50	90	0	0	10	0
29b	Textile, tiny	2011	40	4	Lo	Ex	7	Ex	0.0	Ex	50	24	66	0	10	0
30a	Textile, small	2011	30	11	Lo	Ex	8	Ex	0.0	Ex	51	81	1	1	19	0
30b	Textile, small	2011	30	11	Lo	Ex	8	Ex	0.0	Ex	51	15	67	1	18	0
31a	Textile, mid-s.	2011	29	11	Lo	Ex	10	Ex	0.0	Ex	50	79	1	1	20	0
31b	Textile, mid-s.	2011	29	11	Lo	Ex	10	Ex	0.0	Ex	50	13	66	1	20	0
32a	Textile, large	2011	29	13	Lo	Ex	9	Ex	0.0	Ex	50	78	1	1	20	0
32b	Textile, large	2011	29	13	Lo	Ex	9	Ex	0.0	Ex	50	13	66	1	20	0
Average			36				15		1.3		45	63	22	1	8	0
Average, Sales Fi			32				9		0.1		49	83	1	1	14	1
Average, Sales EU*			29				8		0.2		53	18	66	1	14	0

Notes: For definitions of the column headings, see Table 1. *Case notes.* In this table, *a* and *b* refer to the country of final sale rather than to the assembly location; *a* cases refer to the final sale in Finland and *b* cases to elsewhere in the EU-27. Case 23: Due to losses associated with the product, the value added share of the case company is less than the value added of its internal assembly

Sources: Cases 21, 22, 26, and 28a–b, Langenskiöld (2011); Cases 23–27, Karjalainen (2011); Cases 29a–32b, Alakoski (2012); all others, Ali-Yrkkö (2013)

2c or 3a vs 3c). Across the eleven relevant machinery and metal products comparisons in Table 2, offshored final assembly reduces Finnish value added from 8 to 49. On average, the reduction is 27 percentage points.

5.1 Electronics

To illustrate the process of conducting GVC case studies, we first summarize certain aspects of our original *Nokia N95 smartphone* case study (Ali-Yrkkö et al. 2011). In early 2007, the unbundled pre-tax retail price of the phone was €546, which represents the total value added that we break down. In our analysis, we individually evaluated all 600 of the N95’s components, as well as the software and intellectual property it embodies. We determined the value added by companies, functions, and location for all direct and indirect tangible and intangible inputs (including capital expenses and contributions of such supporting functions as top management), from raw materials and initial idea generation to the final sale. Depending on the input, 1–8 stages were required before the final assembly by Nokia, either in Salo (Finland,

Table 4 GVC case studies: other products

No	Description	Year	By company/function									By location					
			Case		Vend.		Assembly		Logistics		Distrib.		Fi	EU*	US*	Asia	Oth.
			%	%	Loc.	Org.	%	Org.	%	Org.	%	%	%	%	%	%	
33	Sawn timber	2012	18	47	Fi	In	4	Ex	2.0	Ex	33	100	0	0	0	0	
34	Cardboard, lo	2011	26	34	Fi	Ex	40	In	0.0	In	9	89	3	2	2	4	
35	Cardboard, hi	2011	32	27	Hi	Ex	40	Ex	0.0	In	10	43	52	1	0	3	
36	Tissue roll, lo	2011	29	8	Hi	Ex	49	Ex	0.0	Ex	13	28	65	2	1	3	
37	Tissue roll, hi	2011	24	9	Hi	Ex	54	Ex	0.0	Ex	13	22	71	2	2	4	
Average			26	25					37	0.4		16	56	38	1	1	3
Average, Ass. Fi			22	41	Fi				22	1.0		21	95	2	1	1	2
Average, Ass. Lo			27	9	Lo				52	0.0		13	25	68	2	2	4

Notes: For definitions of the column headings, see Table 1. *Case notes.* 33: Logistics include only outbound sales in Finland; 34: Sales in Finland; 35: Sales in the EU-27 outside of Finland; 36–37: Sales in the EU-27 outside of Finland

Sources: Cases 34–35, Leppänen (2012); Cases 36–37, Sortti (2012); all others, Ali-Yrkkö (2013)

Table 1, Case 1a) or in Beijing (China, Table 1, Case 1b), and 2–4 stages occurred after.³ In the case of the N95, the assembly location had little impact on the value captured by Finland, the country that hosts Nokia's headquarters. For a phone assembled in China, the headquartering country's value-added share was 39 %, whereas for a phone assembled in Finland, this value was 41 %—only two percentage points more. This case suggests that value added is largely detached from the physical flows, and the location of final assembly is not of great importance. Internal services, returns on intellectual property rights, and other intangible aspects of the GVC largely determine where the value added is accounted for.

The N95 provides insights for a point in time. However, how does the provision of phones evolve over time? To study this issue, we considered *three feature phones* at different points in time (Seppälä and Ali-Yrkkö 2014): the Nokia 3310 in 2000 (with an unbundled pre-tax retail price of €78.60, Table 1, Case 2a–c), the Nokia 1100 in 2003 (€62.70, Table 1, Case 3a–c), and the Nokia 1200 in 2007 (€27.00, Table 1, Case 4a–b). The chosen models embody identical technologies, features, and functionality. Nokia's overall value added fell from over €30 per 3310 (43 % of the total in 2000) to under €6 per 1200 (21 % of the total in 2007). Although outside vendors faced similar price erosion, their share of the value added increased over time. In terms of business functions, price erosion was the least rapid in services (distribution, logistics, trade, and warranty provision). Finland captured 39 % of the 3310 value added and 8 % of the 1200 value added, and the corresponding shares for Asia grew from 14 to 36 %. The three feature phones illustrate both the plummeting price of a given feature set and the gradual shift of tasks towards developing countries, which also involves intangible aspects of the value chain. For instance, the Nokia 3310 was designed end-to-end in Denmark and Finland, whereas the Nokia 1200 was designed in China, although Denmark still assumed responsibility for the hardware and software platforms.

³ For the most part, we normalize the country of final sale to reflect the geographic distribution of the overall sales for the product/service in question. This choice has consequences in the actual calculations, since for example value added by wholesalers and retailers largely resides in the country of final sale, which in turn has influences on the value added per country.

Table 5 GVC case studies: services

No	Description	Year	By company		By location				
			Case %	Vend. %	Fi %	EU* %	US* %	Asia %	Oth. %
38	Sw. platform	2013	29	71	61	10	11	10	8
39	Digi serv., B2C	2013	30	70	56	14	10	10	10
40	Digi serv., B2B	2013	81	19	72	19	4	3	3
41	SaaS analytics	2010	93	7	97	1	1	1	1
42a	Logistics, Finl.	2013	60	40	85	0	0	0	15
42b	Logistics, Russia	2013	44	56	2	0	0	0	99
43	Translation s.	2011	77	23	72	9	4	8	8
44	Machine parts	2012	56	44	13	30	22	2	33
45	Rock band	2011	68	32	100	–	–	–	–

Notes: For definitions of the column headings, see Table 1. *Case notes*. For discussion regarding 42a and 42b, see text. *Case notes*. 45: Upon considering the geography of value added, we abstract from fuel, instrument, and some other minor costs

Sources: Cases 38–41, Kalm et al. (2014); Case 43, Serbessa (2012); Case 44, Seppälä and Kalm (2013); Cases 42a–b and 45: unpublished manuscripts by Matias Kalm

In addition to mobile phones, we consider *four other consumer electronics products* (made by the same case company, Table 1, Cases 5–8). These cases reveal the significant role of transfer pricing (for a discussion in the context of precision machinery, see Seppälä et al. 2014): The brand holder's subsidiaries worldwide buy products for sale at prices that roughly reflect the costs of components and final assembly. As a result, the locations that host the sales subsidiaries appear to be quite profitable in our calculations, and the headquartering country of Finland commands 5–17 % of the value added. However, the case company has misinterpreted the established transfer pricing principles (OECD 2010). If we correct this error, Finland captures 42–66 % of value added.

Table 1 suggests that in all but the most basic electronics products, the value added by the brand holder is quite large, whereas the share of assembly is quite small. The share of distribution is invariably larger than that of assembly; in the case of a low-end feature phone, even the share of logistics dwarfs that of assembly. At least at the high end, the headquartering country does quite well, provided that the employed transfer pricing practices conform to internationally accepted guidelines.

5.2 Machinery and Metal Products

We studied *a women's bicycle* in 2011 (Kalm et al. 2013), at which point our case company of Helkama was considering three options: in-house assembly in Finland (Table 2, Case 9a, assembly location until 2006) and outsourced assembly either in Lithuania (Table 2, Case 9b, assembly location since 2012) or in Indonesia (Table 2, Case 9c, assembly location in 2009–2011). In Finland, the final assembly is 16 % of the total value added and in either outsourcing location, this value is 2 %. For a relatively simple yet somewhat labor-intensive product such as a bicycle, the difference between a low-cost and a high-cost assembly location is large. However, because logistics and certain other costs are higher with outsource offshoring, the cost disadvantage of Finland amounts to 8 %. In the case of outsourcing to Lithuania, Finland

still captures 58 % of the value added, which reflects Finland's role as the headquartering country as well as the significant share of local distribution (including wholesaling and retailing).

For *ten mechanical and precision engineering products* (Table 2, Cases 10a–19b), our case companies place the assembly in multiple locations, mostly in Finland and China. With local assembly, Finland's value-added share ranges from 31 to 90 %, and with offshore assembly, the share ranges from 2 to 55 %. The difference between onshore and offshore is between 11 and 49 percentage points, which appears large in light of the intuition gained from studying consumer electronics. We attribute this observation to three factors. *First*, unlike in electronics, intermediate inputs are commonly locally sourced and localized support functions may be required; the company might employ local sales and marketing staff and perform location-specific development due to, e.g., national idiosyncrasies in building codes. Furthermore, in selected cases, the factory floor is also the breeding ground for innovations embodied in future offerings, which calls for the presence of local research staff. *Second*, in contrast to electronics, intangible capital tends to be more tacit and embodied in the production process. *Third*, the assembly plant is more commonly defined as a risk carrying entity, in which case a larger fraction of profits is allocated to that location. The ten engineering cases also suggest that with more complex and customized engineering products, the overall cost of operation may be roughly the same or lower in a (seemingly) high-cost assembly location (Table 2, Cases 13a–19b).

Ponsse assembles its *forest tractor* in Finland (Table 2, Case 20), and a large share of components are manufactured by local companies or companies located in Western Europe. Our analysis reveals that 48 % of the product's total value is created in Finland (when sold outside Finland). A significant share of the value added captured in Finland is created by local suppliers.

Table 2 suggests that in machinery and metal products, assembly is quite important, although in most cases its value-added share is still dominated by the case company's (other) value added, which is attributable to broadly understood headquartering functions (the case company value added excluding any in-house assembly, logistics, and distribution). The role of logistics and distribution varies greatly but, on average, the value added share of these two components is roughly equal to that of assembly.

5.3 Foodstuffs and Textiles

A chocolate bar and a bag of rye bread are among the eight analyzed *foodstuffs* (Table 3, Cases 21–28b). These cases highlight the considerable role of wholesalers and retailers, who capture 38 % of the total value added on average, which is approximately the same as the brand owner's share.

In the case of the *four non-apparel textile products* (Table 3, Cases 29a–32b, by the same company), the brand owner outsources production to a contract manufacturer, capturing 7 % of the total value added. Wholesalers and retailers capture half of the value added, and the brand holder captures one-third.

Table 3 on foodstuffs and textiles highlights the dominant role of wholesaling and retailing in certain consumer products, which reflects both the significant associated costs and market power, which is driven by the case companies' inability to directly reach their clientele in a cost-efficient manner. It is nevertheless the case that successful branding and distinctive design features earn considerable returns. In Table 3, the letters *a* and *b* following certain case numbers refer to *the country of final sale* rather than to the assembly location (as in

Tables 1, 2, and 4): a refers to the final sale in Finland and b to elsewhere in the EU-27. A comparison of a and b (the last two lines in Table 3) suggests that the country of final sale makes a 65 percentage point difference in the value-added capture in Finland.

5.4 Wood-Based Products

A piece of two-by-four inch *sawn timber* (Table 4, Case 33) is interesting in two respects. First, 100 % of the value added is captured in Finland. If the tree trunks were imported from Russia, which was a common practice in the early 2000s, Finland's share would decline to 55 %. Second, the sawn timber itself is provided at a loss, and saleable side products, e.g., woodchips, make the process economically viable.

Our cases also include other wood-based products (Table 4, Cases 34–37). The analyses of these products reveal that the value created in *physical* activities, including raw material supplies and processes towards the final product, varies between 56 and 67 % of the value added, whereas the value created in the remaining and more intangible activities varies between 33 and 44 %.

Table 4 suggests that in certain industries, raw materials and assembly still play a dominant role. The geographic breakdown hints that these GVCs often remain quite regional and even local.

5.5 Services

In addition to products, we consider four (mostly) digital and four other service offerings.

A business-to-business *software platform* (Table 5, Case 38, Kalm et al. 2014) offered by a venture-backed startup consists of a developers' toolkit and a library of software elements that may be embedded into clients' products. The company charges a fixed fee for the developers' toolkit, and the variable revenue stream is tied to the sales volume of the product in which the component is embedded. The case company's value-added share is approximately 29 %, and the company spends a substantial amount on overhead services (i.e., law, travel, and consulting services). The share of Finnish value added is 61 %.

A large multinational company delivers a *digital consumer service* (Table 5, Case 39, Kalm et al. 2014) via a delivery platform and the physical infrastructure that it owns, but the actual content is purchased from outside vendors. The revenue model consists of monthly purchases and additional amenities. The case company's value added share is 30 %, which is considerably less than that of the content providers. The share of Finnish value added is 56 %. The same company also provides a *business-to-business digital communications service* (Table 5, Case 40, Kalm et al. 2014). This service relies heavily on the underlying distribution network owned by the case company, but the key component is a software layer that establishes secure private communication "pipes" for client companies operating in multiple locations. Revenue is mostly based on a monthly service fee. The case company's value added share is 81 %. The share of Finnish value added is 72 %.

Whitevector, which was a small startup at the time and is now a component of M-Brain, provides Software-as-a-Service (SaaS) *social media analytics* (Table 5, Case 41, Kalm et al. 2014). Revenues are based on a monthly service fee. The provision of the service is almost purely algorithmic. Because Whitevector obtains its "raw" content for free and the cost of leasing sufficient cloud computing capacity and licensing software that it uses as a component of its in-house software is rather marginal, its value added share is 93 %. The share of Finnish value added is 97 %.

In Tables 1, 2, 3 and 4, on average 5 % of the value added is attributable to *logistics*. In order to study the role of logistics in further detail, we consider an international logistics company based in Finland that first stocked and then delivered—on behalf of a multinational client—a running shoe imported from Asia either to Finland (Table 5, 42a) or to Russia (Table 5, 42b).⁴ A comparison of the two cases suggests that Finland being the headquarters country makes little difference—value added is largely captured in the country where the delivery takes place.

Even though most of the working hours are done by freelancers, the case company providing a *translation service* (Table 5, Case 43) creates 77 % of the value added. Consequently, Finland captures 72 % of the value added.

While the analysis of Seppälä and Kalm (2013) suggests that over the life-cycle of the product *the provision of after-sales spare parts* (Table 5, Case 44) generates more income than the initial sale, it is also demanding when it comes to handling global inventory and distribution—these functions, here handled internally by the case company, account for 38 % of the value added (this share is included under “Case” in Table 5). The direct manufacturing cost of the spare part accounts for 1 % of the value added. Geographically value added largely shows at the distribution centers throughout the world.

Our final analysis concerns a local group providing *live performances* of popular music (Table 5, Case 45). Two-thirds of the value added is captured by the band; for the remainder, it relies on outside vendors for, e.g., booking, logistics, and accommodation. Since the band does not perform or sell recordings outside Finland, effectively all of the value added is domestic.

6 Discussion

From our data we conclude: (1) the term GVC disguises considerable variation within and especially between industries; (2) value chains for raw-material-intense process industries, for example, are not nearly as global as the value chains of industries that provide more advanced products; (3) in many consumer products the value added share of wholesaling and retail is quite large; (4) accounting for where profit is allocated inside a MNE is difficult; (5) inventory carrying costs and logistics are significant but often ignored even by MNEs themselves; and (6) industries vary in their functional “stickiness”. In addition, services have scarcely been analyzed in this context: Our few examples of digital services suggest that the case companies and their headquarters locations can capture large shares of the value added, with little “dribbling” to locations where the service is consumed. In non-digital services, however, value added has a certain tendency to be captured at locations of provision and consumption.

Our case studies suggest three main ways for a company to obtain an “over-sized” chunk of the total value added (in order of importance): acting as the orchestrator and/or brand owner, controlling the customer/user interface, and retaining a gate-keeping position (e.g., by cornering the market for a key input). For an individual, these attractive company positions imply job assignments in high-level service tasks in the broadly understood headquartering functions as well as in the creation and management of intangible assets.

Particularly in selected precision-engineered industrial products, assembly plays a prominent role, but generally, value added is dominated by the intangible aspects of GVCs, i.e., market and internal services as well as the creation and appropriation of intellectual property.

⁴ Should we study the value chain of the running shoe in question, logistics would account for 0.35 % of the value added when delivered to Finland and 0.41 % when delivered to Russia.

Value added shows some tendency to migrate to either the earlier or later stages of the value chain at the expense of assembly/processing or service provision toward the middle.

From the viewpoint of a national economy, the impact of the offshoring of final assembly varies significantly. This variation depends primarily on four issues: (1) the impact of relocation on non-assembly functions and tasks, (2) the role of intellectual property in the product, (3) transfer pricing practices employed after relocation, and (4) the juridical location of the company's profit center.

With the rise of GVCs, national competitiveness begins to depend on citizens' abilities, both as individuals and as organizations, to position themselves well within GVCs. With this understanding, the policy objectives of a nation-state are as follows: (1) to engage nationally active businesses and individuals in attractive GVCs; (2) to place these businesses and individuals in strong bargaining positions; (3) to ensure that value added shows up as national income, returns, and wealth; (4) to ensure sufficient private and public tangible and intangible investments; and (5) to optimally deploy all nationally available resources. These five objectives amount to stating that a nation-state seeks sustainable high and rising labor productivity and full employment within its borders.

Perhaps surprisingly, the OECD (2013) suggests that in the presence of GVCs, the core features of modern economic policy are intact (in the spirit of Schumpeterian or the "new-new growth theory", cf. Aghion and Howitt 2009). Thus, the OECD's policy prescription remains: promote market competition; encourage creative destruction; make public investment in education, research, and infrastructure; and foster a financial and business environment that is conducive to private investment in tangible and intangible assets.

In our understanding, the OECD's (2013) policy prescription is indeed compatible with how GVCs operate in practice. However, our micro-analysis also points toward *several hard-to-resolve paradoxes*. *First*, whereas good policy conduct builds on laissez-faire principles and maintains symmetry across businesses and their functions, there is no denying that certain functions, e.g., headquarters, are nationally more desirable than others. *Second*, with the rise of GVCs, the relative importance of innovative activity has also risen. However, as knowledge flows have grown more international, the core motivation for providing public support for innovative activity, i.e., local knowledge spillovers, has weakened. *Third*, due to both consumer surplus and the smooth operation of GVCs, keen competition in domestic markets is to be applauded. For the same reasons, any national government wants foreign governments and international organizations to promote competition in global markets. However, a national government also wants businesses and individuals within its national borders to have market power and thus a lack of competition when such power is exercised on foreign entities. *Fourth*, GVCs give rise to several features that suggest a need for relatively extensive social safety nets, but the political support for and the scope of financing such safety nets might simultaneously be reduced. *Fifth*, the scope of trade policy broadens to include considerations of all cross-border flows. In fact, in the context of GVCs, any market malfunctioning becomes a trade policy issue. Although a good rule-of-thumb is to treat domestic and foreign provenances equivalently with respect to goods, services, investment, capital, ownership, technology, or workers, it is sometimes rational to depart from this over-arching principle. For instance, if and when ownership acts to choose locations for headquarters and other business functions, controlling local ownership is desirable. *Sixth*, GVCs make setting of wages increasingly global. In most developed countries, this circumstance poses a challenge for existing wage setting mechanisms, not least because it has simultaneously become more difficult to form sensible unions on both sides of the labor market, because large and homogeneous employee and employer groups with aligned interests are less prevalent.

7 Conclusions

GVCs are less tied to their tangible aspects, e.g., the assembly location, than conventional wisdom suggests. The intangible aspects, market and internal services, and creation and appropriation of intellectual property are more important. However, this generalization is not universally true—GVCs are amazingly complex and heterogeneous. Upon comparing value-added of domestic and foreign final assembly, we find significant variation in national outcomes. For example, in cases of offshored final assembly, the value added of the home economy is only two percentage points lower for a high-end smartphone, while it is already ten percentage points lower for a low-end feature phone, and nearly thirty percentage points lower on average for machinery and metal products. We also find that value chains for basic products and services are not nearly as global as those of advanced products.

In the course of our analysis, we observed changes in how corporations operate their GVCs. Sometimes the case companies implemented changes as a response to our analysis, since we explicitly highlighted the roles of inventory carrying costs and logistics. Our observations nevertheless suggest the dispersion of global value chains at ever-finer resolution is *not* reversing but it *is* becoming more precise and smarter. Once the longer-term costs and benefits are evaluated, seemingly high-cost locations, such as Finland, often appear quite competitive.

With the advent of GVCs, policymakers have found themselves in a difficult situation. Just following economic development is challenging. Implicit assumptions in decision making—such as aligning interests of the country and its champion corporations as well as virtues of high-tech industries—are challenged. While policy thinking needs to be adapted, some of the received wisdom on sound policy principles remains valid. Especially high-income European countries nevertheless urgently need new strategies for retaining higher value-added activities and for capturing associated returns.

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References

- Aghion P, Howitt P (2009) The economics of growth. MIT Press, Cambridge
- Alakoski M (2012) Who creates value added in a global value chain? Master's thesis, Aalto University
- Ali-Yrkkö J (2013) Mysteeri avautuu: Suomi globaaleissa arvoverkostoissa. Taloustieto, Helsinki
- Ali-Yrkkö J, Rouvinen P, Seppälä T, Ylä-Anttila P (2011) Who captures value in global supply chains? Case Nokia N95 smartphone. *J Ind Compet Trade* 11:263–278
- Backer KD, Miroudot S (2013) Mapping global value chains. OECD Trade Policy Papers 159
- Cattaneo O, Gereffi G, Staritz C (2010) Global value chains in a postcrisis world: resilience, consolidation, and shifting end markets. In: Cattaneo O, Gereffi G, Staritz C (eds) Global value chains in a postcrisis world: a development perspective. The World Bank, Washington, DC, pp 3–20
- Dedrick J, Kraemer KL, Linden G (2010) Who profits from innovation in global value chains? A study of the iPod and Notebook PCs. *Ind Corp Chang* 19:81–116
- Dietzenbacher E, Los B, Stehrer R, Timmer M, de Vries G (2013) The construction of world input–output tables in the WIOD project. *Econ Syst Res* 25:71–98

- García M (2011) Creating value from innovation: the analysis of an innovative product value chain. Master's thesis, Aalto University
- Grossman GM, Rossi-Hansberg E (2008) Trading tasks: a simple theory of offshoring. *Am Econ Rev* 98:1978–1997
- Kalm M, Pajarinen M, Rouvinen P, Seppälä T (2013) The rise of Baltic Sea value chains—A bicycle producer's world tour. In: Ketels C (ed) State of the region report. Baltic Development Forum, Copenhagen, pp 126–135
- Kalm M, Seppälä T, Ali-Yrkkö J (2014) Who captures value in digital services? ETLA Briefs 27
- Karjalainen J (2011) Where is value created in the Finnish food industry? Case: Finnish food company. Master's thesis, Aalto University
- Kenney M (2012) Where is value in value networks? In: Breznitz D, Zysman J (eds) 21st century manufacturing. United-Nations Industrial Development Organization (UNIDO), Vienna, pp 13–36
- Langenskiöld S (2011) Where is value created: value chain mapping and analysis. Master's thesis, Aalto University
- Leppänen S (2012) Value creation in global value chains of paperboard-packed consumer goods. Case: Finnish packaging board manufacturer. Master's thesis, Aalto University
- Linden G, Dedrick J, Kraemer KL (2011) Innovation and job creation in a global economy: the case of Apple's iPod. *J Int Commer Econ* 3:223–240
- Linden G, Kraemer KL, Dedrick J (2009) Who captures value in a global innovation network? The Case of Apple's iPod. *Commun ACM* 52:140–144
- Neilson J, Pritchard B, Yeung HW-C (2014) Global value chains and global production networks in the changing international political economy: an introduction. *Rev Int Polit Econ* 21:1–8
- OECD (2010) Transfer pricing guidelines for multinational enterprises and tax administrations. Organisation for Economic Cooperation & Development, Paris
- OECD (2013) Interconnected economies: benefiting from global value chains. Organisation for Economic Cooperation & Development, Paris
- Portelligent (2007) Nokia N95: GSM/EDGE 850/900/1800/1900MHz +WCDMA/HSDPA 2100MHz UMTS Cellular Phone
- Seppälä T, Ali-Yrkkö J (2014) Changing geographies of value creation in global supply chains: Evidence from mobile telecommunications. In: Seppälä T (ed) Contemporary determinants and geographical economy of added value, cost of inputs, and profits in global supply chains: an empirical analysis. PhD dissertation, Aalto University, Department of Industrial Engineering and Management. ETLA A 48, Helsinki, pp 105–136
- Seppälä T, Kalm M (2013) Profiting from product innovation: a product life analysis of the economic geography of value added. *Industry Studies Working Papers* 1
- Seppälä T, Kenney M, Ali-Yrkkö J (2014) Global supply chains and transfer pricing: insights from a case study. *Supply Chain Manag* 19:445–454
- Serbessa T (2012) Distribution of value added in a global service production. The case of a Finnish service provider. Master's thesis, Aalto University
- Sorti I (2012) Exploring the distribution of value in the global nonwovens value chain: where is sustained value created? Master's thesis, Aalto University
- Sturgeon TJ, Nielsen PB, Linden G, Gereffi G, Brown C (2013) Direct measurement of global value chains: collecting product- and firm-level statistics on value added and business function outsourcing and offshoring. In: Mattoo A, Wang Z, Wei S-J (eds) Trade in value added: developing new measures of cross-border trade. The World Bank, Washington, DC, pp 289–319
- Tempest R (1996) Barbie and the world economy. *Los Angeles Times*, September 22. http://articles.latimes.com/print/1996-09-22/news/mn-46610_1_hong-kong
- Timmer MP, Erumban AA, Los B, Stehrer R, de Vries GJ (2014) Slicing up global value chains. *J Econ Perspect* 28:99–118