

**Part II**

# **Supply Chain Issues**

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## Chapter 3

# Supply chains and offshoring

### *Abstract*

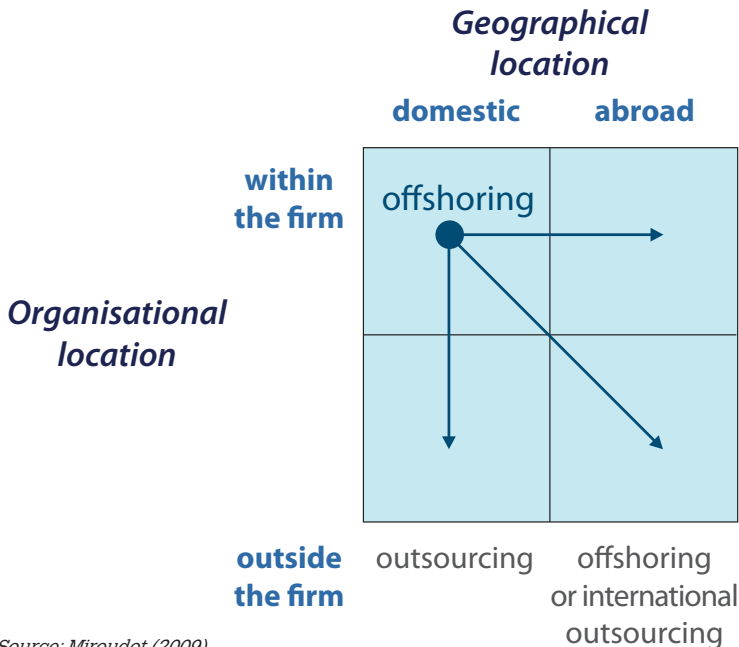
The shuffle of jobs offshore (or back onshore) has caught the attention and concerns of policy makers. The structural shifts in industrial structures are creating new winners and losers. Unskilled labour-intensive parts of the manufacturing production process have been increasingly offshored by advanced country firms to relatively unskilled labour-abundant developing economies. This “offshoring” phenomenon is expected to reduce jobs for low- and semi-skilled workers in advanced economies while increasing them in developing economies. At the same time, resulting productivity increases in advanced economies can raise the demand for native workers – at least in complementary tasks. The empirical literature suggests that fears of job-losses due to offshoring in advanced economies are often exaggerated – restricted largely to the short-run. Policy makers can address these concerns through strengthening social safety nets in the short run and instituting skills-upgrading programmes to create a more flexible labour force in the long run. Greater challenges lie ahead for these policy makers, with an increasing number of services jobs being offshored from developed to developing economies. Even in developing economies, services offshoring can worsen inequality by raising skill premiums, thereby making investment in education equally crucial there. Looking ahead, given increasing wages in certain developing economies, increasing transport costs, new technologies and concerns about separating R&D from manufacturing activities, there is a possibility of a large number of manufacturing and services tasks returning to advanced economies.

### 3.1 A brief history of offshoring and outsourcing

#### *3.1.1 Definitions*

Before beginning our discussion on offshoring and outsourcing, we must first lay down the conceptual boundaries of the two terms. Figure 3.1 illustrates a basic framework describing the changes that define the two terms.

Figure 3.1: Movement of activities in offshoring and outsourcing



Source: Miroudot (2009)

*Outsourcing* describes when firms decide to buy products or services from external vendors, as opposed to making them in house. This is referred to as the firm's "make or buy" decision (Sako 2006; Contractor et al. 2010). While movement towards making more in house can be described as vertical integration, movement towards the "buy" decision is described as outsourcing. Outsourcing is used both with and without geographical constraints in the literature. In some cases, outsourcing describes the sourcing of products and/or services from external firms within the same country, while in others, outsourcing can also involve external firms in foreign countries (sometimes referred to as "international outsourcing"). Regardless of the geographical boundaries, the key component of outsourcing is that a previously internal activity is now being sourced from an external firm.

*Offshoring* is defined by firm activities being geographically relocated from the firm's domestic country to a lower-cost foreign country (Sako 2006; Farrell 2004; Levy 2005; Contractor et al. 2010). In contrast to outsourcing's relocation of value chain activities across organisational boundaries, offshoring entails the relocation of value chain activities across geographical boundaries. However, there is variation as to whether offshoring activities are, by definition, kept in-house (see Marin 2006; Miroudot, Lanz, and Ragoussis 2009), or whether they may also be outsourced to another firm (see Sako 2006; Contractor et al. 2010). A compelling distinction is offered by the WTO and the Institute of Developing Economies, Japan External Trade Organization (IDE, JETRO) (2011), wherein offshoring is used to refer to intra-firm trade and foreign direct investments (FDI), while international outsourcing is used to refer to arm's length sub-contracting. Thus,

the movement of activities to the bottom right-hand quadrant in Figure 3.1 is labelled as offshoring when the recipient firm of the activities received FDI (such as mergers and acquisitions or “greenfield” investment) from the source firm of the activities, while non-FDI-related relationships (i.e. arm’s length relationships) are referred to as international outsourcing. The two different types of relationships hold consequences for the level of technology transfer, investment, trade, and development of involved firms and countries.

Recently, questions as to the real benefits of offshoring, plus the political controversy surrounding the practice, have led to alternate modes of activity relocation. These have been assigned a new body of terms, and include the return of activities back to their original country (referred to as re-shoring, in-shoring, or on-shoring) and the reincorporation of activities into the focal firm (in-sourcing). The faster turnaround times and strategic benefits of geographically shorter supply chains have also produced the term “near-shoring”. Appearing in recent literature from the last five years, it is yet to be seen how these terms will develop (or disappear) in the future.

### *3.1.2 Historical development*

The basic driver of offshoring and outsourcing is lower cost. The economic divergence between the global “North” and “South” through the first part of the 20<sup>th</sup> century set the stage for the cost savings reaped by firms, starting in the second half of the 20<sup>th</sup> century. With wages in developing countries at a fraction of the cost of wages in developed countries, the potential savings to be reaped from labour arbitrage grew with economic divergence. What triggered the realisation of these savings, however, were the technological innovations and regulatory environment that drastically lowered the costs of doing business across firm and country boundaries. Organisational innovation then arose to capture the possibilities created through these economic enablers, driving the growth of supply chains. This, in turn, increased the importance for firms to specialise in order to compete, driving the increasing outsourcing of non-essential activities.

This rise of offshoring and international outsourcing, by enabling the more optimal utilisation of country’s comparative advantage results in a win-win situation. Developing countries – particularly the East Asian economies – took this opportunity to industrialise, while developed countries saw the replacement of industry jobs with higher value-added service jobs. However, continued advances in technological and firm capabilities, in conjunction with general changes in the international economy, have created significant issues for 21<sup>st</sup> century offshoring.

The rapid expansion of supply chains across country and firm boundaries give rise to increased risks associated with offshoring and outsourcing activities.

In addition, the 21<sup>st</sup> century has seen continued information and communication technology advances that have created a problem for developed countries. While in the 20<sup>th</sup> century, fears of unemployment were assuaged by the creation of service sector jobs, service jobs are no longer immune to offshoring. Policy makers are therefore facing an increasingly contentious political issue, where the current geography of global supply chains has created fears of increasing unemployment and disappearing industrial capabilities (Blinder 2006).

## 3.2 For the business practitioner

### 3.2.1 *Disappointment*

Beginning this section with a subheading on “disappointment” may seem strange in contrast to the touted benefits of offshoring, but many business practitioners may be able to associate with this sentiment. At the turn of the new millennium, offshoring was viewed as a necessity for manufacturers and those dependent on manufacturing to compete (Ferreira and Prokopets 2009).

The economic rationale was straightforward – why pay US\$20 per hour for a worker in the US when you could pay US\$2 per hour for a worker in India? By moving activities abroad, businesses could expect to cut costs by up to 70 percent (Farrell 2004). However, the real cost savings often fell short of expectations, with 50 percent of firms failing to generate the expected financial benefits of offshoring (Aron and Singh 2005).

As a result, a central research theme emerged in the literature in trying to understand why offshoring was not working. While initial studies such as Farrell (2004) and Aron and Singh (2005) point to shortcomings in implementation, later studies point to a changing economic equation (Ferreira and Prokopets 2009; Goel, Moussavi, and Srivatsan 2008; Roztock and Fjermestad 2005). We start by reviewing the arguments behind each.

Arguments based on shortcomings in implementation point to the need for a more careful consideration of what activities to offshore and an expanded conception of what offshoring entails. First is the reality that the potential benefits of offshoring vary according to the extent of globalisation across industries (Farrell 2004). The offshoring success stories associated with electronics and apparel, for example, may lead practitioners to overestimate the potential benefits that they may see in lesser globalised industries (say, those with higher regulatory barriers or prohibitive transportation costs, for example).

Secondly, overly simplistic considerations of offshoring may be to blame. Offshoring requires a granular and systematic approach when considering which activities to offshore and how to redesign processes to capture the potential benefits. Simply offshoring sections of current business activities is not sufficient, nor sustainable; practitioners must disaggregate and redesign their processes in order to capture the benefits (Aron and Singh 2005; Farrell 2004; Roztock and Fjermestad 2005).

Furthermore, offshoring entails more than just labour arbitrage. In addition to the benefits to be seen in process reengineering, practitioners should also consider opportunities for revenue growth associated with offshoring – and how to capture those opportunities (Aron and Singh 2005; Farrell 2004).

Another set of arguments arose with the shifting economic climate during the latter part of the 2000s. By this point, the literature seems to concede that the real benefits of offshoring were never as high as they were thought to be; in part, this has been due to the overlooked costs and risks associated with globally dispersed firm activities. Expectations of cost savings, estimated at around 25 to 40 percent, were in reality around 5 to 15 percent (Ferreira and Prokopets 2009). These costs and risks came to the forefront when practitioners found themselves facing a falling dollar, combined with rising costs of oil, commodities, and wages.

From 2000 to 2008, costs for shipping a container tripled due to the price of oil. From 2003 to 2008, wages in China rose by 19 percent on average, year on year; and from 2005 to 2008, global commodity prices increased by 27 percent while the value of the US dollar fell 18 percent relative to the Chinese Renminbi (Ferreira and Prokopets 2009; Goel, Moussavi, and Srivatsan 2008). These drastically shifted the cost savings equations for offshoring, inciting doubts of its viability and a plethora of new terms such as in-sourcing, in-shoring, on-shoring, re-shoring and near-shoring.

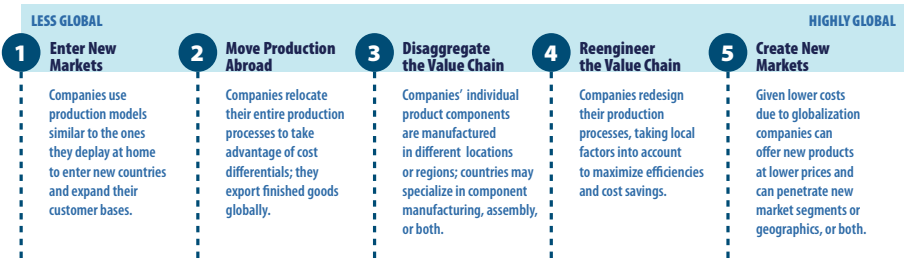
The positive outcome of this reset in expectations, however, is the advancement of concepts and tools to help business practitioners more accurately estimate and capture the benefits of offshoring.

### 3.2.2 Offshoring and outsourcing reconsidered

When overlaying the advised approaches to offshoring in the literature, we emerge with three distinct phases of analysis for the business practitioner: (1) analysis of industry globalisation; (2) analysis of value chain reconfiguration; and (3) analysis of complementary growth opportunities.

Farrell (2004) stresses that the potential gains of offshoring are first determined by the extent of globalisation found in the relevant industry. Industries that are still in the early stages of globalisation may not have the technological infrastructure and global resources to make offshoring feasible and profitable. The extent of globalisation is affected by technical limits in the ability to disaggregate value-added activities, the regulatory environment, and organisational attitudes to change. To guide practitioners on the opportunities and limitations to be found in adding different levels of globalisation, Farrell presents five stages for global industrial restructuring (Figure 3.2).

**Figure 3.2: Stages of global restructuring and consequences of offshoring**



Source: Farrell (2004)

If the industry sector presents attractive terms for offshoring, the next phase of analysis is to consider the optimal value chain configuration to capture gains.

The first step is to take a more disaggregated view of firm activities. Aron and Singh (2005) and Contractor et al. (2010) both propose the classification of activities as core, critical (or essential), and commodity (or non-core) activities.

*Core activities* are to be kept in-house and represent the strategic core competencies for a business. *Critical activities* are areas of the value chain that a business does not wish

to specialise in but is highly dependent on. Critical activities can be outsourced and/or offshored, but require trusted or highly reputable partners. *Commodity activities* are standardised tasks that can be easily sourced from a market of vendors. These are highly attractive for outsourcing and offshoring. To aid in the assignment of classifications, Aron and Singh (2005) suggest ranking activities by value creation and value capture before categorisation (Figure 3.3).

**Figure 3.3: Ranking activities by value-creation and value-capture**

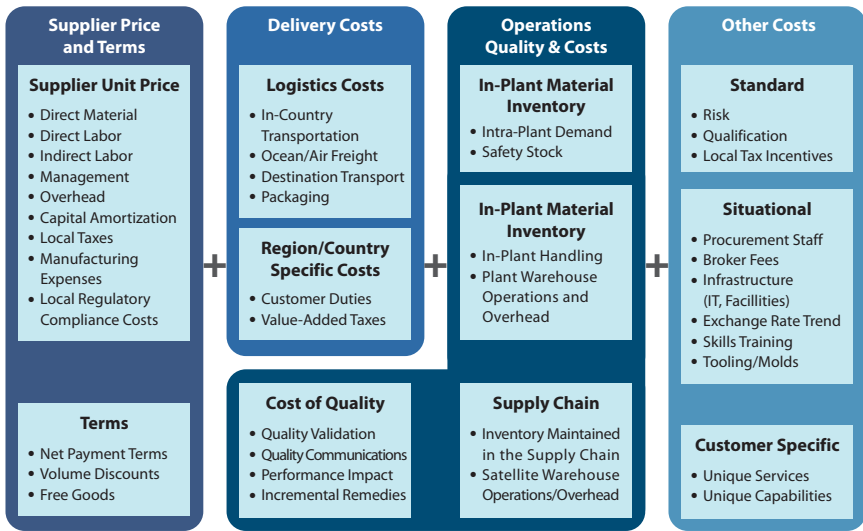
Process	Value-creation ranking*	Value-capture ranking*	Total ranking	
<b>Float management for suppliers and dealers</b>	1	1	2	} <b>Processes the company shouldn't offshore</b>
<b>Working capital management</b>	2	3	5	
<b>Cash-flow forecasting</b>	4	2	6	
<b>Revenue and expense reporting</b>	3	4	7	} <b>Processes the company might offshore</b>
<b>Payment authorization</b>	5	5	10	
<b>Invoice verification</b>	6	6	12	

\* Determined by executive consensus

Source: Aron and Singh (2005)

As business managers have come to realise, outsourcing and offshoring are associated with hidden risks and costs that need to be included in the net cost equation. Risks include exchange rate and factor cost fluctuation, reduced transparency, slower response times, and intellectual property theft. Costs include one-time sunk costs from offshoring implementation and local import and tax implications (Farrell 2004; Ferreira and Prokopets 2009; Goel, Moussavi, Srivatsan 2008). Ferreira and Prokopets (2009) provide a framework for considering costs in Figure 3.4, and a more thorough consideration of the supply chain risks incurred from offshoring and outsourcing can be found in Chapter 5.

**Figure 3.4: Best practice elements of a total cost model**

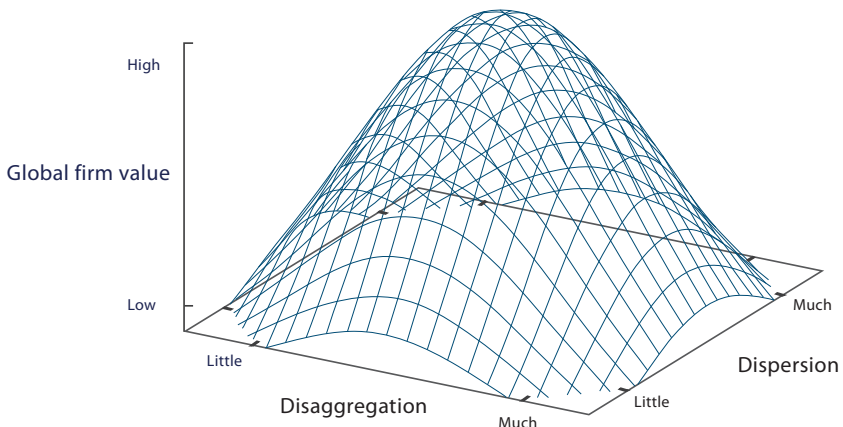


Source: Ferreira and Prokopets (2009)

With a better understanding of the real costs and risks associated with offshoring and outsourcing, the business manager must now make a decision on their optimal disaggregation and dispersion of tasks in conjunction with potential organisational forms (see Figure 3.5).

With offshoring in multiple countries, managers must also tailor the mix of capital investment and labour costs to each market (Contractor et al. 2010; Farrell 2004). Aron and Singh (2005) provide a decision framework based on risks in considering operational options (Figure 3.6).

**Figure 3.5: Concept of optimising disaggregation and dispersion of tasks**



Source: Contractor et al. (2010)



**Figure 3.6: Choosing the right organisational arrangement**

Operational risk	HIGH	Outsource to service provider located nearby (nearshore)  <b>Litigation support</b>	Set up captive center nearby or onshore  <b>R&amp;D, design</b>	Execute process in-house and onshore  <b>Pricing, corporate planning</b>
	MODERATE	Offshore and outsource to service provider over time  <b>Insurance claims processing, customer support</b>	Use extended organization offshore, but monitor closely in real time  <b>Supply chain coordination, bioinformatics</b>	Set up captive center offshore  <b>Equity research</b>
	LOW	Offshore and outsource to service provider  <b>Data entry, transaction processing</b>	Use extended organization offshore  <b>Telecollection, technical support</b>	Use extended organization offshore, but conduct frequent process audits  <b>Customer data analysis, market research analysis</b>
		LOW	MODERATE	HIGH
		Structural risk		

Source: Aron and Singh (2005)

Finally, gains from offshoring should not be narrowly considered as attempts to attain the lowest possible costs. While basic offshoring of activities can cut costs by up to 50 percent, Farrell points to another 20 percent that can be cut, in conjunction with activity offshoring. These are attributed to gains from process reengineering (15 percent) and better training (5 percent). They require less incremental thinking and more architecture-level reconfiguration, along with gains from productivity of low-cost, low-skilled workers.

As against the cost consideration, practitioners should also realise new revenue generation opportunities made available by lower costs and the ability to reach more customers across economic tiers and country borders. In doing so, practitioners may find that their awareness of increased costs to offshoring can be countered by new revenue generation opportunities (Farrell 2004; Goel, Moussavi, and Srivatsan 2008).

### 3.3 For the policy maker

#### 3.3.1 Economic implications of offshoring

In recent years, the focus of analysis of the trade-jobs-wages nexus has shifted towards offshoring. This includes both arm's length transactions with independent suppliers abroad (often referred to as international or offshore outsourcing) and the transfer of certain tasks within a firm to a foreign location via the establishment of subsidiaries or affiliates (foreign direct investment). Here, labour market adjustments in response to trade

opening occur within industries and even within firms, unlike standard models of trade that can only explain adjustments between industries or sectors (Feenstra and Hanson, 2001).

In industrialised countries, where unskilled labour is scarce relative to skilled labour and capital, unskilled labour-intensive parts of the manufacturing production process are likely to be offshored or outsourced to relatively unskilled labour-abundant developing economies.

By substituting unskilled workers with foreign labour, offshoring or international outsourcing enables production in advanced economies to focus on their comparative advantage (more capital) or skilled labour-intensive tasks (Glass and Saggi, 2001). This efficient pattern of task specialisation has a negative effect on unskilled or low-skilled workers (Feenstra and Hanson, 2001). Some lose their jobs (Grossman and Rossi-Hansberg, 2008) while others see their wages fall relative to those of skilled workers (Krugman, 1995; Feenstra and Hanson, 1996).

In a simple theoretical model of trade in production tasks, Grossman and Rossi-Hansberg (2008) refer to the adverse impact of offshoring on employment in advanced economies as the "labour supply effect" and the "relative price effect" respectively.<sup>1</sup> Whether offshoring affects wages or employment levels depends on a country's labour market (Anderton et al., 2002). Wood (2002) and Anderton et al. (2006) show that offshoring and international outsourcing may have also affected the wage gap between moderately and highly skilled workers. As the costs of supply chain coordination continue to fall over time, more production shifts to developing countries, but the offshored or outsourced activities become increasingly skill-intensive. This means that the demand for medium-skilled workers in developed countries declines over time.

However, as the relative demand for highly skilled workers continues to rise, wage inequality among skilled workers increases. It is therefore also possible that eventually, the wage gap between moderately skilled and unskilled workers shrinks rather than widens in developed countries. The recent increase in services offshoring, made possible by new technologies and improved communications, is perhaps indicative of the theory because it has been linked to the displacement of medium-skilled workers in advanced economies. In addition to business process outsourcing and call-centres, financial services, higher education services and certain health services are now being increasingly offshored, either through arm's length contracts or FDI, owing to improvements in technology and rising educational levels in developing countries (Blinder, 2006).

Given these are skill-intensive activities, it is likely that such offshoring would restrain the widening of wage inequality between skilled and unskilled labour in developed economies. Greater competition, brought about by offshoring, could also reduce this wage inequality by inducing firm restructuring of skill-intensive headquarters' activity such as management, marketing and accounting services (Ekholm and Ulltveit-Moe, 2007).

New jobs are also created in developed economies as a result of offshoring or international outsourcing. First, the fragmentation of the production process creates the need for coordination and supervision and thus has a direct job creating effect (Burda and Dluhosch, 2001). Second, the cost savings associated with offshoring unskilled labour-intensive tasks increases productivity in advanced economies, thereby raising the demand for native workers – if not in the same tasks that are offshored, then certainly in complementary tasks (Ottaviano, Peri and Wright, 2012; Jensen and Turrini, 2004).<sup>2</sup>

Several recent papers have argued that this indirect productivity effect of offshoring or international outsourcing could offset or even outweigh the displacement effect and thereby generate an overall positive effect on the wages or employment of native workers (Grossman and Rossi-Hansberg, 2008; Costinot and Vogel, 2010; Harrison and McMillan, 2011; Wright 2012).

The balance of these opposing effects, and hence the net impact, will depend on a number of country-specific characteristics, such as labour market institutions (Anderton et al., 2002). In addition, there is the possibility of indirect employment effects in two forms. If, for example, as a consequence of the efficiency gains associated with offshoring, the firm in question provides its services to other businesses (in the same or in another sector) at a lower cost, they may be able to expand activities and employment.

Moreover, if offshoring or international outsourcing results in lower prices to final consumers, some proportion of their higher real income increases will be spent on domestically produced goods and services, thereby raising overall employment. In other words, when offshoring occurs, there will be second-order intra- and inter-sector spillover effects (Egger and Egger 2005). Given these factors, it becomes an empirical question as to whether job gains will be sufficient to offset job losses in developed countries.

In developing countries, which are generally relatively abundant in unskilled labour and hence mainly destinations of production relocation, offshoring – via arm's length contracts or FDI – should create jobs for unskilled labour (Arndt, 1997).

Moreover, it is possible that a job created in the “South” is not just a job re-located from the “North” – offshoring to countries with a relative abundance of labour should change the factor mix used for production or service provision towards higher employment intensity (Bottoni et al., 2007; Agrawal et al., 2003; Bhagwati et al., 2004).

Greater demand for unskilled workers should also result in an increase in their relative wages, leading to decline in wage inequality. Here, it is important to distinguish between arm's length transactions and “greenfield” FDI on the one hand, and “mergers and acquisitions (M&A)” FDI on the other.

While the former are likely to be associated with an increase in the quantity of labour employed and in the level of wages, M&A FDI is only expected to affect wages. However, it is possible that the skill content of offshored labour-intensive tasks is generally higher than the domestic average of developing countries – activities that are considered to involve low skills from the perspective of a developed country might well be high skilled from the perspective of a developing country (Wood 2002; Feenstra and Hanson, 1997).

Consider the case of call centres in India, for example. Offshoring or international outsourcing can actually increase the demand for skilled labour and thus widen the skilled-unskilled wage differential in developing economies. It therefore has effects similar to those of skill-biased technological change. In addition, knowledge and technological externalities associated with offshoring may lead local firms to increase their demand for relatively skilled labour, which, in turn, would result in an increase in the relative wage of skilled labour and hence wage inequality (Feenstra and Hanson, 1997; Pissarides, 1997). In this context, the distinction between offshoring via FDI and offshoring via arm's length contracts becomes important because the transfer of technology is likely to be associated more strongly with the former. What is more, if foreign investment crowds out domestic investment, this could be mainly at the expense of SMEs, the backbone of employment

in most developing countries (Ghose, 2004). Developing countries may also begin to compete with each other in attempting to become offshore locations for unskilled labour-intensive manufacturing tasks. Such competition may entail greater public expenditure in infrastructure, simplification of business regulations and procedures, and investment incentives in the form of tax concessions.

With a trend towards maximising domestic value-added, the completion of higher value-added activities is also likely to be characterised by competition between countries. In principle, it is therefore possible that certain countries lose industrial production, and therefore employment, as a consequence of fragmentation (Jones and Kierzkowski, 2001). Capacity constraints could play a role in this regard.

Furthermore, if the quality of new jobs created is low, the positive effect of offshoring in terms of job creation is somewhat undermined. It is argued that jobs created in local affiliates of offshoring firms offer better working conditions than domestic firms (Olsen, 2006), perhaps owing to higher productivity levels, as well as private norms and the obligation to sign codes of conduct.

However, the offshoring of labour-intensive tasks could reduce job quality by expanding employment in the informal sector, which is characterised by lower wages and non-wage employment benefits. This would happen if formal sector firms that get an offshoring contract further subcontract the task to enterprises in the informal sector (Jansen and Lee, 2007). A downward pressure on prices and profitability, induced by increased competition among suppliers, as more firms enter the market, may prompt firms to reduce labour costs by subcontracting some tasks to the informal sector (Görg and Hanley, 2004).

Labour standards are another concern. There is the risk that competition for offshoring contracts is mainly done on the basis of price, and hence countries attempt to gain a cost advantage by lowering labour standards.

Finally, if offshoring induces local firms to specialise in the production of component parts and final assembly, it could undermine the future development of higher value-added production stages, and thus skill and wage upgrading (Bottoni et al., 2007). It may therefore be insufficient for developing countries to rely on lead firms' offshoring strategies alone in pursuing industrial upgrading.

### *3.3.2 Empirical evidence for developed countries*

When assessing employment effects of offshoring, either via international outsourcing or via foreign direct investment, it is worth noting several other factors, such as changes in technology, consumers' preferences, and business cycles affect job destruction and job creation. Moreover, the scale of turnover in modern labour markets is quite large.

Given these factors, it is important that the job losses attributed to offshoring are appropriately contextualised. Much of the empirical work shows that while offshoring plays an important role in explaining changes in job status and wages, other explanations like technological change and country specific characteristics cannot be ignored (Regev and Wilson 2007; Ekholm and Hakkala 2006; Geishecker and Görg 2004; Morrison and Siegel 2001) and at times are even more important (Feenstra and Hanson, 1999).

Recent empirical estimates have stirred up a great deal of public debate about the employment impact of offshoring. For example, Timmer et al. (2012) show that the benefits

of deepening production networks have been limited for advanced economies, as activities intensive in the use of capital and highly skilled labour have increased, while the use of low- and medium-skilled workers has declined.

Forrester (2004) predicts that by 2015, Europe and the United States will lose in the order of one and three million jobs, respectively, as a result of “offshoring” to overseas service providers. Others argue that this projection is “conservative” and estimate that as a result of offshoring, 14 million jobs are “at risk” in the United States alone (Bardhan and Kroll, 2003).

In contrast, some studies argue that fears about job losses in advanced economies tend to overestimate “the likely impact of offshoring” (McKinsey Global Institute, 2003).

One crucial shortcoming of the majority of such estimates is that they only consider direct job losses due to offshoring, and neglect both the indirect effects of employment creation and offshoring flows in the opposite direction.

Much of the literature on the subject paints a more nuanced picture. Most studies show that while low-skilled workers are more likely to lose, and high-skilled workers more likely to benefit, the impact of offshoring on the domestic labour market is limited, in quantitative terms.

### *The effect on jobs: industry-level studies*

In a comprehensive analysis of data spanning 12 OECD countries, 26 industries, and two years (1995 and 2000), the OECD (2007) identifies a “job destruction” effect of foreign outsourcing, albeit a small one. It finds that a one per cent increase in offshoring results in a 0.15 per cent decrease in employment in the manufacturing sector. These estimates represent direct effects only.

Extending the coverage to 17 countries, Hijzen and Swaim (2007) refine the methodology used by OECD (2007) to disentangle relocation and productivity effects. They find that in the case of material offshoring, the productivity effect is sufficiently robust, so that new jobs created by increased sales offset job losses due to production relocation.

In a more recent study, using the World Input-Output Database for a sample of 18 European countries between 1995 and 2008, Foster et al. (2012) show that while offshoring has a limited effect on cost shares in services industries, the effects on the manufacturing industries have been relatively large, and that they impact medium-skilled workers to a greater extent than low- and high-skilled workers.

Many industry-level studies for particular advanced economies find that material offshoring to developing economies, measured by imports, is associated with a relative decline in demand for low-skilled labour in advanced economies. This is reflected in falling employment for low-skilled labour, but the magnitude of this negative effect is quantitatively small (Anderton et al. 2002; Kucera and Milberg 2003; Falk and Wolfmayr 2005). Egger et al. (2003) show that the adverse employment effect of offshoring is accentuated for industries with a comparative disadvantage. Others argue that when both the displacement and scale effects are taken into account, offshoring does not have a negative effect on manufacturing employment at the sectoral level. Amiti and Wei (2005), for example, find that this is the case for a sample of 69 manufacturing industries in the United Kingdom between 1995 and 2001.

In a subsequent study on the United States, Amiti and Wei (2006) show that when a sector is narrowly defined (to 450 sectors) and when a short time period is investigated, there is evidence of a minor impact of offshoring on job losses. However, when a sector is more broadly defined (to 96 sectors), and a longer time period is considered, there is no observable link between offshoring and job loss, as both the relocation and indirect productivity effects are picked up.

In the case of services offshoring, certain studies find that this has had little impact on overall domestic employment in advanced economies (Amiti and Wei 2006; Van Welsum and Reif 2006). It may be attributed to the fact that services offshoring has destroyed jobs for low-skilled workers and created jobs for the highly skilled in about equal measures (Crino 2006; Amiti and Wei 2006).

### *The effect on jobs: firm-level data*

Hanson, Mataloni, and Slaughter (2003) show that offshoring to other advanced economies increased the demand for highly-skilled workers in U.S. parent firms. In contrast, the authors also show that offshoring to developing economies reduced labour demand for unskilled or low-skilled workers.

This result is reinforced by the results of Harrison and McMillan (2011) who find that “horizontal” offshoring (aimed at serving foreign markets, often other advanced economies) stimulates domestic employment while “vertical” offshoring (setting up offshore affiliates for trade in intermediates) aimed at producing intermediates, hurts domestic employment.

Several empirical studies using firm level data also find that material offshoring to affiliates in low-income countries leads to significant reductions in employment levels in parent firms. These include Görg and Hanley (2005) for the Republic of Ireland, Harrison and McMillan (2006) for the United States and Biscourp and Kramarz (2007) for France. A potential source of error in many of these studies, however, is that they only consider the direct, short-run effects of offshoring and assume inter-sectoral independence (Egger and Egger, 2005).

Analysing firm-level data for Germany between 2000 and 2006, Wagner (2011) finds that while there are no statistically, discernible effects of offshoring on employment, it does have a strong positive effect on firm-level productivity. This suggests that possible job losses due to offshoring (or, the relocation effect) are more than outweighed by the increased productivity and competitiveness in the firm, which allows it to expand employment (the scale effect).

These results relate to the medium run, being estimated for one to three years after the event. Other studies for European countries also find no evidence for employment loss due to offshoring of manufacturing activity (Marin 2004; Castellani et al. 2007).

For U.S. multinationals, evidence suggests that overseas expansion during the 1990s did not displace hiring in the U.S. by these firms (Desai, Foley, and Hines, 2005; Landefeld and Mataloni, 2004).

Similarly, using Japanese firm level data, Ando and Kimura (2007) show that manufacturing firms expanding offshoring operations in East Asia had higher domestic employment growth rates than other manufacturing firms.

In the case of services offshoring, some studies find that increased imports of intermediate services by parent firms in advanced economies did not have a significant impact on job losses (Hijzen et al. 2007; Borga 200; Schultze 2004).

For computer and data processing services, accounting and auditing services as well as engineering and architecture services, however, Landefeld and Mataloni (2004) find that overseas job growth was much stronger in foreign affiliates of U.S. firms than in their home locations. In these three sectors, domestic employment growth of multinationals also lagged behind overall U.S. employment growth (including the non-multinationals), thereby implying that this is not simply a reflection of cyclical factors.

In a study of services offshoring from the United States to India, Baily and Lawrence (2004) find that while relatively low-skilled programming jobs were lost to the latter, higher-skilled jobs of software engineers and analysts were gained in the former.

### *The effect on jobs: worker-level data*

Using worker-level data to assess the impact of offshoring on an individual's job security has a number of advantages. First, it allows researchers to account for individual characteristics, such as the age, tenure, marital status and skills of a worker, which may play a role in job turnover. Second, relating the employment status of a worker to outsourcing activity in the industry allows one to capture indirect effects – not what happens to workers in the offshoring firm but what happens to all workers in an industry that offshores intensively.

Using this approach, a number of studies find that offshoring to low-income countries reduced domestic employment in different advanced economies, although the effects were economically small (Ebenstein et al., 2009 and Liu and Trefler, 2008 for the United States; Egger et al., 2007 for Austria; Munch, 2010 for Denmark and Geishecker, 2008 for Germany). Geishecker (2008) finds that tenure seems to matter.

In the first six months of employment, offshoring raises the hazard of job loss by more than one percentage point. With higher employment duration, however, the absolute changes in the hazard rate due to offshoring are much smaller. In a study on Germany, Bachmann and Braun (2011) find that offshoring actually increases job stability in the services sector, especially for high-skilled workers.

### *The effect on wages*

A majority of studies report a skill-biased effect of offshoring, either in favour of high-skilled workers or to the detriment of low-skilled workers. For example, on the basis of data for the United States, Japan, Hong Kong and Mexico, Feenstra and Hanson (2001) show that offshoring is associated with a rising wage share for skilled workers.

Similarly, Anderton et al. (2002) demonstrate that offshoring to low-income countries leads to falling wage-bill shares of low-skilled workers in the United Kingdom, the United States, Italy and Sweden. Country studies on Germany (Geishecker and Görg, 2004), France (Strauss-Kahn, 2003), the United States (Slaughter, 2000), Sweden (Ekholm and Hakkala, 2006) and Italy (Helg and Tajoli, 2005) also find that offshoring reduces the demand for



low-skilled workers relative to high-skilled workers. Geishecker and Görg (2005) show that only low-skilled workers in low-skill intensive industries experience reductions in their real wages owing to production relocation. The same holds for high-skilled workers: gains are only made if they are in high skill intensive sectors. Moreover, Head and Ries (2002) show that the inverse relationship between offshoring and relative wages of unskilled labour disappears as production stages are relocated in high-income countries.

Many studies only find a small impact of offshoring on the skilled-unskilled wage differential. For instance, Hijzen (2007) suggests that while offshoring played a part, technological change was the main factor behind the increase in wage inequality in the United Kingdom during the 1990s.

The same conclusion is reached by Morrison and Siegel (2001), when considering the United States. Other studies document an uncertain effect that depends on the country features. Egger and Egger (2003), for instance, find that manufacturing offshoring from Austria to Eastern Europe had little effect on wage rates, and attribute this to union bargaining power and the centralised wage-setting process.

Similarly, in evaluating data from Germany (with rigid labour markets), the United Kingdom (with flexible labour markets) and Denmark (with flexible employment adjustments but relatively rigid wage setting), Geishecker et al. (2010) find that there are small negative wage effects of offshoring on unskilled workers in all three countries, but these effects are the lowest in Denmark.

A small set of studies also show that offshoring will not necessarily widen the inequalities between workers in developed countries. Lorentowicz et al. (2005), for example, find that Austrian offshoring decreased the relative wages for Austrian skilled workers by two per cent in the period between 1995 and 2002. They suggest that this happened because Austria's human capital levels are poor relative to its trading partners in Eastern Europe.

Returns on labour (regardless of skill levels) relative to those on capital may also change as a result of offshoring. It is argued that an expansion of the global workforce due to increased participation from countries with relatively low capital stocks has led to a substantial decline in the global capital-labour ratio (Freeman, 2005). This is likely to depress wages. Offshoring therefore enables companies to cut labour costs by a substantial margin. In theory, these cost savings could be passed on to consumers, distributed to the firm's remaining workforce through increased wages, or kept as profits. Evidence suggests that offshoring has had a negative impact on labour's share of total income in advanced economies (IMF, 2007).

### *3.3.3 Empirical evidence for developing countries*

#### *The effect on jobs*

The evidence regarding how much employment is generated in host countries as a result of offshoring is rather patchy. A recent joint study by WTO-IDE JETRO (2011) provides strong evidence of the numerous job opportunities that have been generated through countries' engagement in regional supply chains. It finds that unlike many advanced economies which are far more domestically oriented, foreign final demand is very important for job creation in many East Asian countries, including Malaysia, Singapore, Chinese Taipei and Thailand.



A survey by UNCTAD indicates that, in terms of new jobs created, India is the greatest net beneficiary of services offshoring in the developing world, with IT-enabled services and business process offshoring being the largest employers (UNCTAD, 2004). The Philippines has also seen a rapid growth in employment due to services offshoring. In Africa, service investment has mainly been in call centres. While South Africa has become the prime location, Ghana, Mauritius, Morocco, Senegal and Tunisia have also attracted some offshoring contracts.

While the number of jobs created as a result of offshoring service provision is likely to grow in the future, there are supply-side constraints that restrict future growth. Only a small fraction of the labour force has college education in disciplines relevant to the skilled segments of service offshoring – such as engineering, accounting and financial services. What is more, an even smaller fraction of young professionals with such degrees are suitable for employment, given obstacles such as insufficient language proficiency, cultural barriers and low educational quality (Farrell et al., 2005; Coe, 2007). Competition for talent from domestic companies and low regional mobility is likely to further reduce the pool.

### *The effect on wages*

Egger and Stehrer (2003) find that material offshoring from firms in the European Union (EU) helped contain the rise of the skill premium in the Czech Republic, Hungary and Poland during the 1990s. In contrast, Feenstra and Hanson (1997) show that the offshoring of production from the United States to Mexico accounted for a large portion of the increase in the skilled labour share of total wages and an associated shift in relative wages. Similarly, Fajnzylber and Fernandes (2004) find that the use of imported inputs and FDI is linked to greater demand for skilled workers in Brazil, while Görg and Strobl (2002) identify the import of technology-intensive capital through offshoring as the main factor behind the increases in relative wages of skilled workers in Ghana. A possible explanation for these diverging results is that skill levels in Central and Eastern Europe are similar to those in the old EU countries, while there is a gap in terms of skill endowments between advanced economies on the one hand, and Mexico, Brazil and Ghana on the other.

There is also some evidence to suggest that increased supply chain activity has not generated relatively low quality of employment in developing economies. For instance, a study by the World Bank (2008) shows that special economic zones (SEZs) – often used to facilitate a country's participation in GSCs – were characterised by higher wages for unskilled labour relative to the rest of the economy. Even working conditions were found to be more favourable, with many SEZs making progress towards meeting international norms for labour standards.

One weakness of most of the aforementioned studies is that they may only capture the wage and employment effects of offshoring in the formal sector, while a possible impact of offshoring is the increased sub-contracting to the informal sector as firms in developing countries seek to minimise costs and externalise risks.

## 3.4 Future directions

The business literature has done much to uncover the realities of the offshoring equation, but in the process it has reached into the areas of business model design and supply chain risk management. A future area of potential development is to integrate the findings

from these two areas (reviewed in Chapters 5 and 9) in order to develop more robust decision support tools for business practitioners.

In the economics literature, it is difficult, if not impossible, to compare studies due to the tremendous differences in terms of countries, databases, and empirical estimations. Moreover, a majority of studies alluded to above consider the short run effects of offshoring (via arm's length transactions or via foreign direct investment) on employment, mainly due to data availability and methodological limitations. Hence, there is a need for further research to investigate differences across countries using a common methodology. In doing so, it must also attempt to calculate the long-run employment effects of offshoring. Despite the limitations outlined above, it is important to contextualise what the available empirical evidence means for policy. First, it suggests that fears of job-losses due to offshoring in advanced economies are often exaggerated. While offshoring may lead to higher job turnover in the short run, there is no indication that trade or offshoring leads to higher unemployment overall.

Looking at the employment impact of offshoring exclusively in terms of the total number of jobs lost or gained, however, would present an incomplete picture. In developed countries, low-skilled jobs will be lost, while higher-skilled jobs will be gained. This shift in the demand towards highly-skilled workers in advanced economies would increase income inequality.

Evidence also suggests that offshoring can weaken the position of workers versus the owners of capital. Given the distributional consequences and the danger that unskilled or low-skilled workers may be excluded from the labour market, policy makers need to find ways to mitigate the associated social and economic costs. This skill-bias implies that the transition from one job to another can entail substantial adjustment costs for individual workers. In the short run, therefore, losers could be compensated through strengthening social safety nets.

In the long run, however, relying on assistance is not sustainable and therefore incentive mechanisms to look for re-employment after job loss need to be put in place (Davidson and Matusz, 2006). Skill upgrading is very important, as a more educated labour force is a more flexible labour force (Auer et al., 2005).

At the same time, advanced economies may retain many jobs that require little education because they are not suitable for electronic delivery. According to Blinder (2006), these include services where personal presence is either imperative or highly beneficial – it could be a waiter taking an order in a restaurant or a nurse performing a physical exam. Training programmes for these jobs are therefore equally important. In general, flexible labour markets are also likely to help, as adjustment costs would be reduced if workers can move freely and flexibly from one job to another.

In developing countries, the evidence suggests that offshoring has had an employment-generating effect. In the case of material offshoring, this has primarily been in the area of unskilled, labour-intensive manufacturing tasks. More research is needed in terms of the impact on the quality of jobs, as well as employment in the informal sector. Services offshoring can, potentially, have negative effects on inequality by raising skill premiums. Hence, skill upgrading to investment in education is equally important in developing economies.

In a recent special report on offshoring, the Economist (2013) outlines a move towards firms in advanced economies bringing back to their home countries a large number of manufacturing tasks that have been offshored for decades. This is being driven, in part, by rising wages in China and India, the lack of scale and efficiency in low-income destinations, such as Vietnam and Indonesia, as well as stagnant wages in the United States and Europe.

Increasing transport costs and increasing risks in extended supply chains (due to the multiplication of policy risks across countries and natural disasters for example) are also playing a part. So too is the concern that separating production from research and development is harming a firm's long-term ability to innovate.

The Economist (2013) also argues that developed countries are increasingly beginning to take back service industry jobs too. While the scale of this re-shoring is still modest, a large number of companies want complex and strategic IT and business process tasks to be done locally. In the long run, education and labour market reforms are likely to be important factors determining the extent of re-shoring in advanced economies. Developments in recent innovations, such as 3D printing, may also reduce the need to offshore unskilled labour tasks to low-wage countries.

### 3.5 Endnotes

1. This theory draws on previous work by Jones and Kierzkowski (1990) and Feenstra and Hanson (1996, 1999).
2. In the short-run, however, offshoring could exert downward pressure on wages or induce firms to downsize their work force since the same amount of goods can be produced with fewer workers (Arndt, 1997). This would result in a rising share of profits in national income (McKinsey Global Institute, 2003).

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# Chapter 4

## Supply chains, upgrading and development

### *Abstract*

“Development” is a far-reaching term, and the subjects of the reviewed literature vary by geographical and organisational coverage, stage of socioeconomic development under study, and perspective adopted. More specifically and substantively addressed is increased participation in global value chains, including upgrading, as applied to firms, industries, and regions. This is driven by both the business practitioner’s and policy maker’s perspectives, and is addressed through the global value chain framework. In contrast to supply chains, value chains provide a better macro-scale perspective on matters such as distribution of income and power across firm networks, and the interlinkages between firms and their socioeconomic environments. Operationalisable typologies of upgrading and value chain governance reviewed here will be of interest to the business practitioner and policy maker. Our literature search also yields a niche body of literature on the subject of rural development and agriculture, which is reviewed near the end of the chapter.

### 4.1 Defining upgrading and development

#### *4.1.1 Development contexts*

With a broad term like “development”, many uses and definitions can be found in the literature. Within the literature applicable to supply chains, four dimensions can be identified when researchers speak of development: geographical, organisational, societal, and subject-specific. In the geographical dimension, one finds development used in reference to local, national, and international development. Regional development is also used, but can refer, confusingly, to either regional development within a country, or regional development of multiple bordering countries. As such, if listed from the smallest geographical scale to the largest, one can find discussions of development at the local, regional (domestic), national, regional (international), and international scales.

The organisational dimension of development discussions is not as neatly arranged in linear fashion as the geographical dimension. The most frequent subjects of

study in this dimension, however, are firms, clusters, sectors, and industries. Clusters originate from the industrial organisation and economic geography literature, and contain an embedded geographical dimension, referring to firms that are located in close geographical proximity to each other. The terms “sector” and “industry” are often used interchangeably in the literature.

The societal dimension refers to the pre-industrial, industrial, and post-industrial socioeconomic stages based on modernisation theory. Each of these stages carries unique challenges for growth. The pre-industrial relevant literature largely focuses on development in a rural and/or agricultural context. The literature on the industrial context is the most populous within the development and supply chains literature, and addresses the challenges associated with industrialisation. The post-industrial literature deals with economic development and growth in the “developed” countries. However, given the popular conception of developed countries as existing outside the realm of discussions on development, we will address these problems in separate sections; namely in Chapter 3 on offshoring, Chapter 7 on services, and Chapter 10 on sustainability.

The subject-specific dimension is rather straightforward, and refers to whether the literature addresses the business person’s perspective and/or the policy maker’s perspective (or neither). This largely applies to the prescriptive studies in development that aim to produce results for implementation.

### *4.1.2 Defining upgrading*

Upgrading is another oft-used term that suffers some definitional vagueness. Morrison, Pietrobelli, and Rabellotti (2008) point to its “fuzzy” conception in relation to innovation, and the term is used in parallel with skills, technology, and learning. While the concept can be found in business and economics literature on clusters, value chains, core competences and dynamic capabilities, Morrison, Pietrobelli, and Rabellotti (2008) point to its origins in international trade theory. The term was originally used to indicate countries that are specialising towards higher value-added goods within the same sector. Amongst recent literature, it is considered to be a critical means to face market competition (Humphrey and Schmitz 2002; Giuliani, Pietrobelli, and Rabellotti 2005; Kaplinsky and Readman 2001; Morrison, Pietrobelli, and Rabellotti 2008). The following is a sample of the definitions of upgrading that have been found in the literature:

- “innovation producing an increase in the value-added” (Morrison, Pietrobelli, and Rabellotti 2008)
- shifts in activities that “increase the skill content of their activities and/or move into market niches which have entry barriers and are therefore insulated to some extent from these pressures” (Humphrey and Schmitz 2002)
- “insertion into local and global value chains in such a way as to maximise value creation and learning” (Gereffi et al. 2001)
- “the capacity of a firm to innovate to increase the value-added of its products and processes” (Giuliani, Pietrobelli, and Rabellotti 2005)

All the definitions share a common goal of enhancing and retaining value. The subject to be upgraded varies, depending on whether the literature utilises the management perspective or the governance perspective, and ranges from upgrading firms to value chains, clusters, regions, and industries.

Upgrading from the business perspective tends to endorse the importance of specialisation to sustain and increase net returns, while the economic perspective tends to suggest the importance of diversification; perhaps beneficial on country or industry dimensions, as opposed to a firm dimension. The means are varied as well, and include upgrading skills, technology, knowledge, products, processes, functions and value chains. The following section elaborates on a widely used typology of upgrading used in the context of value chains.

### *4.1.3 Typology of upgrading*

Giuliani, Pietrobelli, and Rabellotti (2005) present a typology that begins by splitting up endogenous and exogenous factors in firm upgrading. While endogenous factors are simply described as internal firm efforts to upgrade, exogenous factors are further broken into three influences: (1) the collective efficiency of the cluster in which the firm is located, (2) the governance of the value chain in which the firm is linked, and (3) the learning and innovation patterns of the industry sector that the firm participates in sectoral innovation systems. Humphrey and Schmitz (2000, 2002) present a typology that could be used to guide endogenous efforts to upgrade. In this typology, four categories of upgrading are presented: process, product, function/intrachain, and intersectoral/chain.

*Process upgrading* aims to increase value capture through production efficiency. This is done through process re-engineering and/or the introduction of superior technology (Gereffi et al. 2001; Giuliani, Pietrobelli, and Rabellotti 2005; Schmitz 2004). Kaplinsky and Readman (2001) go on to further divide process upgrading along intra-firm efforts, as can be evidenced by increased inventory turns or reduced waste, or inter-firm efforts, such as through increased and more on-time deliveries.

*Product upgrading* increases value capture by moving into product lines with high unit values (Gereffi et al. 2001; Giuliani, Pietrobelli, and Rabellotti 2005; Schmitz 2004). Compared to process upgrading, product upgrading presents the “quality versus quantity” approach. An example can be seen in Gereffi’s (1999) study of upgrading in the Asian apparel commodity chain from supplying discount chains to supplying department stores.

*Functional or intrachain upgrading* increases value capture through two means that focus on: (1) the firm’s functions that embody higher value-added, and/or (2) shifting coverage of activities in the value chain to acquire higher value-added functions. An example of the former would be increased focus on the firm’s outsourcing, accounting and quality functions. An example of the latter would be a shift from manufacturing to design (Gereffi et al. 2001; Giuliani, Kaplinsky, and Readman 2001; Pietrobelli and Rabellotti 2005; Schmitz 2004).

*Intersectoral or chain upgrading* is a strategy whereby the firm utilises functional knowledge in one chain to expand to a similar function found in another chain in a different industry sector. An example would be a radio manufacturer expanding to TVs, computer monitors, and then laptops. Another would be a graphite material specialist in the golf club market expanding to racing bikes and then aircraft components (Gereffi et al. 2001; Giuliani, Kaplinsky, and Readman 2001; Pietrobelli and Rabellotti 2005; Schmitz 2004).

## 4.2 Global value chains

### 4.2.1 *Definition and history*

The concept of the value chain provides a key starting point in understanding the dynamics of industrial organisation, international trade, and regional development. Use of the term “value chains” has been documented as far back as the 1960s in the context of development paths for mineral-exporting economies (Girvan 1987). In the 1980s, however, the term rose to popularity, particularly in the business literature, due to the works of Michael Porter (1980, 1985, 1990). Porter proposed two elements now found in modern value chain analysis: The value chain and the value stream. The value chain referred to the intra-firm activities involved in transforming inputs into outputs, and included not only the physical transformation processes, but also the support functions involved. These include research and development, procurement, human resources management, and many of the tasks that may now be regarded as higher value adding activities. His value system resembles the modern value chain in extending the framework of activities to inter-firm linkages (Kaplinsky and Morris 2002; Gereffi et al. 2001; Hess and Yeung 2006).

While these conceptualisations provide limited utility in the analysis of socioeconomic dynamics and development, they provided many of the theoretical foundations for the value chain today (Henderson et al. 2002). The concept also translated to economic geography, beginning with the works of Peter Dicken (1986), and was followed by a large body of works on transnational corporations and regional development (Hess and Yeung 2006).

Furthering the concept was popular work by Womack and Jones (1996) on value streams in the context of lean production. The proposed value streams were equivalent to the modern value chain, and added yet another term to the increasingly confusing nomenclature on value chains. Most recently, the works of Gary Gereffi, Timothy Sturgeon, Raphael Kaplinsky and John Hubert Schmitz have established the concept in areas of industrial organisation and economic sociology (Kaplinsky 2000, 2004).

While these definitions have varied across authors and across time, the modern definition found in the literature over the past decade is remarkably consistent. In it, a chain is defined as the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplinsky and Morris 2002; Gereffi et al. 2001; Kaplinsky 2000, 2004; Sturgeon 2001; Chang, Bayhaqi, and Zhang 2012). Furthermore, when these value chains span enterprises in more than one economy, they are termed “global value chains” (Sturgeon 2001; Chang, Bayhaqi, and Zhang 2012; Kaplinsky 2000).

### 4.2.2 *Value chain governance*

Value chain governance is defined by Gereffi (1994) as “the authority and power relationships that determine how financial, material, and human resources are allocated and flow within the commodity chain.” The concept recognises the existence of power asymmetries and lead firms that exert political influence or control over other firms and the very structure of the value chain. As such, an understanding of value chain governance is critical in enabling value chain analysis and the investigation of matters such as the ability of developing country firms to access international markets (Kaplinsky and Morris 2002; Gereffi et al. 2001).

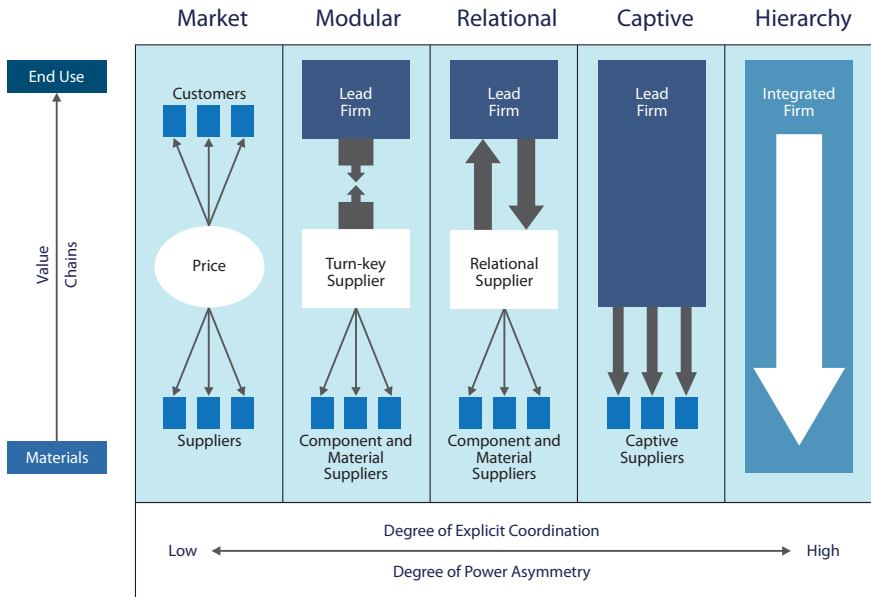
Gereffi, Humphrey, and Sturgeon (2005) attribute the existence of governance patterns in value chain relationships to three drivers: (1) the complexity of the information that needs to be transferred, (2) the extent to which this information can be codified, and (3) the capabilities of available suppliers in fulfilling the transaction. Gereffi et al. (2001) point to risk exposure to supplier failure as another reason for governance patterns and lead firms to emerge.

Lead firms are also judged to emerge due to unbalanced distributions of market power or market share amongst firms and the position of firms in high value segments of the value chain. Power is exercised by these lead firms in the value chain through monitoring of suppliers and control over key resources, chain entry/exit, and information distribution (Gereffi et al. 2001; Gereffi, Humphrey, and Sturgeon 2005).

### 4.2.3 Typology of governance

Early typologies of value chain governance have been proposed by Gereffi (1999) in his buyer-driven versus supplier-driven global commodity chains and by Kaplinsky and Morris (2002) in their legislative-judicial-executive value chain governance analogy. However, Gereffi, Humphrey, and Sturgeon (2005) produced a typology in their seminal work on the governance of value chains that has become widely adopted in the value chain literature. This typology consists of five types of value chain relationships: Market, modular, relational, captive, and hierarchy (Figure 4.1). These types are determined by the complexity of information flowing through the chain, the extent to which this information can be codified, and the available supplier capabilities in fulfilling the transaction.

**Figure 4.1: Typology of value chain governance**



Source: Gereffi, Humphrey, and Sturgeon (2005)

*Market* governance is characterised by low switching costs between alternative partners for both parties. These relationships exist when the complexity of information exchanged between buyer and seller is relatively low, allowing transactions to proceed with minimal intervention or governance. Generally, this is found in situations where product specifications are relatively simple and transactions are easily codified. Transactions are then determined by suppliers' offered product specifications and prices. While the cost of switching parties is low, however, this does not mean that linkages cannot persist over time.

*Modular* value chain linkages arise in situations with relatively low switching costs, similar to market linkages, but with more complex information exchange. These situations tend to come about when specifications for complex products can be modularised. Buyers provide specifications in this case, but the supplier is responsible for possessing the skills and technologies, as well as for making capital purchases on behalf of the buyer for materials and components. In such a relationship, the buyer has minimal need to direct or control supplier activities, but the initial information exchange is more complex than that of a market linkage.

*Relational* value chain linkages are characterised by mutual dependence and high levels of asset specificity between buyers and sellers. These arise in situations where complex product specifications result in the requirement of intensive information transactions and advanced supplier capabilities. These relationships entail frequent interaction and close coordination, making the costs of switching partners high. Transactions along these linkages can be facilitated by close proximity, familial or ethnic ties, trust/reputation, and contractual terms. Outsourcing can be described as a type of relational value chain linkage.

*Captive* value chain relationships refer to the supplier being held captive through dependence on the buyer. In these situations, product specifications are complex but supplier capabilities are low, resulting in significant intervention and control by the buyer. Given the investment of effort required in these transactions, buyers seek to lock in their suppliers through financial or operational dependence. For example, captive suppliers are frequently confined to a narrow range of tasks and depend on the buyer to carry out the more complex complementary tasks. Suppliers are able to gain market entry and some resources in return.

*Hierarchy* linkages arise when satisfactory suppliers cannot be found by the buyer, often due to product complexity or concerns about intellectual property. In this situation, buyers adopt the vertical integration approach to develop and manufacture products in house. As such, the suppliers in hierarchy relationships are actually governed directly by the buyer through managerial control.

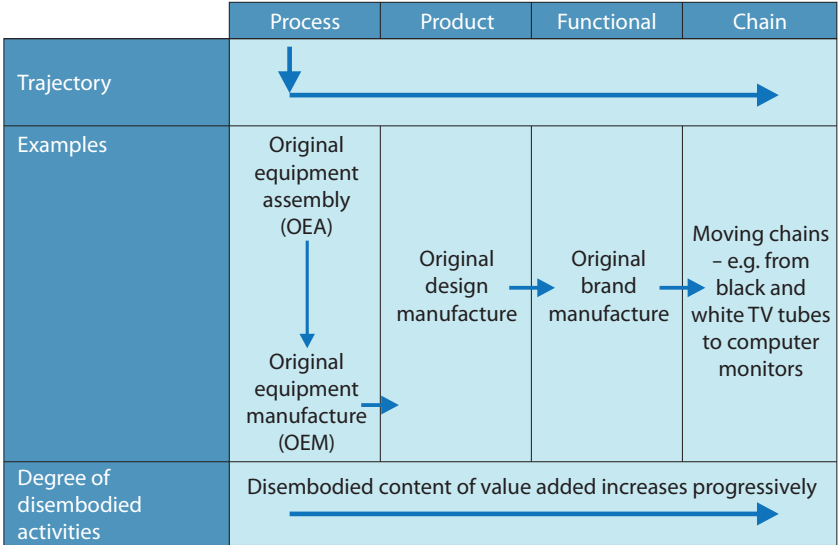
There are some shortcomings to this typology, however. The concept of the lead firm here is restricted to a much narrower context of lead firm and first-tier suppliers. Additionally, it removes the notion of agency from governance by focusing on governance type as determined by transaction type instead of by rent-maximising motivations.

#### 4.2.4 Governance and upgrading trajectories

Gereffi (1999) and Lee and Chen (2000) suggest a trajectory for upgrading, in which firms begin with process upgrading and then proceed to product, functional and finally chain upgrading. This is based on their observations of East Asian firms transitioning through

their roles as original equipment assemblers (OEAs) to original equipment manufacturers (OEMs), own design manufacturers (ODMs), and finally own brand manufacturers (OBMs) (Kaplinsky and Readman 2001; Kaplinsky and Morris 2002) (Figure 4.2).

**Figure 4.2: Example trajectories of upgrading**



Source: Kaplinsky and Morris (2002)

This trajectory of upgrading has encountered criticism as rather optimistic in portraying an automatic conveyor process up the value ladder (Schmitz 2004; Morrison, Pietrobelli, and Rabelotti 2008; Giuliani, Pietrobelli, and Rabelotti 2005).

Humphrey and Schmitz (Humphrey and Schmitz 2000, 2002; Schmitz 2004) address this by investigating how chain governance can affect the prospects for the posited trajectory of upgrading. They utilised a predecessor to Gereffi’s 2005 typology of value chain governance, which consisted of four types instead of five. Modular and relational types were grouped into a “balanced” category at that time, but the other types remain the same. Their studies focused on the captive and balanced types of governance.

For captive, their results show clear indications that captive chain linkages fostered rapid process and product upgrading, but hinder functional upgrading. In these situations, buyers are extremely demanding of low capability suppliers, but invest a significant amount of time monitoring and instructing suppliers as a result. This allows the supplier to progress rapidly through process and product improvements. However, barriers seem to appear when the firm approaches functional upgrading efforts. The first barrier posited is due to the buyer’s self-interest in preserving their core competencies in the non-manufacturing segments of the value chain, which tend to impart higher value and more governance power. These non-manufacturing segments include design, branding, and marketing. Simply put, the buyers have no interest in helping their suppliers become



competitors. The second barrier is the immense investment of capital, time, and effort required for a supplier to independently develop their own brands or set up marketing channels in the same value chain.

The rapid upgrading through production and slow upgrading in non-production segments of captive global value chains is offset by the example of substantial functional upgrading but slow process and product upgrading found in domestic value chains. Cases in India and Brazil show that domestic-focused firms are more likely to acquire functional capabilities and then expand into neighbouring markets, and reveal potential limits to export-driven economic growth.

Balanced linkages offer the ideal upgrading conditions, as power and commitment is shared between firms. This is conducive to focusing on value creation through new product and process development, and is commonly documented in the literature on innovation networks in developed countries. A prerequisite for this type of buyer-supplier relationship, however, is a high level of competencies already held by the supplier – something that is difficult to find in developing country firms. However, research on modular production networks (Sturgeon 2002) point to the ability of developing country firms to form highly complementary clusters that are together able to form balanced type relationships with their respective buyers. Examples include the computer cluster in Chinese Taipei and the Brazilian shoe cluster.

More recently, Morrison, Pietrobelli, and Rabellotti (2008) point out an alternative and largely disregarded source of growth: Deepening firm capabilities at any segment of the value chain instead of rigidly looking at expansion along the value chain as the only source of growth. For example, climbing up the value chain ladder in the horticulture industry might imply upgrading from growing flowers to packaging, distributing, branding, and retailing them. However, there is significant growth to be found in each one of those stages, such as in the development of new flower varieties or in developing new packaging that embeds highly valued characteristics.

These efforts present both clear and immediate utility to both the business person and the policy maker in understanding the various sources of growth and the feasibility of capturing them.

### *4.2.5 The global value chain framework*

Value chain analysis focuses on the dynamics of the interlinkages within the productive sector and their implications for socioeconomic development. In considering the way in which countries and firms are globally integrated, the framework provides insights on the distribution of income and power along the GVC that traditional modes of social and economic analysis are not able to provide (Kaplinsky 2000; Morrison, Pietrobelli, and Rabellotti 2008; Kaplinsky and Morris 2002).

The methodology of value chain analysis contains a rather loose or modular set of analyses to be adapted to the purposes of each study. Kaplinsky and Morris (2002) break the value chain analysis methodology into eight primary components:

- (1) setting the perspective,
- (2) mapping,
- (3) market segmentation,
- (4) market access,
- (5) value chain performance,
- (6) value chain governance,
- (7) upgrading, and
- (8) distributional issues.

Given the descriptive breadth of value chains, the GVC approach can be utilised for a similarly broad range of issues. As such, the first challenge in GVC analysis is in defining the perspective with which to approach the value chain. This perspective will determine the variables to be examined, and sets the stages for the downstream analytical steps. For example, a study of the national distribution of value add in automobiles and a study on women's involvement in the labour market will incur different variables of investigation.

Once the perspective for the analysis is determined, a decision must be made on the network scope of the study. Given the network structure of GVCs, one could trace suppliers and buyers both horizontally and vertically from immediate linkages through to the ultimate supplier and consumer. Methodological boundaries must be defined, most likely through a consideration of resource limitations in conducting the study.

The third component is an examination of the final markets in the GVC, and is particularly relevant due to the prevalence of buyer-driven chains. The type of market study is determined by relevance to the chosen perspective and variables, and typically entails market segmentation and basic quantitative characterisation.

The fourth analysis examines the linkages between the perspective's focal firm/segment in the GVC and the final market. Again, this is done in recognition of the significance of buyer-driven chains. The fifth component examines operational performance of firms in the GVC and/or of the chain, itself. Sixth is a consideration of governance in the GVC, and utilises the typology of chain governance. Similarly, the seventh component utilises the typology of firm upgrading to examine upgrading dynamics in the chain. Finally, the eighth component considers the critical distribution of power and income along the GVC.

## 4.3 Global production networks

### 4.3.1 Definition and history

Henderson et al. (2002) defines global production networks as the "the globally organized nexus of interconnected functions and operations by firms and non-firm institutions through which goods and services are produced and distributed". The concept has many predecessors, ranging from value chains, supply chains, global commodity chains, and actor-network theory – to name a few.

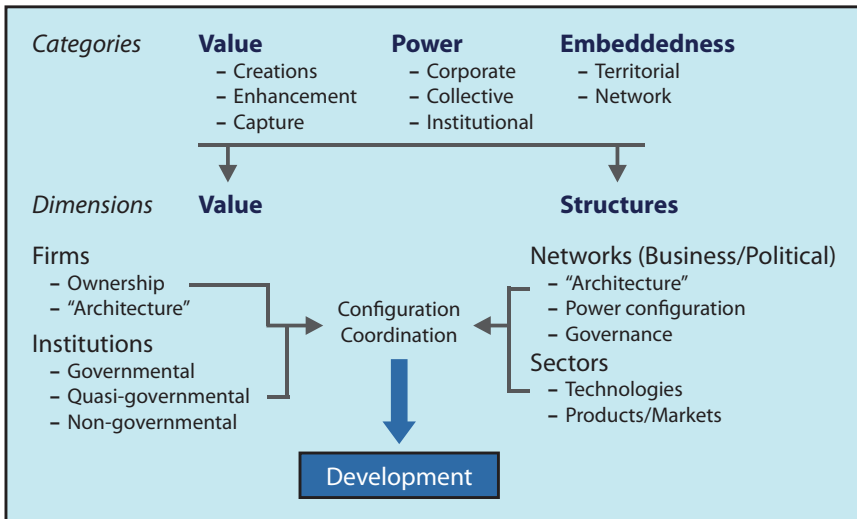
The most recent and relevant of these, however, is Gereffi's concept of the global commodity chain. The "Manchester School" of researchers are including Neil Coe, Peter Dicken, Jeffrey Henderson, Martin Hess, Khalid Nadvi, and Henry Wai-chung Yeung, among others, have done much work to advance the concept. (To avoid confusion, however, it should be noted that while most of the listed researchers are located at the University of Manchester, Henry Wai-chung Yeung is located at the National University of Singapore). They have expanded upon the global commodity chain framework by moving beyond a governance focus and by altering the nomenclature of the "commodity chain" to the "production network" to be more inclusive.

Also significant is the work by Dieter Ernst on global production networks, developed simultaneously but independently. Ernst conceptualised GPNs as an organisational innovation that "combine(s) concentrated dispersion of the value chain across firm and national boundaries, with a parallel process of integration of hierarchical layers of network participants" (Ernst and Kim 2001). However, Henderson et al. (2002) point out here, too, that the concept was derived from a narrow range of sectors – namely the electronics and information technology industries – and does not adequately qualify for general relevance.

### 4.3.2 The global production network framework

The GPN analytical framework, as proposed by Henderson et al. (2002), provides a way to understand the "global, region and local economic and social dimensions" embodied in globalisation. Three principal variables are examined in the global production network: value, power, and embeddedness (Figure 4.3).

Figure 4.3: The global production network framework



Source: Henderson et al. 2002

Value, here, is defined by economic rent and Marxian surplus value. Considerations of value are segmented into the processes of value creation, value enhancement, and value capture. The examination of conditions for each process reveals a wide array of socioeconomic dynamics, such as the role of technology, relationship with labour, and effects of governance.

Power refers to the ability to influence others in the global production network, much like the governance dynamics discussed in GVCs, but is categorised into three types: corporate power, institutional power, and collective power. *Corporate power* is held by the firm and places emphasis on analysing the existence and impact of lead firms in the GPN. *Institutional power* is held by governments and international organisations. These international organisations are classified as international inter-state agencies, such as ASEAN and the EU, the Bretton Woods organisations plus the World Trade Organisation, the UN agencies, international credit rating agencies, and other standard setting bodies. These organisations do not exert their power through direct market competition with corporate power, but rather influence the conditions under which market competition is held. *Collective power* is held by civil organisations such as labour unions and NGOs that seek to influence both the corporate and institutional powers.

Embeddedness refers the socioeconomic relationships or ties that bind firms and other actors to each other. Two types of embeddedness are considered: territorial and network. *Territorial embeddedness* takes into account the interconnections that result due to the geographical location of a firm, and takes a similar perspective to industrial clusters research. *Network embeddedness* takes into account the interconnections that result due to the membership of firms and entities actors in certain economically-motivated networks, and directly relates to the value chain and production network perspectives.

These three variables of value, power, and embeddedness are then considered across four dimensions of analysis: firms, sectors, networks, and institutions. The *firm dimension* is relatively straightforward, and examines the dynamics of value, power, and embeddedness from the firm perspective. The *sector dimension* encompasses a range of companies and various institutional and civil organisations involved in an industry sector. This dimension begins to consider more policy-related influences on industry dynamics. The *network dimension* is still conceptually open, and has yet to be defined. However, its interests are in examining the governance dynamics that arise in networks of firms and other actors. Finally, the *institutions dimension* considers the local and global institutions that are key to enabling the economically and socially sustainable performance of firms and networks in specific locations.

The GPN framework possesses considerable potential in its explanatory powers. However, its ambitiousness, as evidenced by its consideration of a wide range of factors, require intensive effort to move the framework forward. As such, it still remains largely a framework of analysis with which to orient one's considerations, and lacks a clear methodology or tools for generating prescriptive results. Thus far, GPN studies have primarily relied on qualitative interviews to generate data, and have tended to disregard quantitative data such as trade or production statistics. However, this is something GPN researchers in the field are already looking to address (Hess and Yeung 2006).

## 4.4 Supply chains and rural development

### 4.4.1 *Rural development*

Rural development deals critically with the effort to “create additional value for rural regions” (Marsden, Banks and Bristow 2000). Modern rural development research and practice seeks to adapt the rural economy and its actors to the forces of globalisation (Jarosz 2008).

Two main challenges are addressed; one sourced from the producer’s perspective and one sourced from the consumer. From the producer’s side, the previous rural development model of industrial agriculture is no longer seen as economically or environmentally sustainable. This industrial agriculture model is characterised by intensive, large-scale, and commoditised food production geared to maximise economies of scale. The literature addresses a perceived crisis of confidence in this model, with food producers expecting a continuous and steady loss of capital from the farm and rural areas (Marsden, Banks, and Bristow 2000). From the consumer’s side, the literature notes a new pressure for quality food products that meet socially-constructed criteria. This is evidenced in the emergence of new food markets that are differentiated from existing “anonymous mass food markets” (Renting, Marsden, and Banks 2003).

While rural development is a broad concept and difficult to define, van der Ploeg et al. (2000) present an attempt to characterise rural development according to six key aspects. The first refers to rural development as a realignment between agriculture and society at the international and domestic level. The second defines the search for new rural development models as a critical component. The third specifies individual farm households as the subject for operationalising rural development strategies. The fourth defines the countryside and its actors as the realm of applicability. The fifth component of rural development is policies and institutions. The sixth and final component encapsulates the wide array of approaches that result from the attempt to achieve rural development.

Rural development overlaps with supply chains in the area of alternative food networks (AFNs) and short food supply chains (SFSCs). These are viewed as important mechanisms for testing and implementing new modes of rural development. The literature reviewed in this area was largely produced in the late 1990s and early 2000s by European researchers addressing European markets. This is somewhat unexpected, given the relevance of rural development and supply chains to developing economies that are still dominated by the agricultural sector. However, given the fundamental problem addressed – of creating and capturing additional value for rural regions – there is potential for translating findings from rural European markets to developing market contexts elsewhere.

### 4.4.2 *Alternative food networks*

Alternative food networks (AFNs) are efforts to realign food production, distribution, and consumption with economic, social, and environmental objectives. These networks counter the standard industrial modes of agriculture and are seen as potential solutions to the challenges of rural development (Renting, Marsden, and Banks 2003).

AFNs can be characterised as having one or more of the following characteristics: (1) shorter distances between producers and consumers, (2) smaller farm size with the use of organic or holistic means of food production, (3) the use of alternative food distribution and retail means, such as food cooperatives and farmer’s markets, and

(4) alignment to social, economic, and environmental goals (Jarosz 2008). Amongst the variety of AFNs, a particular type known as short food supply chains (SFSCs) has gained significant exposure.

### ***4.4.3 Short food supply chains***

Short food supply chains (SFSCs) can be classified as a type of alternative food network, and focus on the inter-relations between producers, distributors, and consumers of food products (Renting, Marsden, and Banks 2003). SFSCs emerged out of attempts by the farming population to recapture value in the supply chain by short-circuiting the anonymous, commoditised industrial food supply chains to meet new consumer demands for information and transparency.

Accordingly, the defining characteristic of a SFSC is the ability to connect the food producer and the food consumer through the preservation of information through the supply chain. This information critically allows the consumer to make a value judgement about the desirability of a food product. As explained by Marsden, Banks, and Bristow (2000), "it is not the number of times a product is handled or the distance over which it is ultimately transported which is necessarily critical, but the fact that the product reaches the consumer embedded with information."

A typology of SFSCs is presented in Renting, Marsden, and Banks (2003) and Marsden, Banks, and Bristow (2000), consisting of three categories of SFSCs graded along the spatial dimension. The first is face-to-face chains where the producer and consumer conduct transactions directly through personal interactions. These include farm stands and online suppliers. The second is spatially proximate chains, which provide consumers with food produced in the immediate region or locality. An example would be the retail of locally grown produce at specialty food markets or the offering of locally sourced ingredients at a restaurant. The third category is spatially extended chains, where information on the place and means of production is translated to consumers who are outside the region of production. This can be seen in the products distinguished by their terroir, such as the sale of French champagne or Italian gorgonzola in foreign markets.

The result of SFSCs is a "re-socialisation" and "re-spatialisation" of food through communication on the location, method of production, and other food properties to the consumer. As such, SFSCs are viewed as a potential source of new rural development models that break from current industrial food chains to enable more socially and environmentally sustainable methods of agricultural production (Marsden, Banks, and Bristow 2000; Renting, Marsden, and Banks 2003).

## **4.5 Empirical studies**

The contrasts in development perspectives can be seen in the empirical studies (Table 4.1 below). Studies have clearly adopted both firm and policy maker perspectives, while the coverage of industries is heavily skewed towards globalised and lower value-added industries. However, analysis is fairly consistent in adopting the value chain or production network framework, and coverage of all major regions is seen.

Table 4.1: Empirical studies sourced from the literature

Citation	Year	Type	Industry	Geography	Subject
Coe et al.	2004	case study	BMW	Eastern Bavaria, Germany; Rayong Province, Thailand	Global production networks and regional development
Cooke and Morgan	1993	case study	multiple	Baden-Wurttemberg, Germany; Emilia-Romagna, Italy; Basque, Spain; Wales, United Kingdom	Regional SME bolstered development
Fitter and Kaplinsky	2001	case study	coffee	International	Distribution of rent across the global value chain
Gereffi	1999	case study	apparel	Asia	Industry upgrading for countries in the apparel supply chain
Gereffi, Humphrey, and Sturgeon	2005	case study	bicycles, apparel, fresh vegetables, electronics	International	Typology of value chain governance
Giuliani, Pietrobelli, and Rabellotti	2005	case study	manufacturing, natural resources, complex products, software	Latin America	Firm upgrading in clusters and global value chains
Jaffee, Kloppenburg, and Monroy	2004	case study	agriculture, food processing, distribution	United States, Mexico	Fair trade practices in the geopolitical "North" and "South"
Jarosz	2008	case study	agriculture, distribution	Washington, United States	Agriculture and alternative food networks in metropolitan areas
Kaplinsky	2004	case study	fresh fruit and vegetables, canned deciduous fruit, footwear, automotive	International	Distribution of rent across the global value chain
Macpherson and Wilson	2003	survey	manufacturing	Northwest England	Development opportunities for SMEs in the supply chain
Ndou, Vecchio, and Schina	2011	survey	food processing	Tunisia	E-business models for SMEs in developing countries
Sturgeon, Biesebroeck, and Gereffi	2008	case study	automotive	International	Value chain analysis of the global automotive industry
UNESCAP	2011	case study	plastics, ginger and coffee, rubber and electronics	Bangladesh, Nepal, Sri Lanka	Integration of developing country SMEs into global value chains
Walker and Preuss	2008	case study	public sector, health sector	United Kingdom	Sustainable development through public sector sourcing from SMEs
Wang and Cheng	2010	case study	logistics	Hong Kong	Upgrading of Hong Kong from a port city to a supply chain management center

While we are aware of the existence of empirical studies on the service sector, we are surprised to see the lack of works in our sourced literature. Given that the offshoring of services is a recent phenomenon in the 21<sup>st</sup> century and that services have been successfully offshored to developing country settings, such as India, this is a clear area of need for future studies.

## 4.6 Future directions

The past decade has seen significant advances in theory relating to supply chains in conjunction with development and upgrading. This is, in large part, due to a very active body of researchers, including the likes of the global value chain school of thought (including Gary Gereffi, Raphael Kaplinsky, John Humphrey, Hubert Schmitz, and Timothy Sturgeon) and the Manchester school on global production networks (including Neil Coe, Peter Dicken, Jeffrey Henderson, Khalid Nadvi, and Henry Wai-chung Yeung).

With the establishment of theoretical foundations, such as the typologies on upgrading and governance, as well as the analytical frameworks on supply chains in their various forms, we foresee the development of a variety of derivative tools to support the business practitioner looking to manoeuvre in the supply chain and for policy makers looking for paths towards industrial and economic development. The connection between theory and application will require a clearer segmentation, however, of perspectives and scenarios for use other than exists right now in the literature.

After the consolidation and rise of concepts such as global commodity chains and global value chains, we also look to global production networks as a possible next step in the evolution of the network-of-organisations concept. We see the merits in its integration of prior best concepts into a more comprehensive and balanced framework for analysis, and can foresee the GPN concept rising with buy-in from the current research body and more theoretical development to create a portfolio of analytical tools.

In light of the heavy emphasis of empirical studies on a few select industries, such as electronics, automotive and apparel, we also see the need for expanding empirical studies across less understood industries. In particular, we note recent studies on services and their role in development, and hope to see an expansion in studies on the role that services can play in development.

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## Chapter 5

# Supply chains and risk

### *Abstract*

One area in which both business practitioners and policy makers are immediately able to perceive the significance of the supply chain concept is in the new risks that have materialised in an increasingly interconnected world. Isolated events such as the September 11 attack in the United States in 2001, the Eyjafjallajökull volcano in Iceland, the Fukushima disaster resulting from the Tōhoku earthquake and tsunami in 2011, and flooding in Thailand in the same year now precipitate waves of uncertainty that travel faster and further than ever before. Perhaps unsurprisingly, the literature on risk and supply chains is one of the most advanced in theoretical development and operational applicability among the supply chain issues reviewed in the literature. In this chapter, we review the central concept of supply chain risk management (SCRM) and provide a more in-depth analysis of the SCRM framework's underlying concepts of risk identification, assessment, and mitigation.

### 5.1 Defining risk

Firms today have access to a new world of resources as a result of globalisation. However, firms have had to expand their capabilities beyond their traditional boundaries to rely on extended networks in order to capture these new gains. As a result, today's market place is defined much more by competition between teams rather than individual firms. Correspondingly, the fate of the firm is now communally shared, to some extent, and risks that were considered ignorable before have come to take on a new significance due to expanded network exposure (Faisal, Banwet, and Shankar 2006).

Sodhi and Tang (2012) point to three emerging characteristics underlying the new changes that are driving the growth in risk. First is the increasing number of firms found in supply chains and, thus, an increasing number of points for possible disruption. Second is the decreasing visibility and transparency that results from the increasing length of the supply chain, which in turn impedes detection and response efforts. Third is the

increasing global consequences of local actions in a supply chain, which increases the risk of globally suboptimal results from locally optimal decisions.

The nature of these risks is derived from the systemic interactions characteristic of supply chains and their significance was realised through a string of events around the turn of the millennium. The first was the Y2K bug and the rapid realisation of the extent of global interconnectedness by the end of the 1990s. Soon after came the 2000 fuel protests and the 2001 outbreak of foot-and-mouth disease in the UK, which led the UK government to mandate a study on supply chain vulnerability.

This was well under way by the time the September 11 attacks suddenly gave rise to the issue of supply chain risk on the US research agenda (Jüttner, Peck and Christopher 2003; Christopher and Peck 2004). This recognition was not limited to the Western world, given the 2003 outbreak of SARS on the Chinese mainland and in Hong Kong that shut down major economic hubs and raised fears of a global epidemic (Faisal, Banwet, and Shankar 2006). More recently, food security issues such as melamine contamination in infant formula and powdered milk in China have added to the awareness of supply chain risk (Narasimhan and Talluri 2009). Altogether, these events have raised awareness of the importance of supply chain risk and have cemented efforts to establish a research agenda on supply chain risk management.

Supply chain risk is expected to continue being a major issue for both firms and governments. Technology and business model innovation will only further the gains made through trade. Toyota, as of 2012, runs 50 overseas manufacturing operations spread across 26 countries. The produced vehicles and components are then supplied to more than 170 countries and regions. The realisation of risk events can thus travel further and faster than before (UNESCAP 2013).

Firms that are not prepared have much to lose, as a popular study by Hendricks and Singhal (2005) has shown. Their survey of over 800 supply chain disruption-related company announcements over a 10-year period found that negatively affected companies suffered between 33 per cent and 40 per cent lower stock returns against industry benchmarks. Even in the case that the growing global interconnectedness is halted by a rise in protectionism or isolationism, the connections already in existence are at risk of being severed, composing a distinct class of supply chain risks of their own (Narasimhan and Talluri 2009; Manuj and Mentzer 2008b).

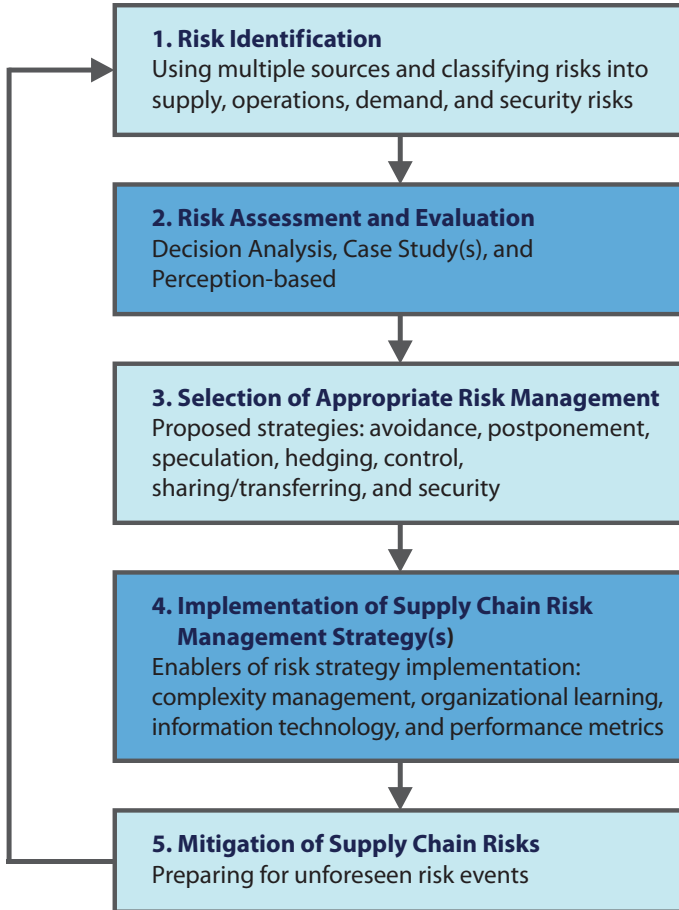
## 5.2 The supply chain risk management framework

Attempts to address risks in the supply chain context have been unusually unified in approach when compared to theory building efforts found in the other supply-chain related issues covered in this volume. Research largely falls under the framework of supply chain risk management (SCRM), with some minor variance in nomenclature and the subcategorisation of issues.

SCRM encapsulates the process of identifying supply chain risks, assessing them and choosing among a range of approaches to mitigate them (Nieger, Rotaru, and Churilov 2009; Manuj and Mentzer 2008a, 2008b; Khan and Burnes 2007; Gaonkar and Viswanadham 2007; Jüttner, Peck, and Christopher 2003). An example of this basic SCRM framework can be seen in the work of Manuj and Mentzer (2008a) in Figure 5.1. In the following

sections, we review the concepts contained in the successive steps of risk identification, risk assessment, and risk mitigation.

**Figure 5.1: An example of the supply chain risk management (SCRM) framework**



*Source: Manuj and Mentzer (2008a)*

### 5.2.1 Risk identification

Approaches to risk identification invariably centre around a typology of risks. The utility of this typology is in aiding the practitioner to make sense of the variety of risks he or she faces and to organise the information needed for risk assessment and mitigation. The most widely used typology of those reviewed is based on a spatial categorisation of risks from the perspective of a focal firm. These categories include the operational risks sourced from within the focal firm, supply risks from upstream firms, demand risks from downstream firms, and environmental risks.

There is general consensus on the definition of the first three, but some variability on the conception of environmental risks. We start with the definitions for operational, supply, and demand risks as compiled from Bogataj and Bogataj (2007), Christopher and Peck (2004), Harland, Brenchley, and Walker (2003), Jüttner (2005), Sodhi and Tang (2012), and Manuj and Mentzer (2008a, 2008b).

*Operational risks* are derived from the operations of the focal firm, and are commonly subdivided into process risks and control risks. Process risks relate to disruptions in the focal firm's set of value-added processes, such as design, manufacturing, and distribution. Control risks, on the other hand, refer to the controls used to govern processes. An example would be established operational policies or procedures, which can both amplify or mitigate risks.

*Supply risks* negatively affect the timing, cost, and/or specifications of all inputs required by the focal firm, whether the inputs are goods, services, or even information. These are sourced from firms upstream from the focal firm. An example of a supply chain risk would be the bankruptcy of a key component supplier.

*Demand risks* are based on the failure to match production with consumer demand, whether it is due to changing consumer preferences or imperfect communication between the focal firm and downstream firms. An example would be the risks incurred when expanding into a foreign market with little knowledge of local preferences.

Risks sourced outside of these three categories include risks at the network level that cannot be defined as upstream or downstream and risks that originate outside the network. These risks have been categorised as environmental risks, security risks, and corporate risks, among others.

The difficulty in categorising these risks arises from the need to define the network boundaries of the supply chain. An additional conceptual difficulty is the transforming nature of risk as it is propagated through a supply chain. For example, an environmental risk such as an earthquake may turn into an operational risk for the affected firm, which in turn creates supply risks that travel downstream and demand risks that travel upstream. Table 5.1 presents a sample of the variety of these risks that do not fall within the operational, supply, and demand risk categories.

**Table 5.1: Examples of environmental or non-operational/supply/demand risks reviewed in the literature**

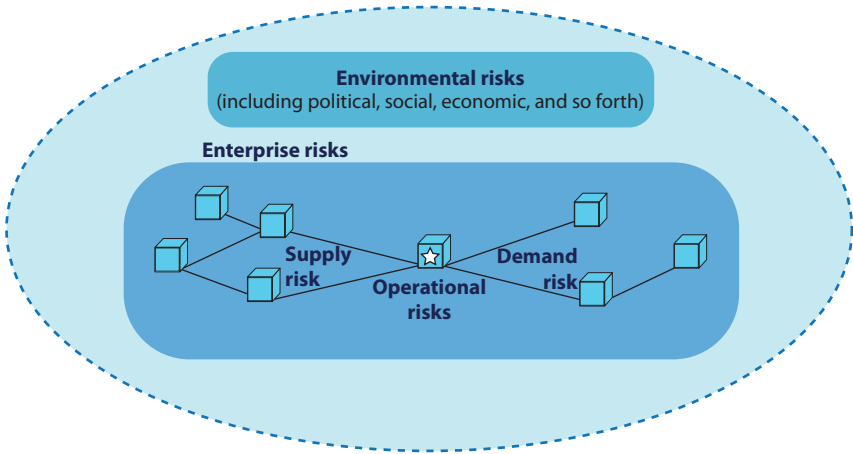
Reference	Environmental or non-operational/supply/demand risks
<i>Bogataj and Bogataj (2007)</i>	risks derived from the physical, social, political, legal, operational, economic, or cognitive environments
<i>Christopher and Peck (2004)</i>	risks derived from socio-political, economic, or technological events
<i>Jüttner (2005)</i>	risks derived from political, natural, or social uncertainties
<i>Sodhi and Tang (2012)</i>	financial risks, supply chain visibility risks, political/social risks, IT system risks, intellectual property risks, exchangerate risks, environmental risks, regulatory risks
<i>Manuj and Mentzer (2008a)</i>	security risks, macroeconomic risks, policy risks, competitive risks, and resource-constraint risks

In reviewing the various attempts, a synthesis of the environmental risk concept and an enterprise risk concept presents a possible solution to creating a clear and coherent segmentation of these risks.

In such a synthesis, *environmental risks* are most simply described as risks sourced from beyond supply chain borders, which in this conception, are an aggregate of firm borders that belong to the supply chain; the criteria for which firms to include in the supply chain are determined by the risk management scenario. Examples of environmental risks vary from tsunamis to labour strikes, to the nationalisation of business assets or even the invention and implementation of the internet.

*Enterprise risks* are distinguished from environmental risks by their origin from within the supply chain. However, unlike operational, supply, and demand risks, enterprise risks originate from systems and infrastructure that span portions or the entirety of the supply chain. Examples of enterprise risk include the failure of central IT systems that manage information flow across the supply chain, leakage of intellectual property distributed across supply chain partners, and legal exposure resulting from inadequate supplier compliance policies. An adaptation of these typology categories is presented in Figure 5.2.

**Figure 5.2: An adaptation of the reviewed risk identification typologies**



Two other typologies to note, aside from this focal firm-centric spatial approach, are a spatial cause-and-effect typology of risks and a magnitude of impact-based typology of risks. Sodhi and Tang (2012) present a spatial cause-and-effect typology, where risk sources are distinguished as locally-derived or globally-derived and their consequences considered at, again, the local and global levels. This typology is more easily demonstrated visually, and a typology adapted from their work is presented in Figure 5.3.



Figure 5.3: Adaptation of a typology of supply chain risk drivers and consequences

		Consequences	
		Local	Global
Risk Sources	Local	<b>Operational risks</b> local risks stemming from supply and demand	<b>Network risks</b> risks stemming from a firm or region that spreads to impact the whole supply chain
	Global	<b>Localisation risks</b> risks from corporate level decisions on specific markets or regions	<b>Enterprise risks</b> risks from corporate level decisions that impact the entire supply chain

Source: Sodhi and Tang (2012)

The magnitude of impact-based typology, also presented by Sodhi and Tang (2012), distinguishes between “normal” risks, classified as “delays”, and “abnormal” risks, classified as “disruptions”. Gaonkar and Viswanadham (2007) present a similar categorisation that divides Sodhi and Tang’s “disruptions” category into “disruptions” and more severe “disasters”. These alternate typologies also hold value for the management practitioner, and a potential area for future work includes integration of these three typologies to provide a comprehensive system for the categorisation of risks. In light of the fact that the perception of risk directly affects the response to risk, the utility of a comprehensive typology should not be underestimated.

### 5.2.2 Risk assessment

Risk assessment is the next step in the SCRM progression, taking the identified risks and assigning them with the significance that will, in turn, guide the development of a risk mitigation strategy. At the most fundamental level, risk assessment centres around two questions: (1) what is the likelihood of a risk event occurring, and (2) what is the significance or impact of that risk event? (Harland, Brenchley, and Walker 2003; Khan and Burners 2007; Zsidisin et al. 2004). While relatively straightforward in theory, answering these two question proves difficult in practice due to three challenges.

First is a *design problem*. In the literature reviewed, there was no universal risk assessment tool being developed by a body of authors. Instead, a myriad of approaches and associated tools have been presented. Perhaps this is fitting, given that risk assessment is highly situation-specific; the same risk will have very different repercussions depending on time and place in the value chain. However, the question of how to design a risk assessment process around a practitioner’s given situation has yet to be fully addressed; and as Manuj and Mentzer (2008) point out, “the heart of risk assessment is asking the right questions.”

Second is a *coordination problem*. Risk assessment requires the gathering of information and the assessment of that information horizontally across firm boundaries and vertically across levels of company hierarchy. Given that visibility and knowledge vary across these organisational boundaries, risk assessment entails a significant coordination challenge in execution.

Third is a *subjectivity problem*. This can be illustrated through a simple example: how does one assess the impact of the discovery of child labour on a consumer good's brand name? Firms hold both tangible and intangible assets. In the case of intangible assets, such as brand value, intellectual property and goodwill, arriving at a dollar valuation is a very subjective process. This is further compounded by the fact that the assessment of risk is significantly affected by the culture, confidence, and knowledge held by the assessor. As mentioned in the previous section, the perception of risk directly affects the behavioural response to risk (Juttner 2005; Juttner, Peck, and Christopher 2003).

Unfortunately, we are not able to present any answers to the above problems. What we are able to do, however, is review the assessment tool classifications that are presented in the literature so that the practitioner may know what options are available. We begin with a broad classification by Manuj and Mentzer (2008) of tools as either decision analysis, case study, or perception based. Decision analysis entails the input of data into a risk assessment formula that produces some solution set of outcomes. In the case that the formula is based on qualitative inputs (such as low-medium-high or yes-no inputs), the tool is referred to as perception based. The remaining type, case studies, allows firms to assess their risks through the process of investigating some aspect(s) of their organisation.

These tools can also be categorised by the types of analysis, inputs, and implementation. Analysis can be based on probabilistic choice (PC) or risk analysis (RA). PC assesses risks as an average expected impact of a risk event. An example of this logic would be multiplying the impact of a risk event by its probability of occurrence to provide an average expected outcome. However, there are situations where the realisation of a risk event is extremely rare but catastrophic. In these situations, the very low probability of occurrence may make the expected outcome appear misleadingly insignificant. For such situations, an RA approach based on minimising regret would be more appropriate (Manuj and Mentzer 2008).

The types of inputs to be used for analysis can be classified as qualitative or quantitative and objective or subjective. It should be pointed out that quantitative inputs are not exclusively objective (for example, considering the question of "what would be the financial damage if someone leaked our trade secret"), and qualitative inputs are not exclusively subjective. Finally, implementation of risk assessment processes or tools can be formal or informal. Formal implementation entails a structured approach with designated assessors, a predetermined time frame, and other protocols. Informal implementation, on the other hand, could be done whenever, wherever, and by whomever.

Further research is needed in understanding how to tailor the various types of risk assessment concepts to the situation. While practitioners have acknowledged the importance of risk assessment, there is a chasm between the generation and the utilisation of risk assessment results (Juttner 2005; Tang 2006). Whether this is due to a lack of credibility or relevance of current assessment tools or whether it is due to the lack of a methodology bridging assessment results with mitigation strategy design is, as yet, unknown.

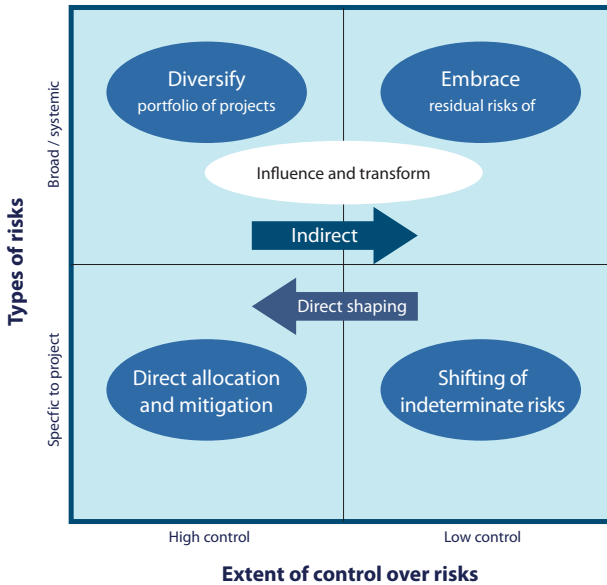
### ***5.2.3 Risk mitigation***

Following risk assessment is risk mitigation. This step contains, in actuality, two parts: (1) the selection, and (2) the implementation of various risk management strategies. Several

excellent reviews have been done on the risk mitigation strategies available to supply chain practitioners, including the works of Jüttner, Peck, and Christopher (2003), Manuj and Mentzer (2008a, 2008b), Sodhi and Tang (2012), and Tang (2006). What will be set forth here is an integration of research findings from such works. These frequently display superficial differences across studies, but most of these conflicts have been found to be rooted in nomenclature and not in logic. The findings are synthesised and presented here as a sequence on the classification, selection and implementation of risk management strategies.

There are a number of risk management strategies both documented and developed in the literature. These can be organised along two lines of classification. The first categorises strategies according to whether they entail risk avoidance, mitigation, or acceptance. Recalling probability and impact as the two key characteristics of risk assessment, avoidance emphasises a minimisation of probability, while mitigation focuses on impact. An example of avoidance would be withdrawing from a risky market or adopting a zero tolerance policy on supplier compliance. Mitigation, or reduction of risk, is often done by maintaining an agile, adaptable, and aligned supply chain (Lee 2004) or an aligned, flexible, and buffered supply chain (Sodhi and Tang 2012). The third category, risk acceptance, is the simplest of the three, and entails no action being taken in preventing or otherwise addressing the risk event. An example of a framework for mitigation responses can be seen in the framework presented by Lessard and Miller (2001) in Figure 5.4.

**Figure 5.4: A framework of risk mitigation strategies**

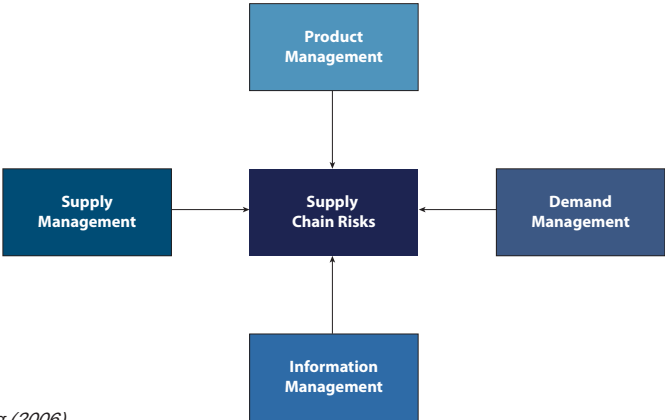


Source: Lessard and Miller (2001)

The second classification of risk management strategies, presented by Tang (2006), is based on the supply chain context; specifically, on whether the strategy addresses supply, demand, products, or information. (Figure 5.5) Supply management encompasses all

upstream-sourced risks, such as commodity constraints and supplier failures. Demand management addresses all downstream risks, such as inventory shortages or changing consumer preferences. Product management can address any part of the supply chain, but focuses on addressing risk through product and process re-engineering. Similarly, information management can also address any part of the supply chain, but targets information management between firms to reduce risk.

**Figure 5.5: A classification of risk management strategies**



Source: Tang (2006)

These two classifications can be combined in the form of the following statement: “Firms can respond to [avoid/mitigate/accept] risks through [supply/demand/product/information] risk management.” This has been displayed in Table 5.2 which organises various strategies sourced from the literature. The most commonly cited of these will be summarised for the practitioner’s reference, below.

**Table 5.2: Matrix of risk management strategies, categorised by risk response and management approach**

		Risk Response		
		Avoidance	Mitigation	Acceptance
Risk Management Approach	Supply management	<i>Divestment, auditing, vertical integration</i>	<i>Contract strategy, multiple/local sourcing</i>	<i>No strategy</i>
	Demand management	<i>Divestment, vertical integration</i>	<i>Stockpiling, pricing, marketing</i>	<i>No strategy</i>
	Product management	<i>Divestment</i>	<i>Postponement</i>	<i>No strategy</i>
	Information management	/	<i>Joint business planning, vendor managed inventory</i>	<i>No strategy</i>

*Divestment* is a means of risk avoidance by withdrawing from supplier, customer, or product markets to entirely avoid exposure to risks. An example is divestment from

a supplier found guilty of ethical violations in order to protect reputation and cut off communicable ethical risks. The downsides of a divestment approach are the high opportunity costs and loss of investment incurred by withdrawing from a market.

*Auditing* is a pre-emptive approach to risk avoidance by implementing controls and safeguards that prevent the development and realisation of risk scenarios. An example would be implementing ethical audits of suppliers to prevent the selection of at-risk suppliers and to maintain the soundness of selected suppliers. As has been seen in real-life case examples, however, auditing is far from a 100 per cent guarantee against risks.

Vertical integration avoids risks of supplier or customer misbehaviour, misunderstanding or mistrust by taking control of them. Continuing with the example of supplier ethics, a firm could implement a vertical integration strategy and take control of a key supplier in order to have direct access and control over supplier behaviour. The cost of such control, however, is an increased management burden, reduced supply chain flexibility, and the adoption of a host of other operational risks associated with the expanded organisational exposure.

*Contract strategy* improves coordination and risk sharing along a supply chain by formalising agreements between supply chain partners. These agreements share risks while increasing aggregate value across the parties involved. For example, a flexible supplier contract allows a retailer to reduce stockpiles and better tailor inventory to demand, while the supplier shares in increased profits through an increased margin for such arrangements. Such contracts allow parties to capture gains that require multi-party agreement and coordination. The cost of contract strategies lie in creating, enforcing, and revising (or not revising) them.

*Multiple/local sourcing* is an approach to mitigating high impact but highly localised risk events through diversification. Multiple sourcing applies when such risks affect upstream suppliers, while local sourcing applies when such risks affect downstream suppliers. An added benefit of local sourcing is the increase in responsiveness to local demand. The repercussions of this strategy are reduced abilities to leverage economies of scale and increased network management burdens.

*Stockpiling* is a redundancy-based inventory strategy to mitigate unexpected fluctuations in demand. Strategic stockpiling stores buffer inventory at key locations that can be accessed by multiple downstream partners and/or enable rapid response to demand. This concept of building in buffers or redundancies can be applied not only to inventory, but also to warehouses, distributors, suppliers, and other elements in the supply chain. Two drawbacks to such an approach, however, are extra costs and reduced transparency in the supply chain.

*Pricing* is a demand management strategy that influences customer behaviour through price manipulation. Also known as revenue management and yield management, such strategies allow supply chain members to adapt to supply disruptions in products, such as perishable goods, that are particularly vulnerable to demand fluctuations.

*Marketing* is another demand management strategy that enables firms to influence demand. We include here concepts of product substitution, product bundling, assortment planning and visual merchandising. These allow firms to shift customer preferences across products in order to counter demand uncertainty and diffuse supply variability.

*Postponement* is a product management strategy that increases the ability to respond to demand variation by redesigning products and/or processes so that resource costs are incurred as late as possible. The benefits can be considered in the example of a restaurant, where food components are standardised and cooking instructions optimised, such that a limited variety of ingredients can be quickly adapted into a large variety of dishes. The costs associated with postponement are the design and restructuring costs associated with new standardised component assemblies and operations.

*Joint business planning* leverages information sharing across supply chain partners to identify areas of strategic alignment and fosters the trust and coordination required to capture the potential gains. This can be done through passive infrastructure, such as enterprise resource planning (ERP) systems, and active management, such as annual partner meetings. The trade-off risks include the hazards of creating opportunities for collaborators to turn into market competitors and creating security risks by sharing sensitive information, such as intellectual property.

*Vendor managed inventory* enables risk sharing through information sharing, and entails a retailer passing on valuable market data to the supplier in return for the supplier taking responsibility for inventory risk. This is quite appealing to suppliers looking to upgrade their capabilities and capture higher value-added activities.

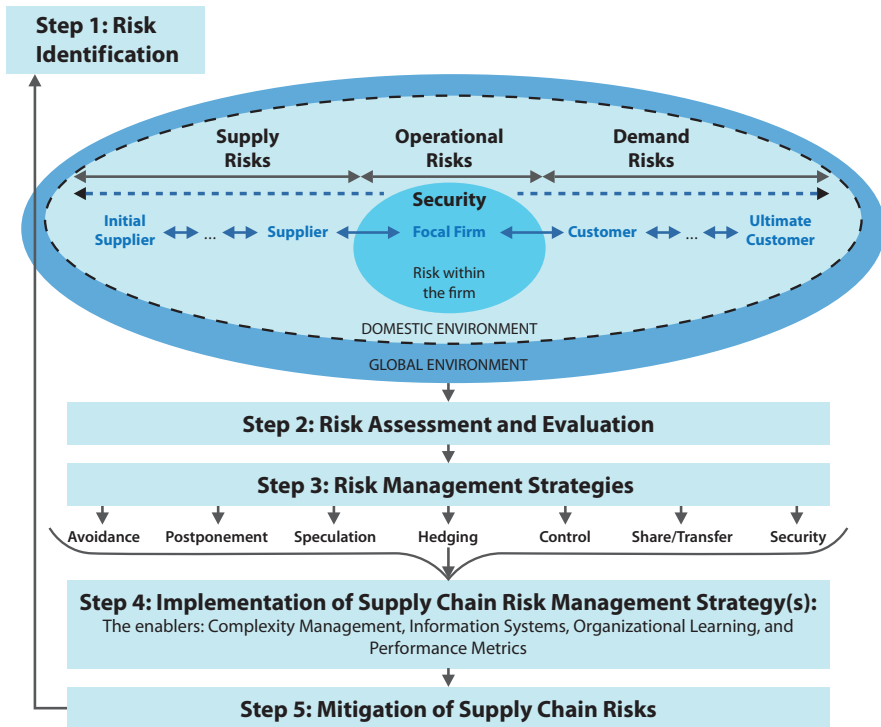
As the above descriptions make clear, every strategy incurs costs. Often, reducing exposure to one risk increases exposure to another, and it is this trade off that presents the real challenge for the practitioner.

Initial work has been presented by the likes of Manuj and Mentzer (2008a) and Sodhi and Tang (2012) on building decision support tools for practitioners choosing appropriate risk management strategies, but further research and development is needed. Additionally, it should be made clear that the list of aforementioned risk management strategies is far from exhaustive, and intentionally so. These strategies are merely intended to provide a starting point for considerations made by the risk management supplier. Appropriate strategies, being situation dependant, are only limited by the practitioner's knowledge and imagination. The strategies mentioned can be utilised beyond their compartmentalised descriptions and in combination.

Beyond the selection of an appropriate risk management strategy is the actual implementation of that strategy. This area is even less developed than the strategy selection literature, and an empirical study of factors affecting implementation of strategy and of the efficacy of various strategies is much needed.

To summarise the preceding discussion, we close with an example of an SCRM framework in Figure 5.6 from Manuj and Mentzer (2008a) that comprehensively visualises the steps reviewed.

**Figure 5.6: The SCRM framework**  
**Global supply chain risk management and mitigation framework**



Source: Manuj and Mentzer (2008a)

### 5.3 Empirical studies

With the emergence of a SCRM framework, empirical studies have already begun to test and revise concepts through real-life use. Studies on SCRM implementation and efficiency have also started to emerge, such as with the works of Ritchie and Brindley (2007) and Sodhi and Tang (2012). (See Table 5.3)

There is wide coverage across industry sectors, but the empirical studies reviewed tend to centre on the developed country perspective and on the UK perspective, in particular. While the developed country perspective can be rationalised, given the presence of the lead firms that are headquartered there, the works seen from the UK were found to be driven by the UK government's proactive stance in understanding supply chain risk.

**Table 5.3: Empirical studies sourced from the literature**

Citation	Year	Type	Industry	Geography	Subject
Harland, Brenchley, and Walker	2003	case study	hi-tech, computers, consumables	United Kingdom, Netherlands, American	Theory building for SCRM
Jüttner	2005	survey	consumer goods, logistics, distribution, retail, public sector, pharmaceuticals, brewing, automotive, finance	United Kingdom and International	Theory building for SCRM
Juttner, Peck, and Christopher	2003	survey	manufacturing, retail, logistics	United Kingdom	Theory building for SCRM
Manuj and Mentzer	2008	survey	appliances, electronics, pharmaceuticals, heavy equipment	N/A	Risk management strategies for global manufacturing
Ritchie and Brindley	2007	case study	agricultural equipment, construction	United Kingdom	6 year longitudinal study of SCRM impact on firm performance
Sodhi and Tang	2012	case study	Boeing, Mattel, plastics manufacturer	International	Application of SCRM theory
Ye and Abe	2012	case study	electronics, chemicals, steel, automotive, others	Japan, Thailand	Impact of natural disasters on global supply chains
Zsidisin et al.	2004	case study	computers, aerospace, semi-conductors, mobile phones	N/A	Risk assessment practice of purchasing departments

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) also sponsored a number of studies on the impact of natural disasters on global supply chains (UNESCAP 2013; UNESCAP and UNISDR 2012; Ye and Abe 2012). These empirical studies document the impact on global supply chains of the 2011 Great East Japan earthquake, the 2011-2012 Thailand floods, and the 2010-2011 Australian floods.

Ye and Abe (2012) point to the fundamental need for both business and government action when faced with natural disaster risks. Their study of the impact and response to the Great East Japan earthquake and flooding in Thailand in 2011 highlights the crucial importance of public-private partnerships in managing natural disaster risk to GSCs.

UNESCAP (2013), UNESCAP and UNISDR (2012) further add policy recommendations and observe the challenges businesses face between streamlining/agglomerating their supply chain activities versus maintaining time and inventory buffers that negatively impact returns and supply chain strategies (such as “lean” and “just-in-time”).

## 5.4 Future directions

What will be immediately apparent for those coming from foreign perspectives is the bias of the literature towards management of supplier (as opposed to customer) risk and towards adopting a perspective that lies in the “centre” of the supply chain. For example, discussions may be relevant for manufacturing and distribution firms, but not as much for the farmer or miner on one end and the retailer or post-purchase servicing company on the other. This is a conceptual limitation that will require empirical and theoretical input from a broader range of supply chain participants to overcome.



Within the SCRM framework, we also see the need for further empirical studies and communication between practitioners and academics in the area of risk assessment. While SCRM theory still tends to lag behind practice, assessment is an area of particular need. Given that the advance of risk assessment is mired in difficulties stemming from organisational psychology and the on-the-ground perspective of practitioners, we recognise the merit of taking a more theoretical approach to the problem.

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## Chapter 6

# Supply chains and SMEs

### *Abstract*

Small- and medium-sized enterprises (SMEs) present an issue of significant political and economic interest as they create jobs and drive development in developing and advanced countries. However, there is a perception that SMEs face a conundrum in the new realities brought about by globalisation. While supply chains present a portal for SMEs into international markets, they also open up SME market niches to encroaching large-sized enterprises (LEs). The competitive capabilities imparted by supply chain management (SCM) literature is suggested here for SMEs to compete against LEs; a slingshot in the battle between David and Goliath. The literature, however, reveals a controversy over whether SCM, in reality, helps or hurts SMEs. Some of the reasoning points to the presence of an LE perspective bias, and SMEs sometimes consider SCM as a threat, not a solution. The recent literature is addressing this issue by taking up the SME perspective, but the question of an SCM for SMEs is still in a very early stage of development. More effort will be required to gather data and build theory for SMEs in both developed and developing markets.

### 6.1 Defining SMEs

As a point of methodological concern, it should be noted that the definition of an SME varies by country and researcher. Classification is universally divided between SMEs and larger enterprises (LEs), with occasional sub-segmentation of SMEs into smaller groupings. Classification is determined by the number of firm employees, and the range of employee cut-offs found in the literature is presented in Table 6.1. Table 6.2 shows further example definitions from South-East Asia (UNESCAP 2009).

**Table 6.1: A sampling of the SME firm size criteria surveyed in the literature**

# Employees	Geography	Source(s)
<200	Norway, Wales, Scotland	Quayle (2003), Wagner, Fillis, and Johnsson (2003), Vaaland and Heide (2007)
<250	United Kingdom	Wynarczyk and Watson (2005)
<500	United States	Hong and Jeong (2006), UNCTAD (1993)
≤500	United States, Mexico, Europe	Arend and Wisner (2005), Fawcett et al. (2009), US SBA (2008)

US-orientated studies tend to adopt the cut-off at 500 employees or fewer adopted by the US Small Business Administration (US SBA 2008). European studies tend to utilise smaller cut-offs of either less than 200 or 250 employees to qualify as an SME. Any firm above the size threshold is automatically classified as an LE.

**Table 6.2: A sampling of SME definitions in South-East Asia**

Country	Definition
Cambodia	Firms that employ between 11 and 50 employees and have fixed assets of \$50,000 to \$250,000 are categorized as small. Firms with 51-200 employees and fixed assets of \$250,000 to \$500,000 are medium sized.
Indonesia	Fewer than 100 employees.
Lao People's Democratic Republic	"Small enterprises are those having an annual average number of employees not exceeding 19 persons or total assets not exceeding two hundred and fifty million kip or an annual turnover not exceeding four hundred million kip". "Medium sized enterprises are those having an annual average number of employees not exceeding 99 persons or total assets not exceeding one billion two hundred million kip or an annual turnover not exceeding one 1 billion kip".
Malaysia	Depends on the business sector. Different criteria, based on the number of employees and annual sales turnover. For details, see <a href="http://www.smeinfo.com.my/pdf/sme_definitions_ENGLISH.pdf">www.smeinfo.com.my/pdf/sme_definitions_ENGLISH.pdf</a> .
Philippines	Fewer than 200 employees, and less than P 40 million in assets.
Thailand	Depends on the business sector. Different criteria, based on number of employees and fixed capital size. For details see <a href="http://cms.sme.go.th/cms/web/homeeng">http://cms.sme.go.th/cms/web/homeeng</a> .
Vietnam	SMEs are independent production and business establishments that are duly registered according to the current law provisions, each with registered capital not exceeding VND 10 billion or annual labour not exceeding 300 people.

Source: UNESCAP (2009)

It should also be noted that SMEs entail very different notions depending on whether the term is used in a developed or developing country context. In the former, SMEs are perceived to be innovative and agile firms that employ high skill labour. In the latter, SMEs are perceived as labour intensive but low skill firms that seek capabilities upgrading.

## 6.2 The significance of SMEs

SMEs are considered key participants in any economy due to a number of unique traits not held by LE counterparts. As a whole, they compose the dominant majority of most economies' firms and jobs, leading Kaplinsky and Readman (2001) to refer to them as the backbone of the private sector in countries both developed and developing. Secondly, SMEs play a critical role in the development process. Finally, SMEs also populate a number

of key roles in the supply chain. As such, a healthy SME sector is considered necessary for a healthy economy.

### *6.2.1 SMEs as the backbone of the economy*

SMEs compose the dominant majority of firms and jobs worldwide. In most economies, SMEs account for more than 90 per cent of total firms and more than 50 per cent of jobs, sales, and value-added (UNCTAD 1993). Worldwide, SMEs represent 90 per cent of all firms and 50 to 60 per cent of all employment on average. The proportion of global employment represented by SMEs rises to 80 per cent when narrowed down to the global manufacturing sector (Kaplinsky and Readman 2001). In the US manufacturing sector, SMEs represent 98 per cent of all firms and two-thirds of all jobs (Fawcett et al. 2009). In the UK, SMEs account for approximately 50 per cent of total GDP and nearly 70 per cent of all jobs. Within Wales, this number rises to 90 per cent of all Welsh jobs, with SMEs representing 80 per cent of all Welsh firms (Quayle 2003). SMEs also play a particularly dominant role in Turkey, where SMEs account for 99.5 per cent of all firms and 61.1 per cent of all jobs (Koh et al. 2007).

The demographic evidence on the significance of SMEs is clear, but SMEs play key roles as job generators, innovators and exporters as well. Not only do they act as a source of future LEs, but they also infuse economies with agility/adaptability. The hypothesis, as reviewed by UNCTAD (1993), is that SMEs have smaller management teams that enable responsiveness, take roles as market price-takers that temper inflation, and drive job creation and innovation. SMEs even expand consumer choice by catering to niche consumer demands that would normally be neglected by LEs seeking economies of scale.

### *6.2.2 SMEs as development actors*

SMEs are considered key participants in a country's development for two commonly cited reasons. First is their ability to create jobs for low-skilled labour that is commonly found in the human resource pool of developing economies. This employment presents opportunities not only for poverty reduction and human resource development, but also for balanced development that is inclusive of poor households and women. Second, SMEs help build the early economic foundations needed for development. SMEs transform endowments of labour and natural resources into capital and industrial infrastructure. In doing so, they establish the economic relationships that enmesh SMEs and LEs across both urban and rural areas. SMEs are also the fount from which LEs are often born, and many national champions in the newly industrialised economies have emerged in such a manner (Kaplinsky and Readman 2001; UNCTAD 1993; UNESCAP 2009). Thus, a strong SME sector is considered a powerful engine for driving country development.

### *6.2.3 SMEs as supply chain actors*

SMEs are playing increasingly significant roles as actors in global supply chains. International organisations consider them as important drivers of development, and are supporting their entry into international markets through global supply chains (UNESCAP 2009). They are already integrated as suppliers of commodities and low cost labour in developing countries and as innovators and technology specialists in developed countries. The former has been documented through extensive empirical studies of the

global agricultural, apparel, and electronics industries. The latter has also been seen in the advanced skills contributed by machinery suppliers in Germany and Switzerland. In addition to being suppliers, they also act as distributors, producers, and customers in the supply chain. Thus, an SME presence is extensive in supply chains and is expected to grow (Thakkar, Kanda, and Deshmukh 2008). The literature on risk and sustainability reflects an increasing awareness and concern from lead firms and large enterprises on understanding and managing the SMEs in their networks (Koh et al. 2007).

## **6.3 The competitive environment for SMEs**

### ***6.3.1 Challenges***

The most commonly cited challenge for SMEs in today's market is globalisation. More specifically, two drivers are documented in the literature: liberalising trade policy and technological/organisational innovation. Liberalising trade policy has reduced barriers to entry into foreign markets for the firms that have the resources to do so; namely, LEs. At the same time, government policies that have protected SMEs and SME niche markets are slowly disappearing. The second driver, technological and organisational innovation, has expanded the capabilities of firms, endowing greater power and reach over geographical and organizational boundaries (Fawcett et al. 2009; Koh et al. 2007; Thakkar, Kanda, and Deshmukh 2008).

The result is an increasingly competitive environment that exacerbates SMEs' characteristic internal resource constraints. These include perennial constraints in accessing finance, technology, human resources, and market information (UNESCAP 2009). Specialised or niche markets that were previously under the domain of SMEs are increasingly being encroached upon by LEs, and SMEs in the value chain often find themselves under the control of more powerful firms. All the while, SMEs continue to be faced with resource constraints in terms of finances, knowledge, manpower and time. This boils down to the simple reality that SMEs must find ways to increase productivity (Fawcett et al. 2009; Thakkar, Kanda, and Deshmukh 2008; Quayle 2003).

### ***6.3.2 Advantages***

SMEs are not entirely powerless in today's global market; they have been able to counter the economies of scale of LEs with superior differentiation. By providing products and services that better cater to their customer's needs, SMEs are able to compete against the low cost but commoditised offers of LEs. That being said, this differentiation advantage is fading with the increased capabilities of today's LEs (Elmuti 2002).

SMEs, however, also have inherent organisational advantages. They tend to be more flexible, faster decision-makers with better communication and utilisation of internal knowledge among employees (Thakkar, Kanda, and Deshmukh 2008). The result is an organisational unit that is better positioned to adapt to change; perhaps it is no surprise, then, that LEs view the outsourcing of tasks to SMEs as a path towards increased adaptability and agility. Finally, as Fawcett et al. (2009) point out, globalisation is conversely providing new opportunities for SMEs' access to the global consumer and resource markets.

## 6.4 SMEs and supply chain management

Theoretically, supply chain management should provide SMEs with guidance on operating successfully within their supply chain. However, to succeed in the new chain versus chain competition of global markets empirical evidence shows that the very value of the SCM literature to the SME manager is in question. We first review the theoretical benefits SCM should provide the SME, and then examine explanations and empirical evidence as to why reality differs.

### 6.4.1 *SCM as the solution*

Because of globalisation, SMEs effectively find themselves facing more advanced challengers in a vastly expanded competitive arena. Thus, the fundamental challenge posited for SMEs is to increase productivity; simply put, to produce more while using less.

In response, the literature proposes that the network-competitiveness concepts of supply chain management should also be applied to SMEs. SCM should theoretically strengthen SMEs through operational excellence, enhanced learning, and new market opportunities. In Thakkar, Kanda, and Deshmukh's (2008) own literature review, supply chain inefficiency is found to be one of the most prevalent issues facing SMEs. Supply and process costs account for 30 per cent of the average manufacturing SME's budget, with 40 per cent of the supply costs derived from logistics costs.

To this end, SCM offers a laundry list of benefits, including shorter lead times, fewer operational disruptions, reduced inventory, better quality and customer service, faster innovation, and reduced risk (Arend and Wisner 2005; Fawcett et al. 2009; Vaaland and Heide 2007). An empirical study by Koh et al. (2007) further investigates the efficacy of SCM for more than 200 Turkish SMEs, and finds evidence supporting a positive and significant effect of SCM for SMEs.

The second benefit offered by SCM is in the enhanced learning opportunities gained by SMEs in the supply chain. By integrating into a supply chain, SMEs gain access to stores of information, knowledge, and even training (Quayle 2003; Macpherson and Wilson 2003; Vaaland and Heide 2007).

The final benefit of SCM posited is market entry. Particularly prevalent in the SMEs and development literature, SCM can be utilised by SMEs to manoeuvre across and within supply chains in order to gain access to new value-added activities and markets (Fawcett et al. 2009; Humphrey 2001; UNIDO 2001). With these potential benefits of SCM, weak SMEs can reach potential benefits through learning and operational efficiency. Strong SMEs can use SCM to manoeuvre to positions in the supply chain that increase its value-added and/or relative influence over partners (Hong and Jeong 2006; Thakkar, Kanda, and Deshmukh 2008).

This body of issues, grouped under firm "upgrading", was addressed in more depth in Chapter 4, which offered a typology of the learning/upgrading paths available and their feasibility according to the type of relationship the SME has with its supply chain partners.

Given that many technological and operational innovations are embedded in the concepts and practice of SCM, researchers are eyeing SCM as a potential and possibly necessary tool for SMEs to survive competition against LEs and other SMEs. In a market that values



responsiveness and innovation, SCM may be the tool SMEs need to enhance their current advantages and sustainably compete in the global market.

#### *6.4.2 SCM as the problem*

A central research question in the literature on supply chains and SMEs, however, is on whether SCM and SMEs are compatible. The theorised benefits have not been fully realised in actual results. This is widely cited to be due to SMEs not implementing SCM properly, if at all (Arend and Wisner 2005; Fawcett et al. 2009; Thakkar, Kanda, and Deshmukh 2008; Vaaland and Heide 2007).

However, we would like to posit an alternative interpretation that shifts the locus of the problem from the SME to SCM. We propose that SCM was not developed with SMEs in mind, and that this is the cause for the lack of managerial interest and the inability to “properly” implement SCM. We derive this claim from the disconnect between SCM and SMEs reviewed in the literature, which we split into disconnects in managerial perspective and disconnects in implementation requirements.

The SCM literature reviewed not just for this chapter, but for this literature review in its entirety, exhibits a consistent bias in managerial perspective. SCM is viewed as a network management tool for firms (typically large multinational enterprises) to manage their suppliers (typically low value-added SMEs in developing countries). Case studies and SCM success stories tend to showcase LEs (Fawcett et al. 2009). The innovative and specialised SME, typically associated with a developed country setting, is found not in the business-centric SCM literature but in the more policy-relevant value chain literature.

The absence of the SME perspective in the SCM literature is often raised in the SME-SCM literature (Koh et al. 2007; Quayle 2003; Thakkar, Kanda, and Deshmukh 2008). This is a significant issue given the near 180-degree difference in the managerial perspective of the SME versus LE perspectives. In contrast to a large organisation concerned with upstream supplier management, the starting point of considerations need to switch to a small organisation concerned with downstream customer/demand management.

For example, SCM currently addresses issues related to supplier compliance, long-term sustainability, and agility at the large organisational scale. However, SMEs face more demanding challenges in managing their customers and understanding how to leverage supply chain resources to enter new markets. Additionally, their resource constraints result in a short-term time horizon that makes long-term considerations of sustainability infeasible. Thus, the LE perspective embodied in SCM concepts is incompatible with the SME setting. This is in line with empirical results from surveys of SMEs, showing that they have little interest in paying attention to SCM concepts – even going as far as to view SCM as a threatening tool used by LEs to control SMEs (Arend and Wisner 2005; Fawcett et al. 2009; Macpherson and Wilson 2003; Quayle 2003; Thakkar, Kanda, and Deshmukh 2008; Vaaland and Heide 2007). To sum up, we quote Vaaland and Heide (2007), who observe that “studies... indicate a considerable gap between what is normally considered as important SCM tools and ideas and the reality that SMEs operate in.”

The implementation requirements of SCM and the resource constraints characteristic of SMEs are another cause of failure in SME-SCM implementation. SCM emphasises information and communication technologies to enable new network-oriented business models. However, SMEs often lack the finances and technical expertise to build such

infrastructure, as well as the human resources to run it (Fawcett et al. 2009; Vaaland and Heide 2007; Wagner, Fillis, and Johansson 2003).

Furthermore, the merits for such infrastructure also include redundant features for the SME, such as enabling more agility. SCM implementation also requires control over one's organisation, and sometimes partnering organisations. However, SMEs in supply chains often find their decision-making power curtailed by the influences of other lead firms in the chain. As such, SMEs that implement SCM are often strong firms that do so by their own will or weak firms that are forced to do so by lead firms (Arend and Wisner 2005; Fawcett et al. 2009; Hong and Jeong 2006; Vaaland and Heide 2007). Interestingly and perhaps alarmingly, Arend and Wisner (2005) find that the former category of strong firms is weakened by SCM implementation, while the latter category of weak firms is strengthened by it.

### *6.4.3 Reconciliation: developing SCM for SMEs*

As the literature makes clear, practitioners and researchers are questioning the very value that SCM can deliver to SMEs. The flagship paper for this concern is Arend and Wisner's 2005 study of more than 400 senior managers, which found that "SMEs more likely to perform well chose to engage in SCM, which was a choice that hurt SME performance."

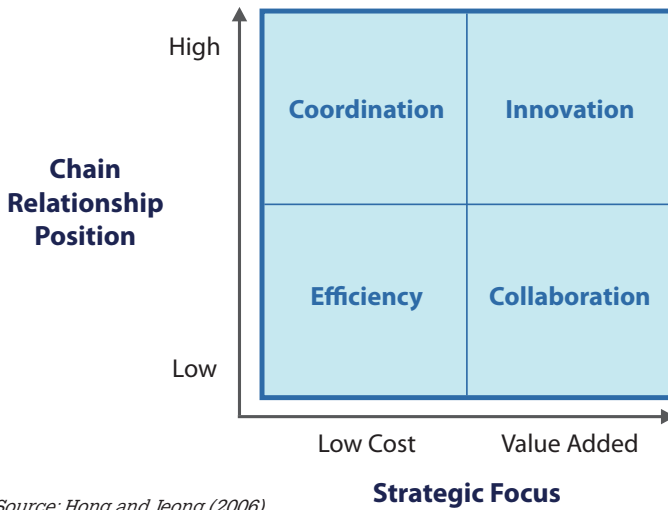
While the idea of SCM as a tool for tackling the challenges of network competition is as relevant to SMEs as LEs, the design of SCM has clearly shown that current SCM solutions do not align well with SME problems. If progress is to be made on understanding how to implement SCM for SMEs, we argue that a shift in rhetoric is necessary from "SMEs as the fault" to "SCM as the fault".

For example, even Arend and Wisner (2005) state that "SMEs are not suited to implementing SCM effectively" – phrasing that is propagated in the literature, as studies seek to understand why SMEs are failing to implement SCM. Instead of asking why SMEs are not suited for SCM, however, it may be more fruitful to ask why SCM is not suitable for SMEs. First steps have already been taken in investigating the differences between SMEs and LEs and in understanding their repercussion in SCM implementation. The next step is to transform these differences into design constraints that can then be used to develop an SCM that is suitable for SMEs.

A future distinction may need to be made between LE-SCM and SME-SCM. Within SME-SCM, further distinctions may also be necessary between what has already been referred to as weak SMEs versus strong SMEs. As Macpherson and Wilson (2003) note, the SME sector is not homogenous, and a distinction beyond the number of employees is needed. For example, a low-cost manufacturer in Bangladesh, an R&D specialist in Germany, and an e-commerce start-up in the US may all be SMEs but each holds a very different position with consequences in the supply chain.

Fawcett et al.(2009) present one typology according to SME business goals. Three paths are proposed: the niche player, the grow-and-sell player, and the long-term growth player. The niche, or status quo, player is satisfied with maintaining its current market niche. The grow-and-sell player is looking to be acquired, and is concerned with establishing a strong track record to indicate the potential for future growth that will raise its valuation. The long-term growth player is to become an LE and industry leader. Hong and Jeong (2006) present a fairly advanced functional typology, assigning two measures to SMEs based on a strategic focus on supply chain position (Figure 6.1).

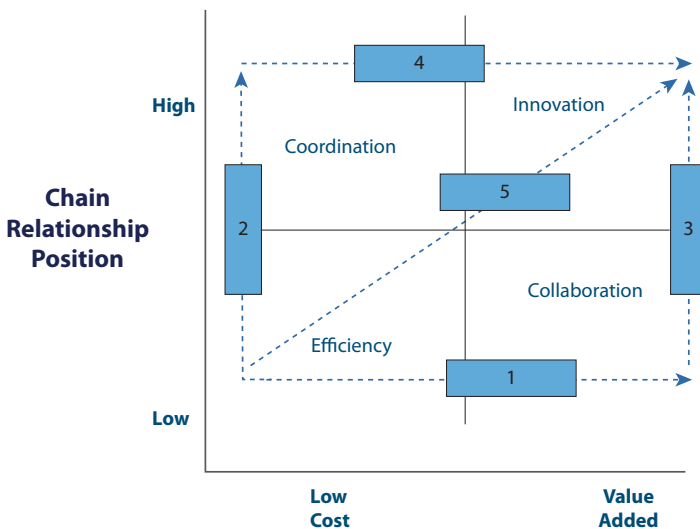
Figure 6.1: A typology of SMEs



Source: Hong and Jeong (2006)

Hong and Jeong’s framework further expands the weak versus strong firm distinction, classifying SMEs by their current position of political power (high or low) in the supply chain and by their strategic focus (low cost or value-added) to produce four strategic roles in the supply chain (coordination, innovation, efficiency, or collaboration). This is further developed by indicating five growth paths that converge upon the innovative firm as the ultimate goal for SMEs (Figure 6.2).

Figure 6.2: Five paths for SME growth



Source: Hong and Jeong (2006)

In reconsidering the question proposed by Arend and Wisner (2005) of: "Is there a fit?", the answer seems to be that there is a fit, in theory, but now the question is "how?"

## 6.5 Empirical studies

The empirical literature shows broad geographical and industrial coverage. However, a closer look at studies of developed country SMEs versus developing country SMEs shows an understandable bias of developing country studies towards the commodities and manufacturing industries while developed country studies remain fairly diversified.

In addition to investigating the question of SME-SCM relevance, studies have also shown an emphasis on understanding technology integration and e-business models for SMEs. Little, however, is seen in terms of SME-SCM in the context of services; a potential area for future investigation.

**Table 6.3: Empirical studies sourced from the literature**

Citation	Year	Type	Industry	Geography	Subject
Arend and Wisner	2005	survey	manufacturing and services	United States, Mexico, Europe	Compatibility between SCM and SMEs
Cooke and Morgan	1993	case study	multiple	Baden-Wurttemberg, Germany; Emilia-Romagna, Italy; Basque, Spain; Wales, United Kingdom	Regional SME bolstered development
Koh et al.	2007	survey	metal product and general purpose machinery manufacturing	Turkey	Compatibility between SCM and SMEs
Macpherson and Wilson	2003	survey	manufacturing	Northwest England	Development opportunities for SMEs in the supply chain
Ndou, Vecchio, and Schina	2011	survey	food processing	Tunisia	E-business models for SMEs in developing countries
Quayle	2003	survey	manufacturing, high tech, electrical, packaging and distribution, finance, services, construction, agriculture	Wales	The SCM practices of SMEs
UNESCAP	2007	case study	fresh fruit and vegetable, wood furniture, apparel, automobile components	Vietnam (Greater Mekong Subregion)	Integration of developing country SMEs into global value chains
UNESCAP	2011	case study	plastics, ginger and coffee, rubber and electronics	Bangladesh, Nepal, Sri Lanka	Integration of developing country SMEs into global value chains
Vaaland and Heide	2007	survey	retail, electronics, telecom, oil and gas, food and beverage, construction, transportation, machinery, paper and pulp, pharmaceuticals, ship building, electricity and water, fisheries, agriculture and forestry, defense	Norway	Compatibility between SCM and SMEs
Wagner, Fillis, and Johansson	2003	survey	engineering, IT, manufacturing, service	Scotland	Adoption of e-business by SMEs
Walker and Preuss	2008	case study	public sector, health sector	United Kingdom	Sustainable development through public sector sourcing from SMEs
Wynarczyk and Watson	2005	survey	manufacturing	United Kingdom	Correlation between SCM and SME growth

## 6.6 Future directions

Research in the area of SCM and SMEs is still in its infancy. However, given the widespread recognition on the part of policy makers of the importance of SMEs to their respective economies, the subject of SMEs is gaining greater ground in the literature. In light of the relative unavailability of information on SME practices and performance, there is a significant need for empirical studies to build foundational data required to build theory. From this, the SME typologies that have been developed can be further advanced to guide the design and implementation of SCM practices.

Theory building need not begin from scratch, however. One potentially fruitful area of development is a reconsideration of current SCM concepts and tools in relation to their implicit adoption of an LE or non-LE perspective. Such efforts will enable a better understanding of the extent of an LE perspective in current SCM theory and evaluate the potential for application or re-adaptation of current theory to address the SME perspective.

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# Chapter 7

## Supply chains and services

### *Abstract*

Supply chain production has likely made production more services-intensive. Only recently has the extent of reliance on services in supply chains become evident, particularly since global trade statistics measured in value-added terms were developed. However, a full understanding of the role of services in supply chains remains elusive. Recent work reported here attempts to capture the multiplicity of distinct services implicated in supply chain production; the interdependent nature of markets; the tendency towards reliance on networks and the resultant bundling or modularising of product offerings that combine different goods and services; the role of services as a driver of innovation; services as a potentially untapped source of value-added capture, and a range of data challenges that will take time to resolve.

### 7.1 The nature and role of services in production and trade

The intangibility of services raises analytical and statistical challenges. Systematic efforts to deepen our understanding of the economic role played by services – particularly at the international level – have only occurred in the last 30 years. These efforts have intensified recently with the increased presence of global value chains, where services fulfil a vital and complex role.

Services have occupied a dominant place in most economies for a long time. According to the World Bank's World Development Indicators (2012), the share of services value-added in world GDP was 70 per cent in 2010, rising fairly steadily from 53 per cent in 1970, 57 per cent in 1990 and 68 per cent in 2000. Besides reflecting the shift towards service economies in advance countries, the growth in these shares over time will almost certainly have been influenced by improvements in statistical methods and techniques.

The services share has also risen as a result of structural changes in economies that have led to greater segmentation and more arm's-length transactions, allowing the separate identification of services transactions. Notwithstanding national variations in the respective shares of GDP attributable to services, manufacturing, agriculture and mining,

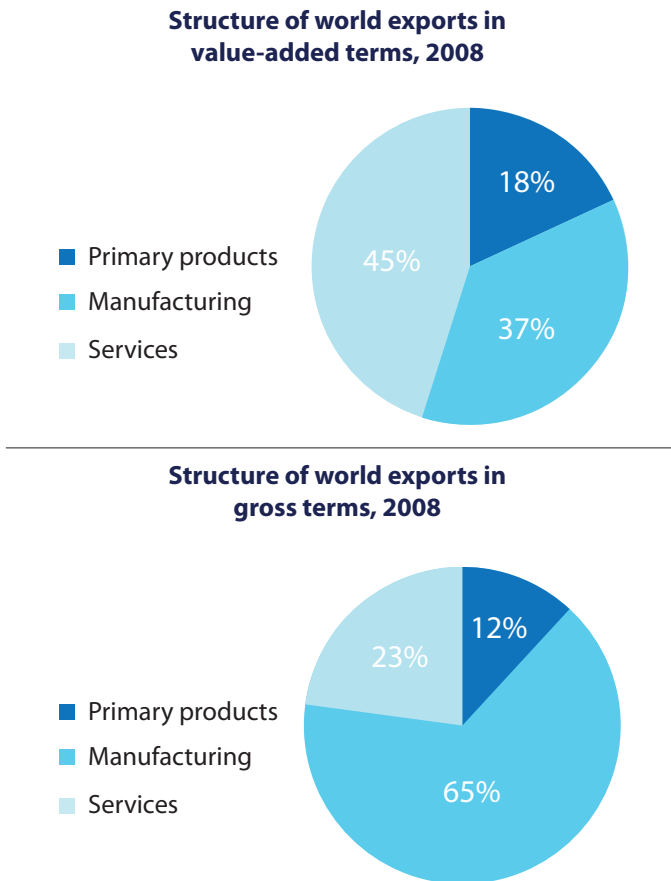


in most economies the services share is greater than that of the other three components of economic activity combined.

The story of the share of services in international trade is even more interesting, reflecting data limitations that the international community has only just begun to address. For many years we have estimated the share of cross-border services transactions in international trade at just over one-fifth of total trade (WTO International Trade Statistics, 2012).

However, the recent OECD/WTO work on measuring trade in terms of the value-added to products by different countries along supply chains, rather than in gross terms, has yielded a dramatically different picture. In 2008, for example, the share of commercial services in world trade was estimated at 23 per cent in gross terms and 45 per cent in value-added terms (Figure 7.1).<sup>1</sup>

**Figure 7.1: Sectoral contribution to total trade, gross and value-added measures (2008)**



Source: WTO Secretariat estimates based on OECD-WTO data

## 7.2 The role of services along global supply chains

Services are part of almost every activity in an economy. This is particularly true of what are often referred to as producer services – transport, communications, finance, distribution and business services. This pervasiveness makes services key determinants of competitiveness and the productivity of capital and labour. But this is only part of the picture, since numerous other services are involved in the production and sale of products, whether the final product is a good or a service.

Services have sometimes been referred to as the “glue” that holds supply chains together and ensures that they function in a fluid manner. This is only one aspect of what services do. They are also part of many production and sales processes, as we will see later.

Modern communication and transportation technologies have enhanced the tradability of services. This has facilitated their incorporation in supply chain production as traded inputs. In addition, what the business literature calls “modularisation”<sup>2</sup> has led to the incorporation or bundling of services to composite products. This phenomenon is similar to what the economics literature refers to as “trade in tasks”<sup>3</sup>, where inputs do not break down readily into the product classification and nomenclature systems with which we are more familiar. A typical example of this would be “business functions”.

While, in the past, productivity growth has been greater in manufacturing than in services, emerging literature on the extent of unidentified service activities in production raises questions about the accuracy of relative productivity measures.

Even if the data reflect reality, services may be a growing source of competitiveness. This conclusion follows from a new appreciation of how the service economy works and in producing and delivering services as elements of aggregated value propositions.

As we discuss below, much of the analysis does not necessarily refer directly to services, but rather to “invisibles.” However, since invisibles are intangible, and the one defining feature distinguishing services from goods is intangibility, there is no doubt that invisibles include services.

### *7.2.1 The consequences of complementary markets*

In terms of their operation, supply chains can be thought of as a series of linked markets for goods and services. These markets are interdependent, in the sense that something happening in one market affects many other markets. This complementarity, sometimes referred to as joint demand or derived demand, is associated with negative cross-elasticities of demand.

It means that if the price of product A increases in one market, then the demand for product B in another will fall. The result is that demand for both A and B falls. This complementarity links goods and services markets with no distinction in terms of economic effects as to whether the products in question are tangible or intangible.<sup>4</sup> Under these multiple-market relationships, changes in conditions in one market – including as a result of policy intervention – provoke ripple effects in others along the whole supply chain, both upstream and downstream. The same logic holds in situations where there is modularisation or bundling, and inputs are composites of at least two products that in principle could be supplied separately.

While the complementary nature of markets is intuitively obvious and doubtless taken into account in many decisions of market agents, this reality does not always seem to be fully factored into the expectations of policy makers in terms of the consequences of their actions. Policy interventions will affect relative prices across different interdependent markets, possibly with unintended consequences.<sup>5</sup> This suggests that policy-making should be an integrated process.

There are two aspects: At the level of measures and policies. When governments adopt measures pursuant upon a policy, they should take into account market complementarities and knock-on effects in the particular market situation at hand. The impact of such reverberations can be particularly pronounced where policies affecting components (goods or services inputs) have a multiplicative or magnification effect as they cross more than one frontier along the supply chain.

At the policy level, this is about the design of different policies with varying objectives and contexts which, in the end, come together to affect outcomes beyond the initial focus of attention and the objectives of individual policies. Outcome linkages and spillovers call for a holistic approach to policy formulation.

Policies formulated internationally that also aim to shape outcomes in areas like trade in goods, trade in services, investment, intellectual property protection and competition will affect many activities in many markets. Getting policy right in each of these areas is therefore essential to the effective overall operation of supply chains.

The current approach that relies on “silo” agreements in these different areas is short on appreciation of the consequences of complementarity. The pattern observed internationally is a reflection of how policy is made domestically, suggesting that any new approach must begin at home.

### *7.2.2 Identifying services along the supply chain*

In practice, it is no easy matter to identify, separately, all the individual service components that make up the full value of a product, not least because of the bundling phenomenon. The detailed product breakdown in Figure 7.2, depicting the value chain for a coat, is a useful illustration of the difficulties encountered in trying to disaggregate a range of different services. Of the US\$425 price tag for the jacket, only 9 per cent of this initial retail price is associated with making the jacket, with the remainder attributable to “invisible” assets.<sup>6</sup> This is the identification problem: what is contained in the invisible assets?

There will be elements both on the pre-manufacturing upstream part of the process, as well as on the post-manufacturing downstream. Upstream sources of value are likely to include design, intellectual property, branding, and so on. Downstream elements include advertising, marketing and retailing. Disentangling the sources of value, the individual services involved, and the implication of policy for these segments of the supply chain, are formidable tasks.

One of the most thorough efforts at achieving this is the case study of the Nokia95 phone undertaken by Ali-Yrkkö et al. (2011). Through meticulous sleuthing, the authors managed to produce a detailed breakdown of the value chain for the product. The parts (including processors, memories, integrated circuits, displays and cameras) accounted for 33 per cent of the product. Assembly only accounted for 2 per cent. The remaining

two-thirds of the product was accounted for by Nokia's internal support services (31 per cent), licenses (4 per cent), distribution (4 per cent), retailing (11 per cent) and operating profit (16 per cent).

Despite the relatively fine detail of the breakdown of invisibles in this case study, a good deal is still missing in terms of the different services that went into production. The missing services problem also applies in the case of the manufacturing part of the operation, notwithstanding its small share.

**Figure 7.2: A suit made in China and sold in the United States**



Source: Fung Global Institute research

**7.2.3 The notion of “servicification”**

The Swedish National Board of Trade has undertaken some useful work in a number of studies in recent years on the servicification of the Swedish economy and of Swedish firms operating internationally (Kommerskollegium, 2010a, 2010b, 2012). Related work based on the same idea of servicification makes reference to servicising (Reisken et al., 2000) and the “manuservice” economy (Bryson and Daniels, 2010). As discussed in Ryu et al. (2012), the term “servitisation” was first used by Vandermerwe and Rada (1988). The definition of servification and similar derivatives of the word used to denote the same phenomenon is not very precise but this captures important ideas about how the role of services has evolved in recent years.

Essentially, servicification refers to the increased use of services in manufacturing, both in terms of production processes and sales. This phenomenon may in part reflect the separation of services functions in manufacturing from core production functions.

In Sweden's case (and no doubt elsewhere) this is linked to the development of enterprise groups, where manufacturing enterprises comprise different firms, some of which are dedicated to service production. Higher productivity growth in manufacturing than in services, and shifting demand and production patterns, underlie the decline in the share of manufacturing and the rise of services in economies like that of Sweden (Kommerskollegium, 2010a).

A significant feature of servicification is the opportunity it offers for strategic firm behaviour designed to move up the value chain. While some of the bundling or modularisation occurring along supply chains as a result of servicification may be occasioned by the exigencies of locational dispersion in production and consumption, or by regulatory requirements, these tendencies are also likely to be fed by strategic motivations internal to firms (Sundin et al., 2009; Kommerskollegium, 2012). Firms may seek to customise their offerings so as to differentiate them in the market place and earn higher returns or to spread risk by diversifying the output mix.

A case study of the Sweden-based multinational Sandvik Tooling (Kommerskollegium, 2010b) revealed that in order to manage the supply chain and deliver goods, the firm had recourse to 40 discrete services. A further 12 services were required to handle customer delivery (Table 7.1). The study does not specify whether these services were separately supplied even if they could be separately identified, or whether they were packaged (modularised) into composite offerings.

**Table 7.1: Services necessary to the Sandvik Tools supply chain**

<p><b>Services for operating the supply chain</b></p> <p>Legal services; Accounting, book-keeping etc.; Taxation services; Medical services; Computer services; Research and development; Rental/Leasing; Advertising; Market research; Services incidental to manufacturing; Placement of personnel; Maintenance and repair; Security services; Packaging; Printing; Publishing; Design; Building-cleaning services; Photographic services; Courier services; Logistic services; Postal services; Telecommunications; Audio-Visual services; Educational services; Environmental services; Banking services; Insurances; Health related services; Hotels and restaurants; Travel agency services; Maritime transport – freight; Inland waterways – freight; Inland waterways – freight; Air transport - freight/passenger; Road transport – freight/passenger; Cargo-handling services; Storage and warehouse services; Freight transport agency services; Feeder services; Energy services.</p>
<p><b>Services for customer delivery</b></p> <p>Computer services; Research and development; Rental/leasing; Maintenance and repair; Management consulting; Technical testing and analysis services; Services incidental to manufacturing; Design; Environmental services; Financial services; Logistics; Warehouse services.</p>

This wide array of services includes both high value-added and low value-added activities. Some of the services are trade-able, others are not. Some may be produced in-house, others at arm's length. Arm's-length services can be outsourced or offshored.

Among this large set of services associated with the production of machine tools, there would doubtless be opportunities for product differentiation and higher average value-added packages – in other words, for repositioning on the supply chain. Some of these services could even be provided to customers of rival manufacturing firms in the same market, or to rival firms themselves.

Finally, depending on the product in question, significant scope may exist for the provision of after-sales services as an additional source of product differentiation and profit. These services can take many forms, including technical assistance and training, maintenance, provision of spare parts and repair services and a range of other customer care services (Saccani et. al, 2007). The means of delivery of after-sales services by a lead firm will vary from direct supply, sub-contracting arrangements, agency relationships and franchising.

### *7.2.4 Services, networks and value analysis*

In a similar vein to the analysis of complementary markets, joint production and trade in tasks discussed earlier, a new literature is emerging that goes under the broad rubric of "service science". The literature has yet to become mainstream but it strives to explain how networks, technology, entrepreneurship and consumers interact to generate innovation and create value. Recently published volumes by Maglio et al. (2010) and Demirkan et al (2011) are examples of a burgeoning literature around service science.

A "service-dominant" logic of value creation and exchange (Vargo and Lusch 2004) underpins much of the analysis, which focuses on service systems. Production is seen more as a dynamic and collaborative, interactive process among people than as the combination of readily definable fixed and variable inputs of capital, labour and components into units of output. The analysis that goes under the name of "service science" bears a resemblance to the notion of innovation systems.

Service science aspires to a high degree of inter-disciplinary or even trans-disciplinary thinking. Spohrer (2009) argues for "an integrated approach that spans not only existing discipline-based silos within academic organisations (i.e. marketing, operations, and human resource management within a business school) but also across academic organisations (i.e. business, engineering, and liberal arts)."<sup>7</sup> Ng et al. (2011) suggest that service science should combine what they describe as a prevailing reductionist analytical perspective with a systems perspective as a means of establishing a disciplinary base for service science.

A useful bridge between services science and more conventional analytical approaches is provided by Allee (2008), examining the relationship between value and tangible and intangible assets. Intangible assets may be unpriced in the market and non-contractual, but nevertheless embody value.

Such "intangibles" could include human knowledge, internal structures, working methods, reputation, business relationships, trust, social citizenship, environmental responsibility, and business values. These intangibles can sometimes command explicit value in the market, such as through consultancy contracts or explicit price premia.

Allee (2008) argues, however, that trying to price these assets in terms of units of input is a fool's errand. An idea of the worth of the assets can be gleaned from the difference between the value of a firm's assets and its sale value. An imperfect and approximate indicator of this value could be captured by the goodwill recorded on a firm's balance sheet. Some of the value emerges as barter relationships among parties to transactions.

For the rest, the argument seems to be that value analysis requires an understanding of how roles and relationships create value. Even unpriced assets can be rendered in negotiable value and a systematic analysis of roles; transactions and deliverables must be undertaken in value creation analysis.

### *7.2.5 The OECD new sources of growth projection*

If the Allee (2008) analysis assists in bridging the gap between service science and more traditional analytical approaches to understanding markets, the OECD's work (OECD, 2011, 2012) on intangible assets as new sources of growth is a further contribution in this direction. The OECD refers to a threefold definitional distinction among the components of

invisible assets. These include computerised information (software and data), innovation property (research and development, intellectual property), and economic competencies (brand equity, human capital specific to firms, networks joining people and institutions, organisational know-how and advertising and marketing strategies).

The “economic competencies” category is strikingly similar to the essential focus of service science. The OECD’s use of terminology has varied over time. Earlier references were to intellectual assets, knowledge assets and intellectual capital, while in later work the term used has been knowledge-based capital (KBC).

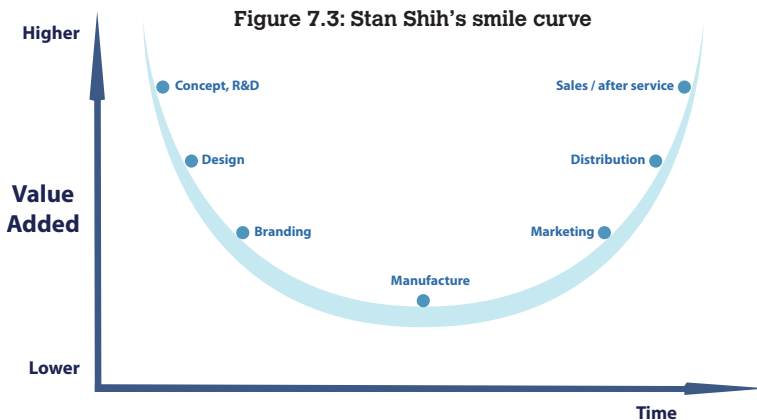
All these terms refer to “invisibles”, which are to be contrasted with tangible assets such as plant, machinery and buildings. The OECD argues that countries investing proportionately more in KBC are doing better via enhanced productivity than those investing proportionately less.

A further useful addition to the OECD’s work in this field is an analysis of the implications of policy on investment in, and production of, KBC. Relevant policies include tax and regulatory regimes, intellectual property, competition policy, investment policy, protection of data, data privacy and policies affecting corporate governance. This discussion reinforces the growing conviction that the segregation of policies into separately constructed regimes is inimical to coherence at the interface of policy and supply chain operations. An integrated approach to policy appears increasingly necessary.

### 7.3 Data challenges

#### 7.3.1 The implications of the “smile curve” for services in global value chains

One of the most commonly reproduced diagrammes in discussions on supply chains is “the smile curve” articulated by the founder of the Chinese Taipei-based hardware and electronics corporation Acer, Stan Shih. The smile curve illustrates the opportunities that exist on a value chain to produce higher value-added components upstream and downstream of manufacturing and assembly (Figure 7.3). This was the strategy from which Acer was born, upgrading from assembly to high value-added invisibles on the supply chain for computers.



Source: Adapted from Business Week Online Extra, May 16, 2005

Unless interpreted with care, the smile curve can be misleading in terms of understanding the role of services on the supply chain. The problem arises from the interpretation of what exactly the smile curve depicts.

The vertical axis does not show what share of value-added each identified activity represents of the total price of the product – in other words, the identified sources of value are not additive. Even the implied relative share of value-added among activities is not established because the position of each activity on the curve is determined by the production sequence depicted on the horizontal axis. We do not know, for example, whether “value-added per unit of output on branding” is less than the same measure for design.

Another interpretative pitfall relates to whether we think of the smile curve as a product, a sector, or an entire economy. This can become particularly troublesome if the assumption that manufacturing is where the jobs are, in contrast to the high-return, capital intensive segments of the production process. If taken to represent the whole economy, it is easy to assume there is an inevitable trade-off between jobs and higher value-added – in other words, “reliance on services destroys jobs”. In fact, some parts of the upstream or downstream value chain may be labour-intensive (such as retailing).

Be that as it may, assuming greater capital-intensity in higher value-added activities does not necessarily mean a job shortage for the economy because the composition of available jobs for the production of a single good is not the same as the job requirements for the economy as a whole.

Indeed, the job consequences of upgrading depend on the structure of the entire economy. It may well be that moving to higher value-added segments on a supply chain implies fewer employment opportunities on that chain. But many other factors, such as skill levels in the workforce and the functioning of the labour market, will determine the employment consequences of upgrading to the economy as a whole.

### *7.3.2 The imperfect statistical identification of services on supply chains*

The only truly distinguishing difference between services and goods is tangibility. The intangibility of services makes them harder to identify and measure. The difficulty is compounded by the heterogeneous (customised) nature of many services transactions and the lack of a properly developed and generally accepted nomenclature for services.

Other challenges arise for the reasons discussed before – services may not be supplied separately from one another, or from goods, and they may not even be contracted for and priced.

From a statistical point of view, it also matters whether transactions are arm's-length. On a supply chain producing goods, any services produced “in-house” – without any recorded arm's-length transaction – may well appear as goods in both output and trade data.<sup>8</sup> While this creates no discrepancy between output and trade data, it still misrepresents services as goods.<sup>9</sup> The degree to which this occurs depends on the structure of the economy. As firms grow, and agglomeration effects create external economies of scale, the outsourcing or offshoring of services previously produced internally are likely to increase. This will lessen the degree of statistical confusion between goods and services.



Another classification issue, however, further militates against precision and predictability in distinguishing between goods and services in production. This results from reliance on ownership as a criterion for determining whether output counts as goods or services.

Contract manufacturing arrangements result in manufactured output being classified as services output. This is the treatment prescribed by the sixth revision of balance of payments statistics and the 2008 revision of the system of national accounts. As Adlung and Zhang (2012) point out, this is not just an accounting matter. In a world where policies applying to goods and services are not uniform, different policy treatment can affect investment and ownership decisions in the real economy. This means that policy can inadvertently distort economic structures.

### *7.3.3 Definitional redundancy further complicates analysis*

The concepts of “embodied” and “embedded” services have been widely used to describe the role of services in production.<sup>10</sup> An embodied service is generally defined as a service whose product constitutes an input into the manufacture of a good. Examples of embodied services include transport, telecommunications, financial services and business services. An embedded service is one that constitutes an input into the sale of a good, such as retail, after-sales support, and inventory management.

One problem with the distinction is that it creates a discrete definitional break in processes along a supply chain that does not seem to serve any useful analytical purpose. From a policy perspective, the distinction is not precise enough – the relevant policy mix is likely to be very different among services categorised within each group. Moreover, the distinction cuts across key service sectors and does not match fully with certain kinds of services such as management, administration and back-office functions or information technology systems, which might be embodied or embedded. The categories therefore overlap.

Perhaps the most serious drawback is that these categories do not distinguish clearly between arm’s-length and non-arm’s-length transactions. It is this distinction that determines whether services are incorporated in goods (and vice-versa) for statistical purposes. The two categories do not, therefore, help us distinguish between statistical (informational) shortcomings and structural/organisational factors, both of which are associated with identification challenges relating to the contribution of services to supply chain production and trade. In short, the key issue for statistical recording is the contractual nature of the supply relationship, not embodiment or embedment.

## 7.4 Future directions

Services matter more than one might judge from the paucity of analytical attention they have received. Much of this summary has emphasised what we do not know and need to understand better. Significant identification problems render difficult the task of making detailed analyses from which policy conclusions and recommendations can be drawn.

Data challenges and the absence of a generally accepted nomenclature for services make an already complicated reality worse. While this is a matter for government action rather than future research, it is certainly something that influences what is feasible, other than

at a highly granulated level through case studies, where data are directly generated and product descriptions are largely *sui generis*.

Methodological challenges will of course arise in any attempt to move from the specific to more generalised conclusions.

The unbundling and separate identification of the services components comprising value addition along supply chains is one useful, if painstaking area of investigation. An understanding of what drives the multiple-product composite offerings of suppliers along supply chains is another for potentially interesting research. An understanding of how services generate value and innovation along supply chains, including where invisibles embody value, but are not priced, remains to be more fully developed.

## 7.5 Endnotes

1. See also Francois and Manchin (2011) for calculations of the services value-added content of trade.
2. Modularisation arises from arrangements whereby the offering of a value chain supplier is a packaged combination of products, be they goods and/or services. Such offerings may reflect cost minimisation considerations or they may be strategically put together as a means of market segmentation (customisation) that provides higher returns for the supplier.
3. For the seminal economics paper on this that brings together previous literature on offshoring and the workings of supply chains, see Grossman and Rossi-Hansberg (2008).
4. In practice, however, the fact that goods, unlike services, are storable and can be held as inventory may influence the complementarity relationships between goods and services.
5. The possibly apocryphal tale of Victorian rat catchers who raised more rats than they killed in order to increase their incomes as rat exterminators is a simple example of how policies taken in isolation of any thought of knock-on effects can have unintended consequences.
6. Since this is a product from the fashion industry, it is likely that the initial retail price would be discounted, in order to avoid the problem of managing inventories in an industry where fashions change quickly. Nevertheless, the invisible assets still represent a major part of the product's value.
7. Cited in Ng et al. (2011). P.15
8. Modern national accounting survey techniques attempt to adjust for this.
9. The same can happen with respect to goods on a services supply chain, but probably occurs less frequently.
10. See, for example, Drake-Brockman and Stephenson (2012).

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## Chapter 8

# Supply chains and trade in value-added

### *Abstract*

The increasing importance of global supply chains challenges the way statistics on trade are collected. Statistics on international trade flows are measured in gross terms and, hence, record the value of intermediate inputs traded along the value chain multiple times. Trade in global supply chains can be measured using firm surveys, customs statistics that record trade flows under special schemes of tariff reduction or exemption, or the Standard International Trade Classification (SITC) classifying goods as being intermediate or final. Because of several limitations associated with these methods, however, using input-output tables has become the preferred method for measuring trade in global supply chains. They are used to compute the value of imported inputs embodied in goods that are exported. A more complete measure of a country's participation in global value chains combines foreign value-added in exports (upstream links) with exports that are incorporated in other products and re-exported (downstream links). Estimates of the ratio of value-added exports to gross exports suggests that the double counting in gross trade flows, and hence international production sharing, has intensified in recent years, especially for fast growing countries undergoing structural transformation. Relying on national input-output tables, however, has its limitations. Combining it with bilateral trade data is difficult because there is no standard international classification, the level of sectoral aggregation is often different and their publication is infrequent. On-going efforts from the international statistics community to estimate trade in value-added go beyond the limitations of the input-output approach.

### 8.1 Gross trade flows and the problem of double counting

Over the past several decades, one of the most important changes in the nature of international trade has been the growing interconnectedness of production processes in a vertical chain that stretches across many countries, with each country specialising in particular stages of a good's production. In the literature, this phenomenon – studied quite extensively by trade economists – is referred to as “global supply chains”, “global value chains”, “international production networks”, “vertical specialisation”, “offshoring”,

“production fragmentation” and “multi-stage production”. Evidence suggests that, on average, more than half of the value of world exports is made up of products traded in the context of global supply chains (OECD 2012).

The increasing importance of global supply chains challenges the way statistics on trade are collected (Maurer and Degain 2010). Statistics on international trade flows are collected in gross terms and hence, record the value of intermediate inputs traded along the value chain multiple times.

For instance, an auto part produced in Country A and exported to Country B for final assembly would be counted again as Country B's exports, although there is no production transformation on that product. Similarly, when a particular intermediate input is imported, it is not clear whether it would be used directly by consumers, or used by a producer for further production and export. As a result of this double recording in trade statistics, countries engaged primarily in product assembly or completing tasks downstream appear to capture most of the value of goods and services traded, while the role of countries providing inputs upstream is underestimated in relative terms.

There appears to be an association between a nation's level of development – as measured by per capita income – and its position in global supply-chain trade. As nations get richer up to a point, they use imported intermediates more intensively in their exports. For example, as China moved up from textiles and apparel to assembling electronics and machinery, the import content of its exports rose.

Beyond a threshold, however, the intensity diminishes. Advanced technology nations, such as the United States, Japan and Germany, focus on sophisticated components that are exported for assembly elsewhere (Gonzales 2012).

This asymmetry between advanced economies and developing economies in global supply chains can affect the measurement of their participation in international trade. The much-talked-about US-China bilateral trade relationship is a case in point. Evidence suggests that the United States' trade deficit vis-à-vis China is reduced by about 20 to 30 per cent when measured in value-added terms rather than in gross terms (Stehrer 2012; Johnson and Noguera 2010).

## 8.2 Measuring trade in global supply chains

There is little systematic evidence quantifying the nature and growth of global supply chains. This is attributable to the lack of relevant data for measuring vertical trade relationships.

In principle, trade in global supply chains can be measured in four ways (Daudin et al. 2011). One possibility is to use firm surveys. But these are only available for a limited number of countries and for a limited number of multinational firms. Another possibility is to rely on customs statistics which record trade flows under special schemes of tariff reduction or exemption. In order to provide incentives for domestic industrial development, many developing countries provide tariff exemptions for imported inputs that are used in exports while developed economies do so for the domestic input content of imported final products.

Special schemes result in customs officials recording the concerned trade under a special heading. This allows researchers to obtain a narrow measure of global supply chains. For example, in examining the US offshore assembly programme (OAP) that records the

domestic input content of imports into the US, Swenson (2005) finds that offshoring activities grew significantly during the period between 1980 and 2000.

Egger and Egger (2005) present a similar result for the outward processing trade (OPT) programme of the EU, especially with Central and Eastern European countries.

China's integration into global supply chains has also been studied by analysing such statistics (Lemoine and Ünal-Kesenci 2004). The major difficulty of this method is that it can be used only for a handful of countries, which make these data available. Another shortcoming relates to the general trend of tariff reduction. As the tariff rate on parts and components becomes lower, firms' incentives to use such special schemes decrease. This results in poor coverage of the international intermediate goods trade under these special headings.

A third methodology to capture the role of global supply chains in international trade is to use the Standard International Trade Classification (SITC) to categorise goods as being intermediate or final. This type of analysis was initiated by Yeats (1998), who found that trade in parts of components of machinery accounts for more than 30 per cent of total OECD countries exports.

In a more recent study, Athukorala and Yamashita (2006) measure vertical trade for most countries in the world in the context of the five-digit SITC (Rev 3) classification, by treating some goods belonging to categories 7 (machinery and transport equipment) and 8 (miscellaneous manufactured articles) as parts and components or intermediate inputs. In doing so, they find that trade in intermediate goods increased from 18.5 per cent to 22 per cent of world manufacturing exports between 1992 and 2003.

In another recent study, Miroudot et al. (2009) show that the share of intermediates in world merchandise trade increased from just over 50 per cent in 1999 to almost 60 per cent in 2007. They also show that in 2007, over 70 per cent of services trade was in intermediates.

Other studies which used this method focus on specific regions. Its extensive use is understandable, because the data can be easily collected and have a wide coverage in terms of regions, time period and products. This method, however, suffers from the important limitation that a classification of goods into intermediate and final may be somewhat arbitrary.

The fourth – and increasingly the most used method of measuring trade in global supply chains – is to use input-output tables. In principle, with such tables for all countries in the world, a value chain can be calculated for each final good sold in each country. This would be a decomposition of its price into the value-added (being the sum of wages, profits and natural resource rents) in each of the sectors and countries which has contributed, directly or indirectly, to its supply (Wood 2001). Its conceptual underpinnings and related empirical evidence are described below.

## 8.3 The import content of exports

### *8.3.1 Conceptual underpinnings*

The seminal work of Hummels et al. (2001) developed a measure that computes the value of imported inputs (or foreign value-added) embodied in goods that are exported. It is referred to as the “vertical specialisation index”. In an ideal world, the estimation of such



a measure would be done using data on the production process and on the direction of trade flow for every stage of each good that is traded. These data are impossible to obtain except on a case-by-case basis. Hence, this measure of vertical trade is estimated empirically by using input-output tables, which include sector-level data on inputs (distinguishing foreign and domestic sources), gross output, and exports.

The use of input-output tables avoids the arbitrariness of methods that classify goods into “intermediate” and other categories. It also enables the calculation of the value of imported inputs used indirectly in production of an exported good; imported inputs may be used in one sector, whose output is employed in a second, then a third, and eventually embodied in an export good.

It is worth noting that the use of relatively aggregate (sector) data from the input-output tables can lead to biases in calculating the true level of the imported input content of exports. Consider, for example, that a sector produces two goods. One good uses no imported inputs but is exported, while the other uses imported intermediate inputs but is not exported. For both these goods individually, the import content of exports would be zero, yet calculation at the sector level would yield a positive value.

It is worth noting that the use of intermediate goods imports for domestic consumption is becoming increasingly important because several global supply chains now end in emerging economies with large markets.

### *8.3.2 Empirical evidence*

Using input-output tables for 14 countries (10 OECD countries and Ireland, South Korea, Chinese Taipei and Mexico), Hummels et al. (2001) show that the growth in vertical specialisation accounted for about one-third of the growth in overall exports between 1970 and 1990. The authors also find that variations in the vertical intensity of all sectors, rather than changes in the sectoral composition of overall exports, accounted for most of the growth in vertical specialisation over time and across countries.

In addition, Hummels et al. (2001) show that the most common geographical pattern of vertical specialisation involved inputs imported from developed economies being transformed into export goods in developing economies destined for other developed economies. This result is reinforced by the findings of Gonzales (2012) who finds that while 37 per cent of the gross value of Mexican exports consists of US intermediate inputs, only 2 per cent of US exports consist of Mexican intermediate inputs. “South-South” vertical links appear to be the weakest.

More recent studies by Daudin et al. (2011) and Koopman et al. (2010) find that small open economies such as the Czech Republic, Luxembourg, Singapore and Estonia source more inputs from abroad than large countries, such as the US and Japan. China is the exception, being a large country with a high import content of exports.

### *8.3.3 Limitations*

In their estimation of the import content of exports, Hummels et al. (2001) assume that the intensity in the use of imported inputs is the same between production for exports and production for domestic sales. This assumption is violated in the presence of processing exports. Parts and other intermediate materials used in the production of processing exports often receive tariff exemptions and other tax preferences from governments.

To compute the share of foreign value-added in a country's exports when processing exports are pervasive, Koopman, Wang, and Wei (2012) develop a formula (for which Hummels et al. 2001 is a special case) which accounts for the possible difference between the intensity of imported intermediate inputs in the production of processing exports and in other production. Using data from China for 1997, 2002 and 2007, they find that the share of foreign value-added in China's manufactured exports was about 50 per cent, almost twice as high as that implied by the methodology employed by Hummels et al. (2001).

In the model developed by Hummels et al. (2001), the only way in which a country can participate in global supply chains is by using imported inputs to produce a good that it exports (directly or even indirectly when imported inputs are used in the production of domestic inputs, which are then used in the production of exports).

It may also be the case that a country imports intermediate inputs, adds value, and then exports semi-finished goods to another country, which adds further value and then exports final goods. For example, Japan produces electronic components, most of which are exported to South East Asian countries, where they are used as inputs to produce TVs, most of which are then exported to other countries.

The literature strikes a note of caution on the terminology used to describe these two concepts of measuring value-added flows between countries (Stehrer 2012). "Value-added in trade" calculates the amount of foreign value-added embodied in the gross exports of a country, while "trade in value-added" accounts for the value-added of one country directly and indirectly contained in final consumption in another country.

The methodology developed by Hummels et al. (2001) also assumes that all imports are 100 per cent foreign-sourced. This implies that a country cannot receive intermediate imports that embody its own value-added, returned home after being processed abroad.

This assumption is unlikely to hold in a world where more than one country exports intermediates. Therefore, given the multi-country, back-and-forth nature of present day global supply chains, the measure of the import content of exports developed by Hummels et al. (2001) is unlikely to provide an accurate reading of value-added trade.

## 8.4 Beyond the import content of exports

### *8.4.1 Conceptual underpinnings*

Estimating the value of a country's exports that are embodied in a second country's export goods is not straightforward because it requires matching bilateral trade flow data to inter-country input-output tables. A number of recent studies in the literature do reconcile input-output tables with bilateral trade statistics to get a set of domestic and import use tables broken down by partner countries. The resulting world input-output table measures, more accurately, the domestic value that countries are adding to goods and services along the global supply chain (Timmer 2012).

For instance, Koopman et al. (2010) calculate the share of exports made of domestic value-added used in third countries to produce other exports, and combine this indicator with the import content of exports to derive a "participation index". This gives a more complete picture of the involvement of countries in GSCs. Simply relying on the import content

of exports would undermine the participation of commodity producers or upstream suppliers of intermediate inputs in GSCs.

On the flipside, only considering the share of exports – comprising domestic value-added – used by other countries to produce other exports would penalise downstream producers and countries that often consume products instead of re-exporting them to third countries. Given the above, a recent report by UNCTAD (2013) constructs a measure of country participation in global value chains by combining foreign value-added in exports (upstream links) with exports that are incorporated in other products and re-exported (downstream links).

According to Daudin et al. (2011), it is also possible to identify that part of a country's exports which, further down the production chain, are re-imported as embedded inputs for final consumption, i.e. the domestic content of invested or consumed imports. In fact, Koopman et al. (2010) demonstrate mathematically how this double counted portion of value-added in intermediate goods trade could be measured and adjusted so that gross exports can be fully decomposed into its various value-added components.

Johnson and Noguera (2012) define "value-added exports" as the amount of value-added from a given source country that is embodied in the final consumption in each destination. A note of caution is the need to differentiate between countries simply participating in global value chains and actually adding value. For example, resource rich or commodity producing countries will have a higher share of domestic value-added in final foreign demand, and hence record a higher rate of GVC participation, even if they add little value to the extracted commodity or raw material.

In the aggregate, the ratio of value-added exports to gross exports measures the extent of double-counting in trade statistics, an important metric of international production fragmentation. At the bilateral level, this ratio is a marker for both bilateral production chains, as well as multi-country production chains, in which value-added transits through third countries en route from source to destination.

### *8.4.2 Empirical evidence*

Estimating the aforementioned "participation index" for OECD economies and selected non-OECD countries, Koopman et al. (2010) show that a large percentage of the (domestic) value of exports is used in downstream industries in other countries.

For example, based on import content of exports measure, the GSC participation of the United States is less than 10 per cent of the value of US exports and is made up of foreign inputs. However, taking into account the use of US intermediates in other countries' exports, the country's participation in GSCs rises to more than 40 per cent.

According to Daudin et al. (2011), the same holds true for other producers of industrial inputs, as well as countries that have an abundance of primary product exports. The above highlights the fact that factoring in the use of exports as inputs into exports by another country is important for improving our understanding of global supply chains.

In terms of geographical concentration, global value chains are not limited to Asia. OECD economies, especially those in Europe, show a comparable level of participation (OECD 2012). Large non-OECD economies, such as China and Brazil, have a lower share of exports used as inputs in further production for export, as opposed to the small ones,

such as Singapore or Chinese Taipei (Koopman et al. 2010). This is because the former are often located in the downstream part of GSCs – as a base for final assembly – whose export products are destined for final consumption instead of further processing. It is worth noting that the data used in this study only include emerging economies. The participation of non-OECD economies in GSCs is likely to have been lower if data for LDCs were included in the global input-output model.

Using the GTAP database to analyse 66 regions and 55 sectors in 1997, 2001 and 2004, Daudin et al. (2011) highlight the fact that standard trade statistics paint an inaccurate picture of the relative dependence of different sectors on international demand. In addition to estimating the import content of exports, they reallocate value-added trade to its initial producer industry. As a result, some sectors have more value-added trade than they have export trade, i.e. they are mainly traded as inputs in other goods.

Services are much more dependent on external demand. So too are agricultural raw materials. For instance, 11 per cent of value-added in services worldwide is consumed by foreign consumers compared to service exports, constituting only 7 per cent. In contrast, despite the fact that industrial exports are equal to 67 per cent of industrial value-added, a large part of these exports embody service or commodities production. Hence, only 32 per cent of world industrial value-added is actually consumed by foreign consumers.

Koopman et al. (2012) even show that a country's revealed comparative advantage in a sector may change with the use of a domestic content in exports measure, rather than traditional trade statistics. For example, with gross trade data, the machinery and equipment sector is a comparative advantage sector for China. With domestic value-added in exports data, however, they find that China has a revealed comparative disadvantage in the same sector.

Daudin et al. (2011) also show that value-added trade reduces the incidence of regionalisation in world trade. For example, Asia relies more heavily on extra-regional final markets than standard trade statistics suggest. This is also the case for America and Africa.

Much of the literature discussed here focuses on measuring trade in value-added over short time spans, often even in a single recent year. A recent study by Johnson and Noguera (2012) computes and analyses the value-added content of trade during the period between 1970 and 2009. They construct an annual sequence of global input-output tables covering 42 countries to show that for the world as a whole, the ratio of value-added to gross exports has been declining over time, falling by between 10 and 15 percentage points over the last four decades. The decline in this ratio was especially steep after 1990.

This suggests that the double counting in gross trade flows and hence international production sharing has intensified in recent years. Beneath these global results, Johnson and Noguera (2012) find that both the magnitude and timing of declines in the ratio of value-added to gross exports differs across countries. Declines appear to be largest for fast-growing countries undergoing structural transformation.

There is ample variation across bilateral trading partners as well. For example, the ratio falls by 0.29 for US exports to Mexico, but is nearly unchanged for US exports to Japan. This bilateral variation reflects both changes in the extent to which exports to a given destination are used in production of exports, as well as changes in how a given source country serves the destination via third markets.

## 8.5 Future research

The most important limitation of the method based on input-output tables is that these tables are constructed at a national level, and have little information about the international aspects. Some recent studies have attempted to combine information from input-output tables with bilateral trade data.

The accuracy of this method also depends on the level of sectoral aggregation in an input-output table. The importance of global supply chains is best captured with a more detail breakdown of production activity in an economy. Moreover, there is no standard international classification, which often inhibits international comparison. Another problem is related to the frequency of publication of such data. It is usually produced every five years, thereby making it difficult for it to be combined with international trade statistics (Damuri 2012).

The OECD, in co-operation with the WTO, has launched an ambitious project on the measurement of trade in value-added terms. Its objective is to look for a synthesis of the existing approaches, in order to define best practices. A world input-output table comprising 56 countries (and 37 industries) that account for more than 95 per cent of world output is envisaged. Such a model would be vital for gaining better estimates of bilateral trade flows in value-added terms, and of the contribution of each economy to global production. While the margin of error would be low at a reasonable level of aggregation, this is not likely to be the case when interpreting more specific results in terms of countries and industries.

Based on stochastic principles developed in exploratory network analysis, a recent study by Damuri (2012) explores a new way to use information in input-output tables to estimate the pattern of international production fragmentation. It takes into account not only bilateral relations, but also captures the whole network of production.

The author constructs a matrix of international production linkages by combining input-output tables of 45 countries and trade statistics. It takes a form of an input-output table, but instead of showing production sectors as rows and columns, it has countries as the sources of production in its rows and countries as destinations in its columns.

On-going efforts from the international statistics community to address issues related to estimation of trade in value-added also go beyond the limitations of the input-output approach. For instance, the 2008 revision of the System of National Accounts (SNA 2008) looked into the estimation of trade values in the specific case of manufacturing services.

Escaith (2008) proposes to expand the concept of value-added trade to other types of business relationships within international value chains and develop “satellite accounts” of the external sector. The objective is to organise all related economic statistics, including business and employment data, and integrate these in line with the SNA directives.<sup>1</sup>

Sturgeon (2013) reviews the various initiatives undertaken by the statistical community and recommends a framework for integrating trade and business statistics into a network of micro-databases within the EUROSTAT context. Tang, Wang and Wang (2013) present an example of combining input-output analysis with business surveys in order to measure trade in value-added by firm characteristics in the case of China.

## 8.6 Endnote

1. The Global Forum on Trade Statistics, organised by several international agencies in Geneva in February 2011, provides a synthesised view of the new requirements on international trade and its relationship with global value chains, employment, the environment and the interdependence of economies. [http://unstats.un.org/unsd/trade/s\\_geneva2011/outcome.htm](http://unstats.un.org/unsd/trade/s_geneva2011/outcome.htm)

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# Chapter 9

## Supply chains and business models

### *Abstract*

While the term “business model” might seem ubiquitous today, its use only arose in the 1990s with the information and communications technology (ICT) revolution. Since then, the business model literature has advanced definitions and conceptualisations that describe, and prescribe, a range of supply chain architectures. In the age of network competition, the business model concept now rests upon the focal unit of the supply chain and no longer upon the individual firm. Theory has emerged to aid the practitioner in designing supply chains and in understanding the latest business models. While not as directly relevant, policy makers also stand to gain from this literature in understanding the considerations that businesses take into account for their business design decisions.

### 9.1 Historical development

The term “business model” is well established in the modern lexicon, but this belies its relatively young age. Business models came to prominence recently in the 1990s during the information and communications technology (ICT) revolution and the dot-com boom. The capabilities introduced by ICT could be implemented in the business environment to create previously infeasible ways of doing business (Brynjolfsson and Hitt 2000).

To grasp the significance of these new ICT technologies, Brynjolfsson and Hitt (2000) conceptualised markets and organisations as information processors. With the new information computation capabilities and dramatically reduced costs, the institutions and thinking from the pre-ICT economy suddenly became outdated; and as with previous general purpose technologies, the implementation of technical innovations also gave way to significant organisational innovations.

It is these new organisations that are the focus of the “business model” term, and Osterwalder (2004) highlights four key drivers: (1) reduced transaction and coordination costs enable isolated firms to shift towards more collaborative and integrated forms of network organisation; (2) brand new products and services, often with an information



component, can now be offered; (3) brand new channels for reaching the customer; and (4) brand new pricing and revenue mechanisms.

The new frontier of business opportunities created by these drivers and the resulting business models being built to capture them drove the rise of business model-related topics in media, management and academia (Morris, Schindehutte, and Allen 2005; Osterwalder 2004). This, however, is not to say the “business model” was invented in the 1990s. Osterwalder (2004) reports that the earliest documentation in the literature goes as far back as 1960. While far from scientific, a search on Google Scholar for academic literature using the exact key phrase “business model” shows a four-order magnitude of difference increase in the number of results between 2000 and 2009 compared to those between 1960 and 1969 (Table 9.1).

**Table 9.1: Results, by decade, from a Google Scholar search of the exact key phrase, “business model”**

Decade	# of Google Scholar search results
2010s (until 24 January 2013)	25,200
2000s	105,000
1990s	5,840
1980s	466
1970s	195
1960s	96
1950s	27
1940s	25
1930s	14
1920s	13
1910s	15
1900s	17

*Source: Search conducted on 24 January 2013*

Much of the literature from the 1990s attempts to document, categorise, and rationalise the plethora of new business models – in particular, e-commerce business models – that were appearing. Much of the theory building during this time focused on developing typologies of business models (see Timmers 1998; Mahadevan 2000). However, the collapse of the dot-com bubble proved many of these business models irrelevant, and the literature shifted its focus to the theoretical underpinnings of business models to understand why (Tikkanen et al. 2005).

Since then, the term “business model” has emerged as a more clearly defined and operationally useful area of research. Indicative of the continual maturation of the field, the most recent literature has now begun to shift from the theoretical underpinnings of business models to the development of managerial tools for business model design and implementation.

## 9.2 Definitions and conceptualisations

A consequence of the rapid proliferation of the business model term during the 1990s was the deterioration of its definitional clarity. Like “globalisation”, business models came to be used by everyone but known by no one (Morris, Schindehutte, and Allen 2005; Osterwalder 2004; Tikkanen et al. 2005; Timmers 1998). As Magretta (2000) notes, “the terms ‘business model’ and ‘strategy’ are among the most sloppily used in business. People use them interchangeably to refer to *everything* [sic] - so they mean nothing.”

In other chapters, we try to separate the definitions from the conceptualisations of issues for the reader, but this proves difficult with the business model literature. Quite often, proposed definitions of a business model take the form of a conceptualisation. Further complicating the deconstruction and analysis of the literature is the fact that many of the conceptual definitions are also presented as conceptual tools for the business practitioner.

In light of the fact that there are more than enough definitions to review, we set aside those dual conceptual definition-tools and address these functional definitions in section 9.3. For this current section, we begin by introducing the variety of textual definitions of “business model” found in the literature (Table 9.2).

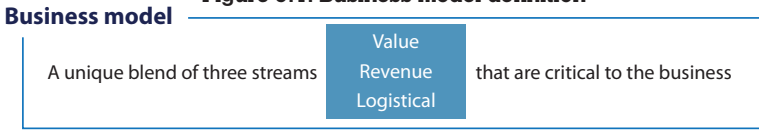
**Table 9.2: A sample of definitions of “business model” reviewed in the literature**

Author	Definition of “business model”
Amit and Zott (2001)	a depiction of the content, structure and governance of transactions that have been designed to create value
Magretta (2002)	a story explaining who the customers are and how to make money by providing them with value
Mahadevan (2000)	a blend of three critical business streams: the value stream for business partners and buyers, the revenue stream, and the logistical stream
Morris, Schindehutte, and Allen (2005)	a concise representation of how decision variables relating to venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets
Osterwalder (2004)	an abstract model of the business and money earning logic of a company and a business layer binding business strategy with business processes
Tikkanen et al. (2005)	a system of components and related material and cognitive aspects of the firm
Timmers (1998)	an architecture for the flow of products, service, and information that includes descriptions of the business actors plus their roles, the incentives for each actor, and the sources of revenue

In Table 9.2, we can see the ambition embodied in the business model concept. Described as an “architecture”, a system, flows and streams, the business model is a metaphysical abstraction of a firm’s most essential features. What these essential features are, however, and where the business model concept stands, relative to strategy, marketing, and other complementary ideas, varies significantly across authors. To gain a better view of how the literature orients the business model concept, we present several visualisations of the definitions found in the literature, starting with the simplest (Mahadevan 2000) (Figure 9.1 - Figure 9.7).

Mahadevan (2000) utilised a basic concept of flows that exist across the supply chain. This is shared as a characteristic with many other definitions found in the literature (Figure 9.1).

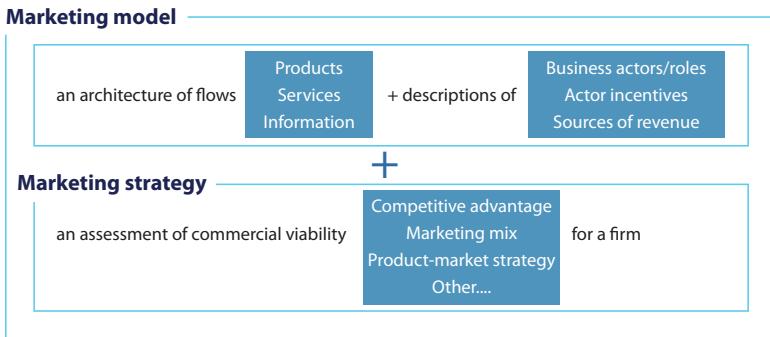
**Figure 9.1: Business model definition**



Source: Adapted from Mahadevan (2000)

Timmers (1998) introduces the context of marketing with the business model in his landmark work on e-commerce business models. In Timmers' conception, the business model is a subset of an overarching marketing model, and exists at the multi-firm level. In order to derive firm-specific insights on value creation and capture, however, the context of the business model needs to be complemented with a firm-specific marketing strategy (see Figure 9.2).

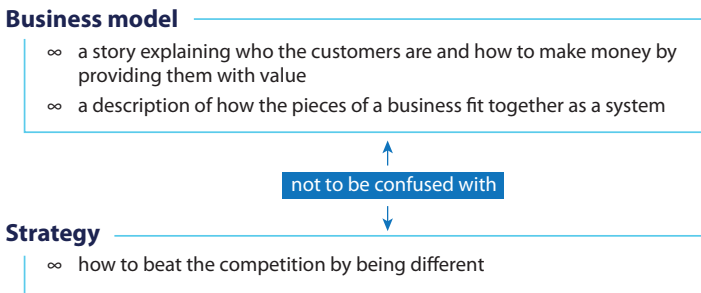
**Figure 9.2: Business model conceptualisation**



Source: Adapted from Timmers (1998)

Magretta (2002) takes a very different approach compared to the typical analytical deconstruction approach of other authors. In her conception, the business model is, very simply, related to a story; this is appropriate given the significant qualitative considerations involved in business model design. Magretta also makes a distinction between business models, which describe the money-learning logic (as Osterwalder (2004) puts it) of a firm or system of firms, and strategy, which describes how to sustainably beat the competition. (See Figure 9.3)

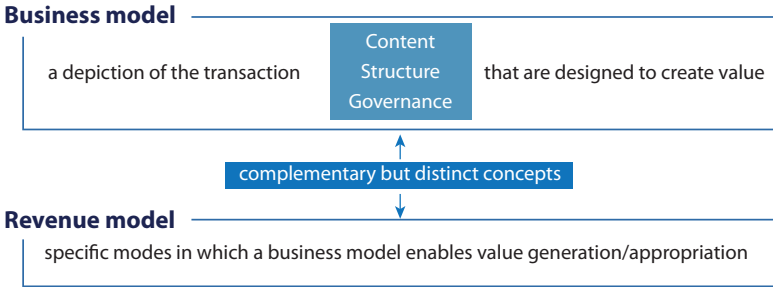
**Figure 9.3: Business model conceptualisation and validation test**



Source: Adapted from Magretta (2002)

Amit and Zott present a conceptualisation in their 2001 work wherein the business model contains the more structural and static components of a business, while a complementary concept of the revenue model describes the dynamic modes in which the business model operates to create and capture value (Figure 9.4).

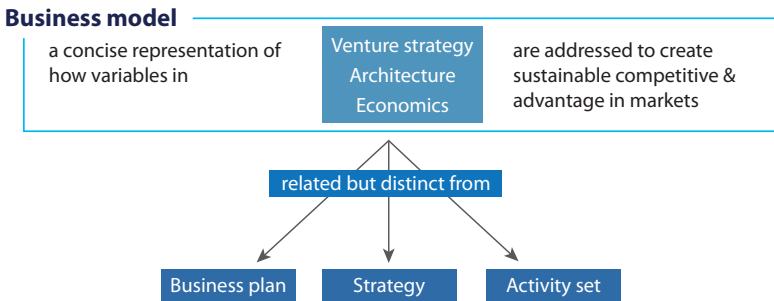
**Figure 9.4: Business model conceptualisation and design framework**



Source: Adapted from Amit and Zott (2001)

Progressing forward in complexity, Morris, Schindehutte, and Allen (2005) present a definition of business models derived from the entrepreneur’s perspective (Figure 9.5). Here, they distinguish business models from business plans, strategy, and activity sets. In contrast to Magretta’s (2002) conception the issue of sustainable competitive advantage is directly addressed by the business model.

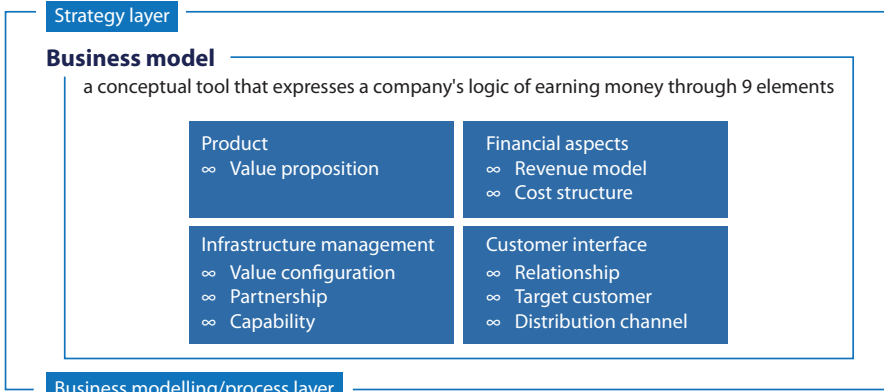
**Figure 9.5: Business model conceptualisation and design framework**



Source: Adapted from Morris, Schindehutte, and Allen (2005)

Osterwalder (2004) presents a landmark work in the review, consolidation, and advancement of the business model in his doctoral thesis. In his efforts to build a “business model ontology”, he proposes the segmentation of the business model into nine key elements that address the products/services, structure, finances and customer interfaces of the firm (Figure 9.6). Osterwalder also distinguishes a strategy from a business model, locating strategy at the highest macro perspective. Offered below are business models in terms of scope of consideration and a business modelling or process layer to represent a more operational/on-the-ground perspective.

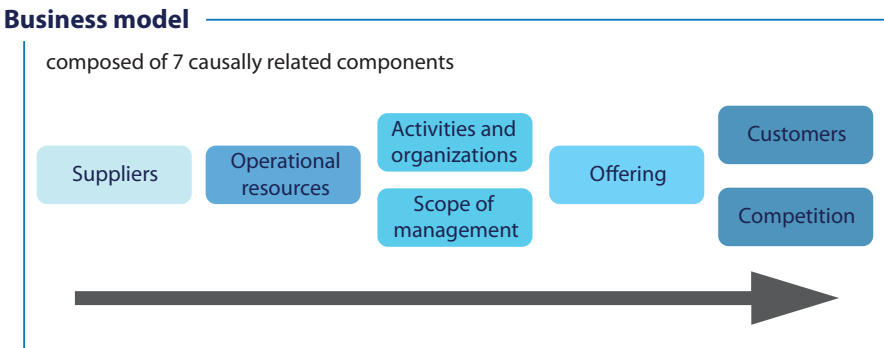
**Figure 9.6: Business model conceptualisation**



Source: Adapted from Osterwalder (2004)

Finally, Hedman and Kalling (2003) present a conception that segments the business mode into seven interrelated components. This conceptualisation directly adopts the up-stream/down-stream process perspective of the supply chain, as shown in Figure 9.7.

**Figure 9.7: Business model conceptualisation**



Source: Adapted from Hedman and Kalling (2003)

Overall, the variance in perspectives makes it impossible to present a clear and universal definition of the business model. That said, we consider the very existence of the concept to be valuable for one critical reason. The concept of the business model draws the attention of the practitioner to the logic underlying the existence of their business, and encourages the practitioner to ask why information goes into this database, why we outsource these activities, why we serve these customers with these products, and so on. In a global market characterised by rapid change and increasing intangible components (information and services), these questions enable the practitioner to evaluate and adapt their business at a more fundamental level.

For a more in-depth review and discussion of the variance in business model concepts, we highly suggest Osterwalder's (2004) work on business model ontologies.

## 9.3 Supply chain business models

As can be seen from the definitions and conceptualisations of business models, one can not escape the inclusion of a supply chain – or otherwise, network-centric component – in the business model. The ICT revolution that gave rise to the business model concept also gave rise to the proliferation of supply chains, and the two concepts can be considered as being related through this common source. The business literature makes it clear that businesses can no longer afford to disregard one another if they are to survive in an increasingly integrated world economy. To address this new reality, the literature presents a variety of approaches and best practices in supply chain business models.

### *9.3.1 The business and engineering approach*

Typically, the design of a supply chain involves generating several alternatives and evaluating them on the basis of benchmark performance measures. These often incorporate considerations of long term strategic planning in a general time frame of three to twelve years (Goetschalckx and Fleischmann 2008). Benchmarking considerations, often centred on optimising revenues, are constrained by a series of business risks, be they strategic (“make or buy decision”, long term strategic alliance with key suppliers or customers) or operational (such as those linked to demand considerations, lead-time and inventories).

Geoffrion and Powers (1995) provide a comprehensive review of the early literature and how the corporate status of logistics has changed dramatically since the late 1970s. Their review addresses the formal research of a minimal-cost configuration for a company’s production and distribution network that satisfies product demand at specific customer service levels. They show, inter alia, how progress in IT and software improved the information and decision-support systems used to assist business management.

International decision-support models have the same characteristics, variables and constraints as single country frameworks, but need to also model exchange rates, tax and duty rates, and border and beyond-the-border regulations. In addition, geo-political considerations may complicate the analysis, especially in the case of long-term strategic planning. Risk analysis is particularly complex in these international designs, including many third parties, as “every company pays for the inefficiencies up-chain and down-chain” (Geoffrion and Powers 1995).

In addition to the more advanced algorithmic models to support decision making and supply chain operations, management schools have also developed strategic approaches, based on game-theory.

A key differentiating factor in the supply chain decision making scenario is the importance of cooperation. Unlike the “win-lose” business propositions derived from more traditional import substitution industrialisation (ISI) and defensive trade policies, a key merit of the supply chain approach is the possibilities of enabling “win-win” scenarios. However, doing so requires the balancing of focal firm objectives and constraints (such as profit maximisation and long-term growth) and cooperative supply chain objectives (such as process optimisation and market competitiveness). Cooperative game theory helps design a supply chain by selecting an optimal coalition of partners. But non-cooperative (also called strategic) outcomes should not be ruled out and are often identified in order

to determine the set of equilibrium points that can be reached in trade conditions (Cachon and Netessine 2004; Hennet and Ardax 2008).

While these tools remain largely conceptual, their practical implications in terms of private and public decision making should not be ignored. These strategic aspects of outsourcing for lead firms or large first-tier suppliers often determine the set of feasible strategies for the insertion of new players into a global value-chain, and further upgrading. The following section addresses specific design tools in the literature.

### 9.3.2 Design tools

A number of supply chain business model design tools emerged from the literature, and can be broadly classified as either quantitative or qualitative in approach. Our review sourced a limited number of articles on quantitative design tools, and our discussion will be limited, as a result. However, one excellent review on the evolution of quantitative models from operations research is presented by Meixell and Gargeya (2005).

The quantitative tools are predominantly based on mathematically modelling supply chain components to optimise around the goals of either maximised profit or minimised cost. An example can be seen in the IBM supply chain simulator, which takes the form of a fully-fledged software programme that allows managers to simulate location, replenishment, and inventory decisions, among others (Bagchi et al. 1998). The appeal of such tools is clear for the business practitioner: One can quickly, conveniently and cheaply evaluate outcomes of decisions without the real-world consequences. However, while such models have been seen in more specific applications, such as inventory management or sales forecasting, current models do not yet account for the breadth of considerations that must be taken into account at the business model design level. In particular, models need to be expanded to cover more activities and organisations across the supply chain, in addition to considering performance measures that move beyond simple profit/cost calculations (e.g., reliability, responsiveness, or flexibility) (Meixell and Gargeya 2005).

Qualitative tools were much more prevalent in our surveyed literature. These take the form of frameworks built around key design questions or considerations for the business practitioner to answer. We present four such frameworks from the literature, which have been sufficiently developed to hold utility for the business practitioner.

Zott and Amit (2010) interpret the process of value creation as a system of activities in the supply chain, and prescribe two groups of design parameters: one group of three design elements, and one group of four design themes. The *design elements* consist of content, structure, and governance of the activity system. These elements embody the activities, interconnections, and actors in the supply chain. To guide the business practitioner are the infinite configurations possible with these elements.

Zott and Amit point to four design themes which represent the strategic source of value creation that guides the structuring process of design elements. The themes, or rather, value-creating strategies presented are pursuing *novelty* through investment in organisational innovation, lock-in of control over supply chain participants (e.g. customer bases, key suppliers), complementarities or synergies between activities, or *efficiency* with the aim of lowering costs. A summary of components can be found in Figure 9.8.

**Figure 9.8: Components of the activity system design framework**

**Framework provides insight by:**

- Giving Business Model Design a *language, concepts, and tools*
- Highlighting Business Model Design as a *key managerial/entrepreneurial task*
- Emphasising *system-level design* over partial optimisation

**Design Elements**

- Content *What activities should be performed?*
- Structure *How should they be linked and sequenced?*
- Governance *Who should perform them, and Where?*

**Design Themes**

- Novelty *Adopt innovative content, structure or governance*
- Lock-In *Build in elements to retain business model stakeholders, e.g., customers*
- Complementarities *Bundle activities to generate more value*
- Efficiency *Reorganise activities to reduce transaction costs*

*Source: Zott and Amit (2010)*

Nenonen and Storbacks (2010) present another business model framework based on interaction with multinational firms as well as previous literature. Also focused on value-creation components and processes, their framework considers three types of business model components (design principles, resources, capabilities) in four settings (market, offering, operations, management).

Design principles guide the structure and execution of operations, and echo the concepts of the design themes of Zott and Amit. Resources refer to tangible, static (operand) resources and intangible, dynamic (operant) resources that combine to create value. Capabilities refer to the skills and knowledge used as instructions for value-adding activities.

The four settings focus on relevant dimensions of firm and supply chain activities. The market dimension relates to consideration of the three business model components in the context of customers and the marketing activities in reaching them. Offering refers to offering design and earnings logic, and also to the product and process designs underlying a firm's products and/or services. The latter two dimensions are relatively straightforward, with operations referring to the context of operational design and infrastructure and management referring to support and development of human resources.

Figure 9.9 presents a visual framework from Nenonen and Storbacks (2010). Overall, the logic of this framework is not as easy to grasp relative to Zott and Amit's (2010) framework, but the four specific settings addressed may hold more utility for relevant practitioners.



**Figure 9.9: Framework of business model design considerations**

	Design principles	Resources	Capabilities
Market	Market & customer definition	Customers & brand	Market & customer management
Offering	Offering design & earnings logic	Technology	Offering management & R&D
Operations	Operations design	Infrastructure, suppliers & partners	Sourcing, production & delivery
Management	Management system	Human & financial resources	Management & leadership

Source: Nenonen and Storbacka (2010)

Morris, Schindehutte, and Allen (2005) also utilise a multi-component, multi-level approach in building their business model framework. In this case, the components are actually six key questions that must be answered in developing the value-creating logic of the firm. These questions are: (1) “how do we create value?”; (2) “who do we create value for?”; (3) “what is our source of competence?”; (4) “how do we competitively position ourselves?”; (5) “how do we make money?”, and, (6) “what are our time, scale, and scope ambitions?”

These questions are asked at three levels of operational specificity: foundation, proprietary, and rules. The foundation level refers to the answer of questions by entrepreneurs at the most fundamental level when formulating a non-operationally specific business model. The proprietary level then advances from the foundation level to consider how questions can be answered in a unique manner that will be proprietary and characteristic to the firm. Finally, the rules level asks for specific operational actions to realise the answers produced at the proprietary level. The resulting framework is presented in Figure 9.10.

This framework holds value in identifying the right questions and the difference in answers according to operational scenarios, but the guidance provided to practitioners gets weaker with increasing operational specificity. Nonetheless, the questions provide a high-level reality check for the practitioner’s consideration.

**Figure 9.10: Decisions-based business model framework**

	Level of decision making		
	Foundational	Proprietary	Rules
Factors related to the offering <i>How do we create value?</i>			
Market factors <i>Who do we create value for?</i>			
Internal capability factors <i>What is our source of competence?</i>			
Competitive strategy factors <i>How do we competitively position ourselves?</i>			
Economic factors <i>How do we make money?</i>			
Personal / investor factors <i>What are our time, scope and size ambitions?</i>			

Source: Adapted from Morris, Schindehutte, and Allen (2005)

Tikkanen et al.'s (2005) business model framework is unique in recognising the significance of managerial perceptions (belief systems) in business model design. The logic behind such an approach is that managerial perception of the firm and the environment determines resulting actions and outcomes.

The framework proposed by Tikkanen et al. examines the relationship between managerial perception and material, or rather objective, components of the firm. The perceptions are organised into a belief system with four components: industry recipes, boundary beliefs, product ontologies, and reputational rankings.

Industry recipes refer to perceptions of the economic, competitive, and institutional environments and their influence on firm performance. Boundary beliefs refer to the firm's boundaries, and are socially shared beliefs on the delineation and relationships of a firm within a greater environment or community of organizations. Product ontologies refer to the characteristics that are used to define a firm's products and/or services. Finally, reputational rankings refer to the perception of competitors relative to the perception of personal performance. The framework can be seen below in Figure 9.11.

**Figure 9.11: Materials and beliefs-based business model framework**

	Reputational rankings	Industry recipe	Boundary beliefs	Product ontologies
Strategy and Structure	<i>The longer the industry life-cycle and the more stable the related industry recipe the more narrow the alternatives for structural change</i>		<i>The less ambiguous the link between firm strategy and the totality of firm's belief system, the more crystallized the strategic intent of a company and the more consistent its actions</i>	
Network	<i>The higher the cognition of a firm's own reputational ranking, the higher reputational rankings the firm seeks and expects from its customers and suppliers</i>		<i>The targets of a firm's marketing efforts are constrained by the firm's boundary beliefs about who it can pursue as a customer or serve as a supplier</i>	<i>The more focused the product ontology, the more structured and goal-oriented the management of the product development project portfolio</i>
Operations		<i>The stronger the industry recipe, the more uniform process architectures will be across competing firms</i>	<i>The narrower the firm's beliefs in its operational boundaries, the fewer are its unique resources and competencies</i>	<i>Managerial cognitions of current and future product ontologies is a major constraint and reinforcer in the evolution of product / service offerings</i>
Finance & Accounting	<i>The stronger the cognition of reputational rankings, the more uniform the capital budgeting and financial reporting practices of competing firms.</i>		<i>The firm's cognition of its boundaries constrains its use of management accounting practices and financial instruments</i>	

Source: Tikkanen et al. (2005)

While the reviewed frameworks each present their own merits, a universal framework is yet to emerge from the literature. This is a consequence of the drastically different perspectives and approaches associated with business model design. Given the early state of the literature, we expect that much more empirical testing and iterative design will be required before a unified supply chain business model framework emerges.

### *9.3.3 The agile supply chain*

In contrast to the "bottom-up" approach that practitioners can adopt from the various business model frameworks, best practices in current business models can also be used as references in a "top-down" approach towards designing the business model. To this end, agile supply chains have emerged as a key reference model in the literature.

#### *Definitions*

Agile supply chains are defined through their ability to rapidly, and cost-effectively, respond to change as enabled through the seamless flow of information from the market and across the supply chain (Barnes and Lea-Greenwood 2006; Lee 2004). The concept originates from flexible or agile manufacturing systems from the 1990s, and requires appropriate organisational structures, information systems, logistics processes and mindsets (Christopher and Towill 2000; Gunasekaran, Lai, and Cheng 2008).

Given that the agile concept is often discussed in conjunction with "lean" chains, we cannot avoid addressing this as well. Lean supply chains focus on the elimination of waste (Christopher and Towill 2001).

Naylor et al. (1999) further establishes the following definition: "Leanness means developing a value stream to eliminate all waste, including time, and to enable a level schedule." The concept was popularised with the Toyota Production System, although UK production of the Spitfire aircraft during World War II and US production of automobiles in 1915 are also cited as origins (Christopher and Towill 2001). When comparing the two concepts, "lean" wins when the criterion is low cost under conditions of stable demand and low product variety. However, "agile" proves superior when the criteria are service and customer value and when the scenario entails volatile demand and high product variety (Christopher and Towill 2000, 2001),

#### *Significance*

The agile supply chain concept has been showcased as best practice in the literature due to a number of environment factors. First, is the fact that new standards of competitive advantage require firms to leverage the combined capabilities of their supply chains, competing as networks instead of as individuals (Christopher and Towill 2000, 2001). Secondly, the growing geographical and organisational reach of supply chains are increasing operational strains to maintain transparency and responsiveness across the supply chain (Barnes and Lea-Greenwood 2006); finally, there is agreement in the literature that supply chain risks and disruptions are increasing for today's firms (Christopher and Towill 2001, Lee 2004).

In light of the increasingly challenging environments, agile supply chains have offered a solution for business practitioners. Case studies have highlighted firms that have benefited from implementation, such as Nokia, Dell, and fast fashion companies (e.g. H&M, Mango, Zara), while showcasing firms that have missed out on opportunities because of the lack of agility (e.g. Ericsson, Compaq).

### *Implementation*

Agile supply chains require the development of a strong virtual dimension, as enabled through ICT infrastructure (Barnes and Lea-Greenwood 2006). It is essential that information is able to drive decisions in real time across the supply chain. In that sense, a defining characteristic of agile supply chains is that they are real time demand-driven instead of forecast-driven (Christopher and Towill 2000). Four categories of requirements are identified: IT infrastructure, trust-based relationships, product/process redesign, and risk management.

IT infrastructure is needed to build the virtual supply chain, which refers to the dimensions of the supply chain that manage information, as opposed to inventory. Investment in IT infrastructure is required to create real-time nerve networks that integrate supply chain firms with each other and each of their respective markets. Proposed methods include the implementation of point-of-sales (POS) systems to draw market data, use of electronic data interchanges (EDI) for integration of IT systems across firm boundaries, and electronic systems such as computer aided design (CAD) to improve the efficiency of information flow across partners (Barnes and Lea-Greenwood 2006; Christopher and Towill 2000; Lee 2004).

Strong relationships based on trust are also required across the supply chain to enable both rapid and unified response. This needs information sharing and strong communications between firms. To this end, Christopher and Towill (2000) suggest adopting practices such as joint strategy determination, buyer-supplier teams, information transparency and open-book accounting.

Another key component of the agile concept is the redesign of products and processes to be integrated and optimised at the supply chain level. The required operational capabilities include postponement of product/service offering until the “last possible moment” combined with the use of strategic inventory buffers. Additionally, an emphasis is placed on the required for reliable logistics to support the redesigned process (Barnes and Lea-Greenwood 2006; Christopher and Towill 2000; Lee 2004).

Finally, Lee (2004) also calls for the implementation of risk management practices as part of agile concept. These include the establishment of contingency plans and crisis risk management teams. The result of successful implementation is that firms are able to effectively compete in the market as a confederation of partners linked together as a network (Christopher and Towill 2000).

Somewhat tangential to the agile supply chain concept is “strategic agility”, which can be possibly considered as an enabler. Strategic agility is an organisation’s soft skill or meta-capability to transform their business model and remain open minded to change. This concept is in response to the paradox wherein successful firms and supply chains become inflexible over time, and aims to maintain the ability to transform and adapt as a business against the complacency engendered by success (Doz and Kosonen 2010).

### *9.3.4 Other best practices*

In addition to agile supply chains, there are a few other “business model best practices” that are identified in the literature. These entail sustainability, post-purchase servicing, and dynamic pricing.

Sustainability, in all its popularity, has also found its way into the business model literature. Nidumolu, Prahalad, and Rangaswami (2009) position sustainability as a source of business model innovation. Pirkin, Pokesie, and Lewis (2009) add empirical studies of this, studying Nordic companies for evidence of a new business model incorporating the concepts of sustainability. Also falling under the umbrella of sustainability is the concept of closed-loop and reverse supply chains, which extend considerations of the product lifecycle to post-purchase activities. Closed-loop supply chains contain a standard forward supply chain and the oft-neglected reverse supply chain that handles return/exchange and refurbishment activities (Guide, Harrison, and Wassenhove 2003). These activities add significant operational complexity for business managers, but present opportunities for increased profitability and consumer value by efficiently reusing or reselling products and supporting the customer beyond the point of sale. More in-depth coverage on the subject matter of both sustainability and closed-loop supply chains can be found in Chapter 10.

“Rocket science retailing” is a term taken from the work of Fisher, Raman, and McClelland (2000). The concept describes dynamic pricing using big data methods for consumer information gathering and analysis. Dynamic pricing is highly compatible with the agile supply chain concept, given their requirements for intensive ICT infrastructure and emphasis on rapid and seamless communication across the chain. In addition to Fisher, Raman, and McClelland (2000), Kung, Lin, and Dyck (2013) delve into dynamic pricing in the supply chain context.

## **9.4 Empirical studies**

Much of the empirical literature has focused on case studies of best practices, either in context of an industry leader or a gold standard supply chain design. Given that industry leaders and supply chains these days tend to be international by default, little focus is seen on any one country or region.

**Table 9.2: Empirical studies sourced from the literature**

Citation	Year	Type	Industry	Geography	Subject
Appelqvist, Lehtonen, and Kokkonen	2004	case study	Patria (A380 supplier, aerospace)	Finland	Product and supply chain design
Barnes and Lea-Greenwood	2006	survey	Fashion industry	United Kingdom	The fast fashion business model
Boyson, Corsi, and Verbraeck	2003	case study	US Air Force	United States	An e-supply chain portal business model
Chung, Yam, and Chan	2004	case study	Hashro	International	The information hub business model in global sourcing
Haynes et al.	2012	case study	Cocoa	Costa Rica	Value analysis of organic and fair trade cocoa
Kraemer, Dedrick, and Yamashiro	2000	case study	Dell	International	IT as a business model enabler
Montgomerie and Roscoe	2012	case study	Apple	International	The “own the consumer” business model
Morris, Shirokova, and Shatalov	2012	case study	Food service industry	Russia	Effects of business model design and performance in Russia
Ndou, Vecchio, and Schina	2011	survey	Food processing	Tunisia	E-business model for SMEs in developing countries
Nenonen and Storbacka	2010	survey	Power and automation tech, chemicals, electronics, utility, printing, ICT, real estate, machinery, metals, telecom, forestry	International	Business model framework development
Reiskin et al.	2008	case study	Chemical Strategies Partnership (service organisation)	United States	The servicification business model
Vonderembse et al.	2006	case study	Black and Decker, IBM+Hitachi and DaimlerChrysler	International	Lean, agile, and hybrid supply chains

Interestingly, case studies on supply chain business models have also adopted the “policy maker” perspective, focusing on specific countries or regions. These include studies on the cocoa industry in Costa Rica, the food services industry in Russia, and supply chain-related services industry in Hong Kong.

## 9.5 Future directions

Conceptions of the business model still remain scattered and they are in need of some unification; possibly under a business model framework. Several such candidates have been seen in the literature, but no one prevailing framework has yet emerged.

In light of the daunting breadth of the ideas underlying business models, however, the creation of a universal design framework may be infeasible in the short term. As a sort of “holy grail” in terms of management tools, it may be infeasible in the long term as well. Instead, continued empirical studies on the latest supply chain business model innovations, such as the sustainable and agile concepts, can provide more immediate utility for business practitioners, while also producing the data that will be required to inform future attempts towards design theory.

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# Chapter 10

## Supply chains and sustainability

### *Abstract*

The concepts of “supply chains” and “sustainability” are highly compatible in their shared recognition of a network-centric reality and the resulting interpretations of system dynamics. Furthermore, the aggregate flows across global supply chains are significant – and increasingly so – for considerations on social, environmental, and economic sustainability. A plethora of theories have developed in this overlap between supply chains and sustainability, including sustainable supply chain management (SSCM), green supply chain management (GrSCM), and close-loop supply chains. These theories and their basic definitions and history will be reviewed in this chapter. While theoretical development has been distinguished in its intensity and productivity over a short period of time, progress is still needed in translating theory into application for the business practitioner. To this end, empirical case studies are needed to showcase best practices and guide the development of prescriptive tools.

### 10.1 The rapid rise of sustainability

The topic of sustainability has expanded rapidly within the public arena since 1987, when the UN-initiated Brundtland Commission published its landmark report entitled “Our Common Future”. The 1990s saw many environmental and socially sustainability issues rise to the forefront in cases such as global warming, child labour, and corporate social responsibility.

The 2000s brought more corporate awareness and acceptance, with the adoption of an economic sustainability dimension; that of profiting sustainably (Elkington 1998; Linton, Klassen, and Kayaraman 2007; Nidumolu, Prahalad, and Rangaswami 2009). This public awareness and recognition of the significance of sustainability has resulted in substantial political momentum demanding the implementation of sustainability policies. For example, Linton, Klassen, and Jayaraman (2007) point to legislation that was adopted worldwide over a relatively short timeframe to phase out chemicals with ozone depleting potential. Research, then, has a significant opportunity to contribute to the policy making process,

and to business strategies on sustainability (Srivastava 2007; Halldorsson, Kotzab, and Skjott-Larsen 2009).

As embodiments of global flows of goods, labour, capital, and information, supply chains provide a powerful context for understanding sustainability. Both share an emphasis on system dynamics, and the concept of an ultimate supply chain extending from raw inputs to final outputs provides fertile grounds in which to test concepts of sustainability.

From a business perspective, the advancement of sustainable supply chain management (SSCM) is particularly pressing, in light of the fact that current legal and political trends will force many changes, regardless of whether academics or practitioners are prepared. The Stern Review on the Economics of Climate Change (2006) attributed 40 per cent of global greenhouse gas emissions to agriculture, industrial production and transport, and Elkington (1998) anticipates that individual companies will be pushed to take increasing responsibility over an extending network of partners (Halldorsson, Kotzab, and Skjott-Larsen 2009).

The following section will review the field by first defining sustainability and its closely associated concepts of corporate social responsibility (CSR) and the triple bottom line. Following that, is a discussion of the theoretical frameworks that have been built on top of these definitions, with a particular emphasis on SSCM. Finally, the empirical work is reviewed by research methodology and industrial/geographical coverage before concluding with opportunities for future research.

## 10.2 Key definitions and concepts

### *10.2.1 Defining sustainability*

The most widely cited definition of “sustainability” in the literature comes from the Brundtland Report, which states that: “Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their needs.” (WCED 1987; Carter and Rogers 2008). While this definition set the backdrop for further discussions on sustainability and added a critical time dimension, its breadth produced multiple interpretations. As a result, Halldorsson, Kotzab, and Skjott-Larsen (2009) showed that there is no single understanding of sustainability, with interpretations ranging from reverse logistics to strategic sustainability on a corporate level.

In addition, the plurality of interpretations and the broad starting definition make it difficult to create operational tools and to clarify the practitioner’s role in the greater macro context (Srivastava 1995; Stead and Stead 1996; Linton, Klassen, and Jayaraman 2007; Carter and Rogers 2008).

That said, a tremendous amount of attention has been directed towards the issue of sustainability and supply chains in the quarter of a century since the Brundtland Report, and there has been rapid progress in establishing an operationalisable theory of sustainable supply chain management, particularly within this past decade.

The starting interpretation of sustainability in the research field until the 1990s was effectively interchangeable with “environmentalism”. It was not until the popularisation of corporate social responsibility (CSR) that the concept of social sustainability was widely adopted (Carter and Easton 2011).

The economic dimension of sustainability then became popularised with Elkington's triple bottom line (1998), and has since established sustainability as a three-dimensional concept of environmental, social, and economic sustainability.

This has provided the foundation for the sustainable supply chain management (SSCM) framework that was introduced in 2008 (Carter and Jennings 2008).

The following sections provide a more detailed review of the concepts of CSR and the triple bottom line, before moving on to the review of theoretical works and the SSCM framework.

### *10.2.2 Corporate social responsibility*

Corporate social responsibility (CSR) broadly refers to the notion that companies must uphold a social and ethical role in maintaining the well being of human beings and the environment (Andersen and Skjoett-Larsen 2009; Halldorsson, Kotzab, and Skjott-Larsen 2009). Like sustainability, CSR also suffers from a broad definition that makes it difficult to present a unified and operationally significant theory.

One possible reason is that CSR comments on the ideal relationship between business and society – a philosophically contentious issue for which there is still debate today (Hill et al. 2003; Andersen and Skjoett-Larsen 2009).

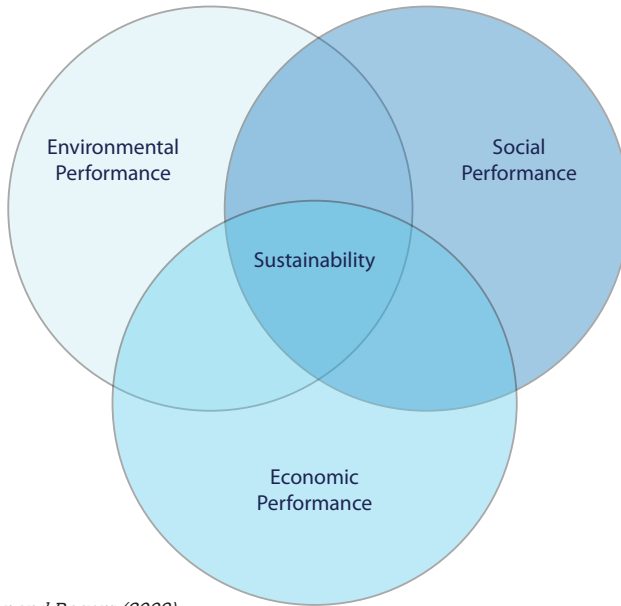
However, there is general consensus that CSR is increasingly relevant to the domain of supply chains. Recognition of supply chain governance structures in the literature and in the real world, such as the Nike “sweatshop” and Conoco Burmese oil production scandals, have extended social and ethical obligations across a network of stakeholders. Furthermore, firms that have power or control over partner firms may be held responsible for their partners' behaviour (Carter and Jennings 2002; Gereffi, Humphrey, and Sturgeon 2005; Andersen and Skjoett-Larsen 2009).

In order to create a more actionable theory of CSR for the supply chain practitioner, Carter and Jennings proposed the concept of Logistics Social Responsibility (LSR) (later refined to Purchasing Social Responsibility, or PSR). LSR and PSR specifically acknowledge these new responsibilities of lead firms within the supply chain, and propose a framework for practitioners to manage their partners (Carter and Jennings 2002, 2004). These would serve, in conjunction with the triple bottom line, as precursors to the development of the sustainable supply chain framework (SSCM), (Carter and Rogers 2008).

In light of the progress made in defining CSR theory and application, it is worth noting that there is still a gap between the standards endorsed by firms and the standards actually delivered by firms, a so called failure to “walk the talk” (Cramer 1996; Roberts 2003). This would be an inherent weakness of CSR's reliance on the supply chain practitioner's sense of obligation or responsibility, and would find a compelling response in the triple bottom line which addresses the firm's need to deliver profit.

### *10.2.3 The triple bottom line*

The triple bottom line was popularised by Elkington (1998), and represents the most popular conceptualisation of sustainability to date (Figure 10.1). The triple bottom line expands upon earlier definitions of sustainability as environmental and/or social sustainability by adding the economic criteria.

**Figure 10.1: The triple bottom line**

*Source: Carter and Rogers (2008)*

Referring to the business concept of profit as the bottom line in determining success, Elkington expands the definition of success for business to account for not only profits, but also people and the planet. This forms the basis for Carter and Roger's evolution of the LSR and PSR concepts into a complete framework of SSCM (Carter and Jennings 2002, 2004; Carter and Rogers 2008).

### 10.3 The sustainable supply chain management framework

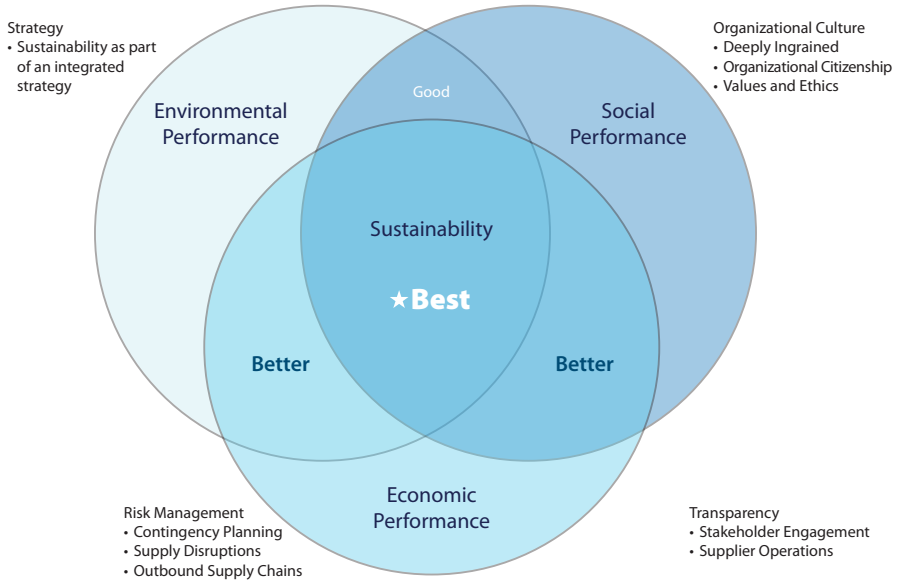
Much of the early work on sustainability and supply chains was pursued in a standalone fashion, with issues such as diversity, the environment, safety and human rights being pursued independently without considering potential interrelationships (Carter and Easton 2011). The works of Murphy and Poist (2002), Carter and Jennings (2002, 2004) and Carter and Rogers (2008) were significant in their attempts to build theory integrating many of the dimensions explored within sustainability and supply chains.

Out of these efforts arose the concept of sustainable supply chain management (SSCM), which will be reviewed with many of its parallel approaches in this section.

In their landmark paper, Carter and Rogers (2008) define SSCM as, "the strategic, transparent integration and achievement of an organisation's social, environmental, and economic goals in the systemic coordination of key inter-organisational business processes for improving the long-term economic performance of the individual company and its supply chains." The latter half of this statement is particularly salient, as it addresses the supply chain manager's question: "What is it that we need to do, not just to survive, but to thrive, and not just for one year, three years, or five years from now, but for 10

years, 20 years, and beyond?” (Carter and Easton 2011). The SSCM framework (Figure 10.2) provides managers with a structured approach towards answering that question.

**Figure 10.2: SSCM framework**



Source: Carter and Rogers (2008)

In the SSCM framework, sustainability is evaluated by the dimensions of the triple bottom line and achieved through four enablers:

- Strategy: sustainability considerations play a key role in formulating business strategy;
- Risk management: adoption of supply chain risk management considerations such as contingency planning, supply disruptions and demand disruptions;
- Organisational culture: maintenance of high ethical standards and expectations of sustainable behaviour towards the firm, society and the natural environment;
- Transparency: managing trust and communication with stakeholders through traceability and visibility both upstream and downstream.

These four enablers and the triple bottom line provide a clear set of criteria that unify many of the achievements from disparate fields, to provide managers with an operationally relevant theory.

Among the approaches represented here are resource dependence theory, transaction cost economics, population ecology, and the resource-based view of the firm. These perspectives bring together cross-paradigm insights from the disciplines of sociology, political science, economics, biology, and management (Carter and Jennings 2008).

In this overall literature review, there are already key achievements identified in the sections on “business models and supply chains” (Chapter 9) and “risk management and supply chains” (Chapter 5) that are ripe for integration into the SSCM framework.

### 10.4 Other frameworks

As discussed in the previous section, the conception of SSCM did not occur in isolation within any one field, but rather integrated the advances of several approaches studying sustainability from a systems perspective.

In this section, we will review some of these parallel research efforts, bearing in mind that while these efforts may not be complete in themselves, they may contribute to theorising and SSCM (Seuring 2004). The concepts to be reviewed are as follows: Reverse logistics, reverse/closed-loop supply chains, product stewardship, green/environmental SCM, industrial ecology, lifecycle management, integrated chain management.

Table 10.1 and 10.2 below list a few of these concepts by coverage of the supply chain.

**Table 10.1: The coverage of sustainability concepts**

Stage in supply chain: streams of SCM research	Design	Sourcing	Production	Distribution	Consumption/Use	Disposal
Reverse logistics	◐	○	◐	◐	●	●
Triple bottom line	○	◐	●	●	◐	◐
Product stewardship	●	◐	◐	◐	●	●
Green SCM	●	●	●	●	◐	◐
Corporate social responsibility	○	●	◐	◐	●	◐
Carbon footprint in supply chains	○	◐	●	●	◐	◐

- : Very limited if any consideration
- : Comprehensively addressed
- ◐ : Partially or only more recently considered

Source: Halldorsson, Kotzab, and Skjott-Larsen (2009)

**Table 10.2: Supply chain activities**

Concept	Distinctive feature	Actor network	Material flows/ system boundaries	Time frame
Integrated chain management	Stakeholder integration	Companies involved in and stakeholders affected by material flows	Material flows within their societal and legal boundaries	Societal and legal systems (decades)
Industrial symbiosis	Geographical approach / regional application	Companies involved in an industrial symbiosis	Material flows in a regional network	Factory life cycle (years to decades)
Life-cycle management	Product design as most important decision phase	All production stages involved in designing and producing products and services	Material flows that are related to a product life cycle	Product life cycle (months to years)
Supply chain management	Managerial activities needed within the actor network	All production stages directly involved in fulfilling customer demands	Operational material and information flows to satisfy customer needs	Supply chain development (months to years); delivery cycle (hours to weeks)

Source: Seuring (2004)

### *10.4.1 Reverse logistics*

Reverse logistics can be thought of as studying processes which involve “reversing” production – that is, in the study of processes such as recycling, repair and returns. The following definitions are offered in the literature:

“The role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal and refurbishing, repair, and remanufacturing” (Stock 1998)

“The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal” (Rogers and Tibben-Lembke 2001).

Most of the processes fall under post-consumption activities, aside from source reduction. For a more in-depth review, please refer to Andersen and Skjoett-Larsen (2009), Rogers and Tibben-Lembke (2001), and Carter and Ellram (1998).

### *10.4.2 Reverse/closed-loop supply chains*

The concept of reverse supply chains/closed-loop supply chains is closely related to reverse logistics. To start with the broader concept, close-loop supply chains refer to two supply chains: a forward supply chain of production and a reverse supply chain of return (Halldorsson, Kotzab, and Skjott-Larsen 2009). Emphasis is placed on the concept that return management is a shared activity across the supply chain, and cannot be limited to a single party. More in-depth coverage can be found in special issues of the California Management Review (2004) and Interfaces (2003), (Andersen and Skjoett-Larsen 2009).

### *10.4.3 Product stewardship*

Product stewardship scrutinizes the product development and production process for opportunities to reduce a product’s ecological footprint. In doing so, “some manufacturers can reduce costs, promote product and market innovation, and reduce the environmental impact of their products.” (Halldorsson, Kotzab, and Skjott-Larsen 2009).

### *10.4.4 Green/environmental supply chain management*

Green SCM and environmental SCM are terms referring to environmental and economic concerns and are effectively interchangeable. For the sake of choosing one, we will use green SCM (GrSCM).

Srivastava (2007) identifies GrSCM’s roots in the environment management and supply chain management literature and defines the approach as “integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life”. Seuring (2004) identifies further definitions in Table 10.3.



**Table 10.3: Definitions of green or environment SCM surveyed in the literature**

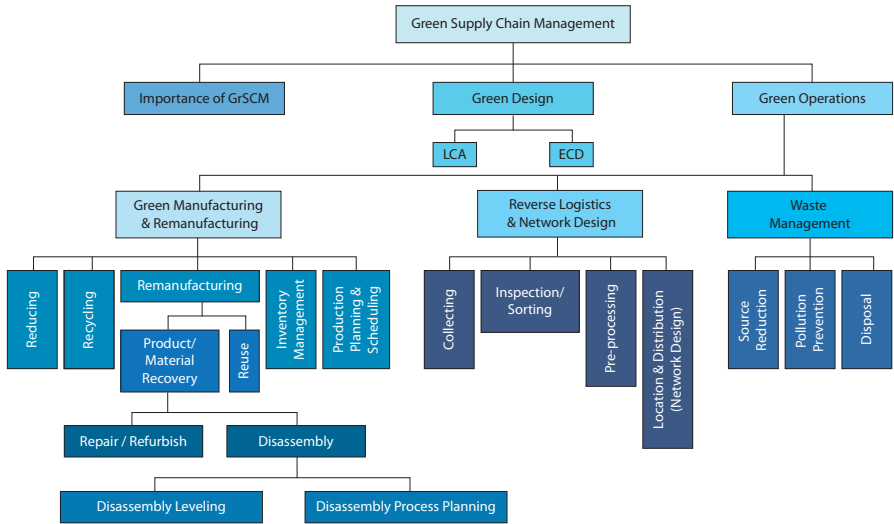
Author(s)	Green or environmental supply chain management (ESCM)
Beamon, 1999, p.337	'The fully integrated, extended supply chain contains all of the elements of the traditional supply chain (Figure 1), but extends the one-way chain to construct a semi-closed loop that includes product and packaging recycling, re-use, and / or remanufacturing operations.'
Bowen <i>et al.</i> , 2001, p.175	'The term "green supply" indicates supply [chain] management activities that are attempts to improve the environmental performance of purchased inputs, or of the suppliers that provide them. Two main types of green supply can be identified. The first is termed <i>greening the supply process</i> , while the second is <i>product-based green supply</i> .'
Zsidisin and Siferd, 2001, p. 69	'Environmental supply chain management (ESCM) for an individual firm is the set of supply chain management policies held, actions taken, and relationships formed in response to concerns related to the natural environment with regard to the design, acquisition, production, distribution, use, reuse, and disposal of the firm's goods and services.'
Rao, 2002, p. 632	'The concepts pertaining to greening the supply chain or supply chain environmental management (SCEM) are usually understood by industry as screening suppliers for their environmental performance and then doing business with only those that meet regulatory standards. The driving forces for implementing the concept into the company operations are many and comprise a range of "reactive regulatory reasons to proactive strategic and competitive advantage reasons.'

*Source: Seuring (2004)*

The literature on GrSCM is fairly extensive, and can be classified as reactive, proactive, or value seeking, in a progression that goes from least committed to most committed. "Reactive" literature covers green activities that require minimal commitment, such as labelling recyclables. "Proactive" takes environmental considerations into account throughout business operations, such as in undertaking green design or reducing waste. "Value seeking" adopts not only GrSCM practices, but considers GrSCM philosophy to be an integral part of the business strategy (Kopicki et al. 1993; van Hoek 1999; Srivastava 2007).

In the classification by problem context, Srivastava (2007) segments the literature into the categories exhibited in Figure 10.3.

**Figure 10.3: A framework of green supply chain management**



Source: Srivastava (2007)

For a definitive review on GrSCM, refer to Srivastava (2009). Seuring (2004) also provides a useful comparison of GrSCM to other sustainable supply chain approaches.

### 10.4.5 Industrial ecology

Industrial ecology studies industrial systems and processes from a biology-derived ecological perspective. Industrial activities are considered as a part of a larger ecosystem, and by-products at each step are considered for reuse as inputs elsewhere.

This systems perspective also provides a unique geographical/spatial dimension, and can be applied to understanding sustainable development of local industrial parks or regional industrial clusters. Given the natural sciences roots of the systems perspective, industrial ecology has sometimes been referred to as the “science of sustainability” (Seuring 2004; Linton, Klassen, and Jayaraman 2007).

Seuring (2004) finds the following definitions of industrial ecology, and notes that the Frosch and Gallopoulos (1989) work is seen as the initial trigger for development of the field.

**Table 10.4: Definitions of industrial ecology surveyed in the literature**

Author(s)	Industrial ecology (IE)
Frosch and Gallopoulos, 1989, p. 95	'The traditional model of industrial activity - in which individual manufacturing processes take in raw materials and generate products to be sold, plus waste to be disposed of - should be transformed into a more integrated model: an industrial ecosystem. The industrial ecosystem would function as an analogue of biological ecosystems.'
Graedel, 1994, p. 23	'Industrial Ecology (IE) is a new ensemble concept in which the interactions between human activities and the environment are systematically analysed. As applied to industry, IE seeks to optimize the total industrial material cycle from virgin material, to finished product, to ultimate disposal of waste.'
Ayres and Ayres, 1996, pp. 278-279	'Industrial Ecology is a neologism intended to call attention to a biological analogy: The fact that an ecosystem tends to recycle most essential nutrients, using only energy from the sun to "drive" the system. [...] In a 'perfect' ecosystem the only input is energy from the sun. All other materials are recycled biologically, in the sense that each species' waste products are the "food" of another species. [...] The industrial analogy of an ecosystem is an industrial park (or some larger region) which captures and recycles all physical materials internally, consuming only energy from outside the system, and producing only non-material services for sale to consumers.'
Korhonen, 2000, p.19	'Industrial ecology has been understood as material flow management concept for industrial companies. It will focus on the physical material and energy flows that a company uses from its natural environment as well as from its co-operation partners. It will focus on the flows that a company will produce as its waste and on emission outputs dumped back to nature.'

Source: Seuring (2004)

### 10.4.6 Lifecycle management

Life cycle management (LCM) and its methodology of life cycle analysis (LCA) provide business practitioners with a decision-making approach that demands achievement of both environmental and economic criteria. Seuring (2004) identifies four main definitions of LCM in the Table 10.5 below.

**Table 10.5: Definitions of lifecycle management surveyed in the literature**

<b>Author(s)</b>	<b>Life-cycle management (LCM)</b>
Linnamen <i>et al.</i> , 1995, p. 121	'Life cycle management consists of three views: (1) the management view - integrating environmental issues into the decision making of the company; (2) the engineering view - optimising the environmental impact caused by the product during its life cycle; and (3) the leadership view - creating a new organisational culture.'
Fava, 1997, p. 8	'Life cycle management is the linkage between life cycle environmental criteria and an organisation's strategies and plans to achieve business benefits.'
Heiskanen, 2002, pp. 428, 429	'LCA-based ideas and tools can be viewed as emerging institutional logics of their own. While LCA makes use of many scientific models and principles, it is more a form of accounting than an empirical, observational science. Thus, the life cycle approach implies a kind of 'social planner's view' on environmental issues, rather than the minimisation of a company's direct environmental liabilities.'
Hunkeler <i>et al.</i> , 2003, p.19	'Life cycle management (LCM) is an integrated framework of concepts and techniques to address environmental, economic, technological and social aspects of products, services and organizations. LCM, as any other management pattern, is applied on a voluntary basis and can be adapted to the specific needs and characteristics of individual organisations.'

*Source: Seuring (2004)*

LCA is largely based on an environmental analysis of the product life cycle, and targets the product design phase for implementation of improvements, as 80 per cent of a product's environmental burden and cost are determined during this phase (Seuring 2004).

#### ***10.4.7 Integrated chain management***

Integrated chain management builds off of LCA, but is distinct in its consideration of the public policy perspective. This may not be surprising, given ICM's origination from Dutch and German government initiatives (Seuring 2004).

Seuring (2004) lists some of the definitions of ICM produced by government and academia in Table 10.6 below.

**Table 10.6: Definitions of integrated chain management surveyed in the literature**

Author(s)	Integrated chain management (ICM)
Enquete Kommission, 1994, p. 549	'Integrated Chain Management (Stoffstrommanagement) is the management of material flows by stakeholders [to be] the goal-orientated, responsible, integrated, and efficient manipulation of material flows. Set targets derive from the ecological and economic realm. under consideration of social aspects. Goals are set on the level of the single firm, within the supply chain of actors, or on public policy level.'
Cramer, 1996, p. 36	'Integrated Chain Management (ICM) is the integrated management of a supply chain in terms of the environmentally, socially and economically responsible management of the production, consumption, distribution and ultimate disposal of a product.'
Wolters <i>et al.</i> , 1997, pp. 121, 122	'Integrated Chain Management (ICM) is the incorporation of sustainability considerations into supply chains and related networks. Integrated Chain Management has two main features. The first is the flows of materials which result from economic activities. The second is the institutional framework which shape the production and consumption processes driving the material flows. ICM considers the entire material cycle from cradle to grave - in one sense it is the organisational implementation of life cycle analysis (LCA). [Such life cycles or] product chains involve institutional networks of companies, consumers, professionals and other entities as well as material flows. ICM has to address both dimensions to be successful.'
Boons, 1998, p.22, 2002, p. 496	'The framework for [integrated] product chain management, and the improvement of the ecological performance of a product, consists of three building blocks: (a) the product chain as a network of actors; (b) the options available to reduce the ecological impact of a product; and (c) assumptions about the behaviour of actors in the product chain.'

Source: Seuring (2004)

## 10.5 Empirical studies

While possibly due to a bias in search terms, much of the empirical literature identified integrates with the theory building process for sustainable supply chain management. Both case studies and surveys are found, with a geographical emphasis on the United States and Europe. A wide range of industries are covered, with agribusiness and manufacturing appearing most commonly. Table 10.7, below, provides a brief survey of the identified articles.

**Table 10.7: Empirical studies sourced from the literature**

Citation	Year	Type	Industry	Geography	Subject
Andersen and Skjoett-Larsen	2009	case study	IKEA	International	CSR practices in global supply chains
Carter and Jennings	2002	survey	food, textile and apparel, print publishing, chemicals, petroleum and coal, rubber and plastics, primary metals, fabricated metal products, industrial machinery, electronics, transportation equipment, instruments and related products	United States	Theory building for logistics social responsibility
Carter and Jennings	2004	survey	consumer products manufacturing	United States	Theory building for purchasing social responsibility
Closs, Speier, Meacham	2011	case study	food, pharmaceuticals, electronics, retail	International	End-on-end value chains and SSCM
Haynes et al.	2012	case study	cocoa	Costa Rica	Value analysis of organic and fair trade cocoa
Marsden, Banks, and Bristow	2000	case study	beef production	Wales	Food supply chains and rural development
Murphy and Poist	2002	survey	manufacturing, merchandising	United States	Theory building for socially responsible logistics
Pagell and Wu	2009	case study	cleaning products, forest and wood products, electronics, food service, IT equipment, paper and pulp, construction	United States and International	Theory building for SSCM
Seuring and Müller	2008	survey	n/a	Germany	Identification of core issues facing SSCM
Walker and Preuss	2008	case study	public sector, health sector	United Kingdom	Sustainable development through public sector sourcing from SMEs
Zhu and Sarkis	2004	survey	manufacturing	China	Correlation between green SCM and firm performance

## 10.6 Future directions

The development of sustainable supply chain concepts is impressive for both its variety and theoretical utility. However, these still fall short of presenting prescriptive and easily tangible value for the business practitioner.

SSCM provides a theoretical framework for practitioners to orient their thoughts and goes as far as offering general guidelines or criteria for success. However, usefulness as a heuristic engine to generate management tools is not yet there.

To that end, we see the need to focus next on the development of prescriptive tools to

guide implementation of sustainability concepts for supply chain managers. Moreover, empirical case studies on best practices would help create awareness of the real outcomes in relation to the many theoretically posited benefits of sustainable supply chain management.

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# Chapter 11

## Supply chains and trade policy

### *Abstract*

Supply chains and trade policy are tightly linked to each other. Trade distorting effects of tariff and non-tariff barriers (which are levied on the gross value of imported goods, rather than value-added) are magnified in global supply chains; it takes many more cross-border transactions to provide a single unit of a final good than before. Global supply chains create new forms of cross-border spillover effects and have therefore generated a demand for deep forms of integration, which could make production-sharing activities less vulnerable to disruptions or restrictions. For instance, it is not possible to disentangle merchandise trade from services trade, and standards may need to be stipulated to make each stage of production compatible with the other. At present, “deep” provisions in international trade agreements – covering the areas of services, investment, competition policy and intellectual property, among others – are largely found at the regional level. “Deep” RTAs, in turn, may stimulate the further proliferation of global supply chains if they cover a sufficient number of economies and do not introduce distortions with third countries. However, the wild and tangled growth of RTAs and stringent rules of origin have created problems (“spaghetti bowl” trade). To the extent that RTAs are consolidated and gradually multilateralised, they might prove a useful step to achieving the first-best solution of multilateral trade liberalisation that goes beyond tariff reduction. Examples can be found in the field of technical barriers to trade, trade facilitation, the opening of markets for trade in services and the presence of contingency measures within trade commitments. The multilateral trading system faces the challenge of addressing the need for trade integration between countries while preserving non-discrimination between regulatory regimes..

### 11.1 The evolution of supply chains and trade policy

Global supply chains have made the trade policies of different countries more interdependent, thereby reducing the incentive for purely “domestic” control of competitiveness through import-substitution. The efficiency of exporters is increasingly dependent on obtaining imports of high-quality intermediate inputs from the lowest-cost source.

Amiti and Konings (2005) argue that tariff liberalisation on intermediate products has been shown to double the improvement in productivity of domestic plants compared to tariff liberalisation on final goods. Hence, raising import costs by applying tariffs or non-tariff barriers on intermediate goods can adversely affect a country's competitive edge. This is especially true for developing countries, which are generally located downstream in the value chain, and hence have a relatively larger share of foreign value-added embedded in their exports (Koopman et al. 2012). Debaere and Mostashari (2010), for instance, show that the expansion of developing countries' exports to the US in recent times is largely explained by their own trade liberalisation – more so than by cuts in US import duties.

The building blocks of East Asia's involvement in global supply chains were laid by an export-promotion industrialisation strategy at a time when the industry relocation process from Japan gained momentum. Many countries, particularly those in the Association of Southeast Asian Nations (ASEAN), unilaterally cut their effective tariff rates in the form of duty-drawback schemes and duty-free treatment for unskilled labour-intensive enterprises in export processing zones (Baldwin 2006). Exempting exporting firms from paying import duties on their inputs enhanced their cost advantage in the world market (Engman et al. 2007).

During the 1980s and early 1990s, many of these countries switched from such special treatments to lowering applied most favoured nation (MFN) tariff rates unilaterally (Baldwin 2007). Tariff policies were seen as a critical component of competition between economies in the region to induce foreign firms to locate production stages there. Through this period, policy changes to attract FDI flows also took centre stage (Kimura 2006).

Exports of parts and components became increasingly important, rising from about 2 per cent of ASEAN's total exports in 1967 (the year of the association's founding) to 17 per cent in 1992 (the time when the free trade agreement was signed). The share of parts and components in total intra-regional trade increased from 2 per cent to 18 per cent during the same period (Ando and Kimura 2005; Kimura et al. 2007).

The post-World War II period has seen a progressive reduction in tariffs on manufactured goods through successive rounds of multilateral negotiations, regional agreements and unilateral liberalisation. This has certainly played a part in shaping global supply chain trade.

For instance, consider the WTO's Information Technology Agreement, which has removed tariffs on key technology and telecommunications products, initially for 29 signatories and now for 75 countries, covering 97 per cent of world trade in information technology products (Baldwin 2006; Kimura and Ohashi 2011). Global value chains, especially in Asia, are found to be particularly strong in the industries covered by the agreement and their expansion coincides with the agreement's entry into force after the conclusion of the Uruguay Round (Anderson and Mohs 2011).

Even a seemingly "small" tariff, however, can have a sizeable impact on costs when production is globally fragmented. At the same time, non-tariff measures (NTMs),<sup>1</sup> that have become increasingly important trade policy instruments in recent years, also pose a threat to the smooth functioning of global supply chains.

For instance, the effects of differentiating the use of tariff policy on intermediate and final goods as well as implementing NTMs – such as non-automatic licensing – should not be overlooked; they are important policy instruments for countries seeking to maximise

domestic value-added. The consolidation of production networks in the future is therefore likely to create demands for deeper integration between economies, which, at present, appears to have acquired a largely regional (rather than multilateral) dimension.

## 11.2 Trade policy barriers and trade flows in GSCs: a magnification effect

Global production fragmentation means that it takes many more cross-border transactions to provide a single unit of a final good than before. And given that tariffs are levied on the gross value of imported goods, rather than value-added, the cumulative cost of tariffs adds up (Hanson et al. 2005; Yi 2010; Yi 2003).

Consider the global supply chain for producing a computer disk drive, as discussed in Hiratsuka (2005) and Baldwin (2008). The disk drive is assembled in Thailand, which acts as the hub of the supply network, using 43 components from 10 other countries in addition to 11 components produced in Thailand. Hence, there are at least 10 moves across international borders, and perhaps more, depending on the extent to which shipments can be bundled. Furthermore, since the disk drive will be shipped to the location of final computer assembly (such as China) where the other major computer components are gathered, the number of cross-border moves multiplies even further.

In a global supply chain such as that which requires semi-finished goods to move back and forth across international borders multiple times, the adverse effects of tariffs are magnified. Koopman et al. (2012) show that taking into account the foreign value-added content of exports significantly raises the extent of measured protection, especially in emerging economies. For instance, they find that the effective tariff rate is 17 per cent higher than the nominal rate in the United States, 71 per cent higher in Hong Kong and as much as 116 per cent and 171 per cent higher in China and Mexico, respectively, due to trade in intermediates.

The same holds true for non-tariff measures (NTMs). Consider transport and administrative procedures, for instance. Moisé et al. (2011) show that the simplification of customs and port procedures results in a reduction of trade costs of up to 10 per cent. These costs are magnified in global supply chains, where intermediate inputs cross borders multiple times. In sum, the effect of a marginal increase in trade costs, owing to trade policy instruments, such as tariffs and NTMs, is much larger than would be the case if there were a single-stage production framework. Yi (2003) refers to this as the “magnification effect”.

In the case of non-tariff barriers, the cumulative price increase at each step would include not only the monetary costs of moving along the supply chain, but the costs associated with time barriers as well (Ferrantino 2012). Trade in parts and components is very time-sensitive – the cost of an extra day is estimated to be 60 per cent higher for importers of intermediate goods than for importers of final goods – because upstream firms may have limited foresight of how much time will be needed for goods to cross the border and comply with required procedures; “just-in-time” production is not feasible when components travel through multiple countries.

Hence, uncertainty introduced by delays at border checkpoints, for example, force firms to maintain larger inventories and incur an opportunity cost of delayed sales. Exporters may also be subject to depreciation costs on immobilised goods. Hummels and Schaur (2012) estimate that, per day of delay, these costs are equivalent to an ad-valorem tariff of

between 0.6 per cent and 2.1 per cent. In fact, given that the effects of trade barriers are compounded along GSCs, they can have a discontinuous effect on trade flows. Increased levels of trade costs can lead to a “tipping point”, beyond which the operation of a modern supply chain becomes infeasible (Yi 2003).

### 11.3 GSCs and the demand for deep integration

With the advent of global supply chains, it is not possible to disentangle merchandise trade from services trade because the efficient provision of services plays an important role in facilitating the international production of goods. This implies that domestic regulations and foreign investment limitations, which act as a barrier to services trade, are also likely to have a negative impact on merchandise trade (Deardorff 2001).

Logistics and related services are particularly important for the operation of global supply chains. Most often, these services are facilitated by third-party logistics firms, which provide coordinated services in supply-chain consulting, transport management, freight transport services, trade finance, express delivery, wholesale trade and customs brokerage (USITC 2005).

Hence, measures to liberalise market access in logistics services can substantially lower the costs of operating supply chains. Global supply chains are associated with several additional trade costs. These range from managerial costs associated with monitoring and coordinating international production to learning about the laws and regulations that are required to do business in another country. Such costs are likely to be especially high for developing economies that may lack the kind of sophisticated business laws and the product and labour regulations which rich countries use to consolidate their trade in intermediate goods (Baldwin 2010).

Furthermore, when production networks are global, firms may set standards for their input suppliers to ensure a level of quality, to make the input compatible with other stages of the production process in order to produce a differentiated product, or to externalise the management of risk. This is especially relevant for food supply chains where ensuring the quality and safety of products is often paramount (Henson and Reardon, 2005). It has led firms in the field to adopt product and production standards that have implications for market access (Ponte and Gibbon 2005; Gereffi et al. 2005).

However, as supply chains span different regulatory environments, harmonisation or mutual recognition of these standards assumes importance; greater uniformity will enable producers of intermediate goods to participate in the supply chain in more locations (Henson and Reardon 2005; Marucheck et al. 2011).

The above suggests that for supply chains to operate smoothly, particularly in the context of “North-South” production sharing, certain national policies need to be harmonised across jurisdictions (Lawrence 1996). Hence, the expansion of global supply chains has generated a demand for deep forms of integration aimed at covering all dimensions of market access and filling a governance gap between countries. International trade agreements that include provisions related to trade in services, investment, competition policy, intellectual property, the institutional framework and product market regulations could make production sharing activities more secure and less vulnerable to disruptions or restrictions (Yeats 2001).

In a recent study, Antràs and Staiger (2008) show that the rise of global supply chains creates new forms of cross-border spill over effects that go beyond the standard trade policy externality (the terms-of-trade effect) and hence affect the demand for deep integration. Specifically, when prices are set by bilateral bargaining because international production involves exclusive contracts with input suppliers, input producers experience rent-shifting (i.e. shifting profits from the input supplier to the domestic producer), while downstream products experience the traditional terms-of-trade effects.

In this context, governments of input-exporting countries must therefore negotiate not only lower tariffs on the imports of the input, but also tariff and other policies which affect the final product. For example, suppose country A is seeking to export auto parts to country B. Country A's interest is no longer only to seek reductions in tariffs on auto parts, but also the domestic regulations and standards in country B for the sale of completed automobiles. Without such a commitment, country B may inefficiently tax or protect the final goods market, knowing that part of the pain is suffered by auto parts manufacturers in country A.

Hence, with increased offshore outsourcing, deeper commitments that can address these new cross-border effects are likely to become more important.

The foregoing discussion suggests that externalities associated with production offshoring are different from those associated with traditional market access. In a global supply chain, barriers between third-party countries upstream or downstream matter as much as the barriers put in place by direct trade partners because the cost impact of any trade policy measure is transmitted along the supply chain. Therefore, the more international the value chain, the broader should be the number of partner countries in agreements, thereby underscoring the importance of multilateral trade liberalisation.

Unfortunately, these concerns cannot be easily addressed with existing GATT/WTO rules, such as non-discrimination and reciprocity, because they were designed for a world in which international trade predominantly consisted of trade in final goods (Bagwell and Staiger 2002). Moreover, "deep" economic integration covering issues beyond tariff reduction might be easier to achieve within the context of RTAs with a more limited number of partners than in a multilateral setting. Countries might therefore turn to available instruments, such as PTAs, to solve their coordination problems.

## 11.4 The role of preferential trade agreements

### *11.4.1 GSCs have facilitated the proliferation of deep PTAs*

Since global supply chains seek to minimise transactions costs, they often operate on a regional basis, such as in East Asia for electronics or in North America for motor vehicles. This had made preferential trade agreements (PTAs) an increasingly important component of trade policy. The recent wave of such agreements with their deep integration provisions in the area of services, investment and competition may, at least in part, be an institutional response to the new problems associated with the growth in global supply chains.

PTAs, such as the North American Free Trade Agreement (NAFTA), not only increase market access, through tariff reductions, but also include disciplines that reduce the risks and increase the profitability of investment in Mexico. The recent accession of eastern European economies to the European Union, as well as some of the euro-Mediterranean

agreements, could be partly explained as a response to the demand for deep integration agreements associated with expanding international production sharing.

The evolving nature of trade agreements in East Asia, where a significant and growing share of international production sharing takes place, also highlights the link between global supply chains and deep integration.

The increased regionalisation of trade in parts and components in the ASEAN countries began before the negotiation of PTAs, with a market-led integration process, which saw a reduction of tariff barriers and openness to foreign investment (UNESCAP 2011). But to keep the momentum of supply chains going, countries in the region, starting in the late 1990s, began to expand their integration agenda by turning their attention to differences in economic institutions and regulations – in areas such as product standards, intellectual property rights, infrastructural services and investment protection – which could have become a potential hindrance to production sharing.

In the ASEAN region, more recent North-South agreements, such as Japan's economic partnerships with Malaysia, Indonesia, Thailand and Vietnam, and ASEAN's push for deeper disciplines, clearly show that the region is moving towards deeper integration. Pomfret and Sourdin (2009, 2010) find that ASEAN countries used their PTAs as vehicles for concerted trade facilitation and that the driving force behind these policies was the desire to increase the efficiency of global supply chains.

Cross-country empirical evidence also suggests that higher levels of trade in parts and components, relative to total trade, increase the likelihood of signing deeper regional trade agreements (World Trade Organization 2011). Orefice and Rocha (2011) show that (after taking into account other PTAs determinants) a 10 per cent increase in the share of production network trade over total trade increases the depth of an agreement by approximately 6 percentage points. It is possible that the presence of international fragmentation of production can alter political economy forces in favour of trade policy measures that are less discriminatory.

### *11.4.2 Can deep PTAs facilitate the further growth of GSCs?*

PTAs can stimulate the creation of global supply chains or facilitate the insertion of firms into existing production networks by enabling trade among potential members. This may be because “deep” provisions in PTAs ensure the predictability of the trade policy environment, which could be crucial for trade in global supply chains (GSCs) that involve long-term contractual relationships. It may also be attributable to the fact that “deep” arrangements, such as the harmonisation of certain regulations, are a prerequisite for trade in services.

The simultaneous reduction of trade costs in several neighbouring countries, through regional reform initiatives that improve the efficiency of customs procedures, reduce corruption and develop port infrastructure, can help bring supply chains to new parts of the world, such as sub-Saharan Africa. Just as many regions are on the wrong side of the “tipping point” and do not attract global supply chains at present; “deep” integration in the area of trade facilitation is likely to have combined benefits that exceed those to each individual country.

The literature emphasises the role of EU enlargement in the increased fragmentation of production across Europe (Altomonte and Rungi 2008). NAFTA is also described as an agreement at the origin of some GSCs in North America. Using data for 200 countries between 1980 and 2007 and defining the depth of an agreement in terms of coverage of areas, Orefice and Rocha (2011) find that deep preferential trade agreements increase bilateral trade in parts and components by 35 per cent among country members.<sup>2</sup>

A limitation of this index of “deep” integration is that it gives the same weight to each of the areas covered in a PTA, thereby assuming that the potential impact of each provision on supply chains is of the same magnitude. The WTO (2011) uses an alternative method – principal component analysis – that addresses this problem by generating an index capturing the depth of an agreement. It shows that, on average, signing deep agreements increases trade in production networks between member countries by almost 8 percentage points.

In another study, Johnson and Noguera (2012) show that regional trade agreements have large effects on bilateral ratios of value-added exports to gross exports (VAX). For a typical agreement, gross trade rises by about 30 per cent while value-added trade rises by 23 per cent, resulting in a drop in the VAX ratio of about 7 per cent. This is indicative of greater interdependency between economies through trade in parts and components. Furthermore, the authors find deep trade agreements are associated with larger declines in VAX ratios than shallow agreements, i.e., they strengthen trade in global supply chains.

WTO (2011) also considers two other indices capturing the depth of an agreement in the areas of competition policy and technical barriers to trade (TBTs). The choice of provisions is determined by their importance in production sharing. The integration of TBT measures, involving mutual recognition, harmonisation of standards and transparency, makes international fragmentation of production easier by lowering the costs of testing and product certification.

Competition policy allows multinational enterprises to take full advantage of cost differences among countries when production is fragmented. The authors find that including an additional provision in competition policy and TBTs will increase trade in global supply chains by one and three percentage points, respectively. At the same time, RTAs can inhibit the growth of global supply chains through strict rules of origin (RoO), creating trade diversion that undermines the benefits from preferential market access (Baldwin 2006). Krishna (2005) outlines three broad approaches for determining whether products are eligible for preferential treatment. The “change in tariff” approach requires the final product to have a different tariff heading than the input used<sup>3</sup>; the “value-added” approach consists of a minimum domestic content requirement, while the third approach requires that some specific production processes be undertaken in the local economy.

Such rules can be used as instruments of trade protection if they force firms to switch to more costly suppliers of intermediate goods within the RTA, in preference to other lower cost sources outside. While this distortion in the production structure may stimulate the formation of regional supply chains, it separates firms from the broader global supply chain and raises costs (Krueger 1999).

Higher production costs may also arise from the costs incurred to document, administer and verify compliance (to the relevant authorities) for multiple rules of origin (RoO) and agreements (Brenton and Manchin 2003; Brenton and Imagawa 2005).



East Asia's multiple RoO approach, embedded in the overlapping RTAs, for example, created the "spaghetti bowl" effect (Kawai and Wignaraja 2011). Similarly, when firms from EU countries started to relocate labour intensive stages of production in low-wage neighbouring nations from the 1990s (in Central and Eastern Europe and in the Southern Mediterranean), the European Union engaged in bilateral agreements with a number of them. These agreements contained non-harmonised rules of origin, giving rise to a spaghetti bowl effect that restricted firms' ability to source intermediate goods from the cheapest source (Gasiorek et al. 2009).

Global production fragmentation challenges the design of effective rules, as it becomes difficult to clearly identify the origin of products that incorporate inputs from many different countries within and outside the RTA. This highlights the need for designing less restrictive, GSC-friendly RoO to limit their trade-distortive impact.

"Diagonal cumulation", which means that inputs from anywhere in the region can be used without undermining the origin status, is one way forward (Manchin and Pelkmans-Balaoing 2007). "Full cumulation", by implying that the processing activities carried out in RTA participant countries are deemed to satisfy the content requirements regardless of whether the activities are sufficient to confer originating status on the input materials themselves, is likely to further facilitate increased product fragmentation (Estevadeordal and Suominen 2004). Furthermore, overlapping RoO across multiple trade agreements should also be harmonised. In East Asia, there has been some movement towards establishing substantially simpler RoO. For instance, RoO provisions in the ASEAN FTA with China and the Republic of Korea allows producers of a large range of products to choose the change in tariff heading rather than the value-added content as the method for determining origin status. The latter method is harder to comply with given the high degree of production fragmentation in major manufacturing products traded within the ASEAN region.

Similarly, the signing of the Pan-European Cumulation System (PECS) on rules of origin in 1997 permitted diagonal cumulation, i.e., allowing EU final good producers to source inputs from a wider set of countries without fear of losing origin status (Baldwin et al. 2009).

## 11.5 Going forward: GSCs and the multilateral trading system

Global supply chains have created the demand for "deep" integration across economies. "Deep" integration, in turn, can play a positive role in the reduction of trade costs and thus enable firms to vertically specialise. At present, "deep" provisions in international trade agreements are largely found at the regional level.

Regional trade agreements (RTAs) can certainly help in the proliferation of global supply chains if they cover a sufficient number of economies and do not introduce distortions with third countries. Guiding principles or even binding disciplines to harmonise and simplify RoO in PTAs might be helpful in this context.

Furthermore, to the extent that RTAs are consolidated and gradually multilateralised, they might prove a useful step to achieve the first-best solution of multilateral trade liberalisation that goes beyond tariff reduction.

The multilateral extension of certain “deep” provisions is already under way. Examples can be found in the field of technical barriers to trade (TBTs), trade facilitation, the opening of markets for trade in services and the presence of contingency measures within trade commitments (Baldwin et al. 2009). In TBTs, global supply chains may help explain the adoption of international standards, at least in parts and components, in industries characterised by global sourcing.

The growing relevance of trade facilitation measures is reflected in the WTO’s “Aid-for-Trade” initiative, which focuses on alleviating international supply chain bottlenecks, such as infrastructure. Given a broad consensus, there is also the possibility of a WTO agreement on trade facilitation being carved out of the Doha Development Agenda.

Concerning the opening of markets for trade in services, offshore outsourcing led firms to require more access to efficient services inputs, which, in turn, encouraged governments to put services trade opening on the multilateral trading system agenda (Hoekman and Kostecki 2001). Given the importance of ensuring the affordability of key services, the incentive for nations to apply international standards to improve the competitiveness of their own exporters and to make their own services markets more attractive to foreign investors is only likely to get stronger. Appropriate domestic regulatory reform is also likely to be crucial in this regard.

Finally, global production fragmentation may create greater support for new multilateral rules on contingency measures, such as safeguards, anti-dumping and countervailing measures, in trade commitments. When firms engage in global supply chains, they prefer measures discouraging the imposition of contingency measures in as many bilateral trading relationships as possible, rather than in any single bilateral trade relationship. This highlights the producer support for the spread of a common or similar set of rules on the application of contingency measures (Baldwin et al. 2009). In sum, the institutional challenge for the WTO is to find an approach that can facilitate the deeper integration that countries are seeking, while upholding the core principle of non-discrimination at the same time.

PTAs are promoting deep integration at the moment. But the multilateral trading system needs to ensure coherence among divergent regulatory regimes, which, in practice, may segment markets and raise trade costs. In order to achieve this, member countries need to revisit current rules of the multilateral trading system, some of which may be outdated, in light of the proliferation of GSCs. This may involve overcoming differences in national interests, as some countries seek to preserve their domestic value addition, while others attempt to move up the value chain.

Disciplining the use of tariff escalation policies, on the one hand, and export restrictions, on the other, might represent one such area where the legitimate concerns of all WTO members would need to be taken into account.

## 11.6 Endnotes

1. NTMs encompass a variety of trade impediments and regulations, including administrative customs procedures, technical regulations, health or safety standards, quantitative restrictions and subsidies.
2. The authors follow Yeats (1998) and Hummels et al. (2001) in using trade in parts and components to proxy for global production sharing.

3. This could be done at different levels of disaggregation, the most common being at the Harmonized System 4-digit level.

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# Chapter 12

## Supply chains and trade finance

### *Abstract*

The issue of finance is an integral one in the supply chain context, given that supply chains embody flows of information, capital, goods, and labour. The concept of credit chains, reviewed here, directly addresses this. The supply chain concept has traditionally tended to emphasise the tangible/material dimensions of the chain. As a result, the financial dimension had been relatively neglected in the literature. This changed with the 2008-2009 global financial crisis. As both a potential aggravator and victim of the crisis, trade finance and supply chains became the subject of a new and rapidly growing body of literature. Previously, the subject had been largely addressed in the context of operations research and economic development. We review findings from all research areas in the literature, and observe significant merit in the credit chain concept of supply chain financial flows. Migration of the concept to other areas of supply chain research could potentially address financial dimensions of supply chains that are otherwise underemphasised in the literature.

### 12.1 Definitions and concepts

#### *12.1.1 Trade finance*

Broadly defined, trade finance refers to “any financial arrangement connected to inter-firm commercial transactions”. It is often used in the context of international trade, in which it refers more specifically to “the funding of individual international commercial transactions by financial intermediaries” (Ellingsen and Vlachos 2009; Bénassy-Quéré et al. 2009). Trade finance is considered critical to lowering trade frictions, and 80 to 90 per cent of trade transactions involve some form of trade finance, whether as trade credit, insurance, or guarantees (Auboin 2009). The wide array of financial arrangements and instruments can be divided according to purpose in either securing a trade transaction or in using a transaction as collateral to access credit.

### *Securing a trade transaction*

When formalising a purchase order, the buyer and seller utilise a bank or another trade finance entity as a third party in either serving as a basic financial intermediary or as a guarantor of payment. The former refers to an “open account” setup, while the latter refers to an arrangement involving “letters of credit” (L/Cs). In an open account arrangement, the buyer is responsible for payment upon an agreed time after receipt of deliverables. The time for payment typically ranges from zero to 180 days after arrival. In an L/C arrangement, a bank or trade finance organisation will act as guarantor of payment, and effectively serves to reduce the risk of non-payment from the buyer. The supplier receives payment earlier, typically upon the presentation of shipping and insurance documents. Insurance is also offered in securing the transaction. Letters of Guarantee serve to cap potential losses in the case of non-performance from either party. Furthermore, credit insurance can be purchased to protect against a variety of transportation, exchange rate, and political risks (Hurtrez and Salvadori 2010; Auboin 2009).

### *Accessing credit using the transaction as collateral*

In addition to serving as intermediaries, guarantors, and insurers of trade transactions, trade finance companies also offer suppliers credit using a secured sales transaction as collateral. Pre-shipment financing options issue credit based upon purchase orders or L/Cs, and is used by the supplier to purchase production inputs or provide general liquidity. Post-shipment financing uses the accounts receivables or the produced assets as collateral.

The purchase of a supplier’s accounts receivable by a bank or trade finance company is known as factoring or forfeiting. Factoring tends to be used for short-term contracts (less than 180 days), while forfeiting offers similar access to liquidity on a transaction-specific basis for longer, medium-term contracts (180 days up to seven years). The produced asset, itself, can be used as collateral in a variety of financing strategies. One example is trade-receivables-backed finance, where assets are securitised and rated on the credit-worthiness of the buyer. This offers smaller, non-investment grade suppliers a source of liquidity during the waiting period before payment (Hurtrez and Salvadori 2010; Auboin 2009).

These forms of trade financing are largely dominated by private banks, which make up 80 per cent of the trade finance market. However, other actors, such as export credit agencies, regional development banks, multilateral financial institutions, suppliers, and buyers also offer credit or insurance (Auboin 2007, 2009).

#### **12.1.2 Trade credit**

Trade credit is a subset of trade finance, and is offered by suppliers to their buyers in the form of an option to delay payment after the receipt of goods. Trade credit is usually extended through open account contracts that define the number of days during which the supplier will wait for payment and/or extend trade credit. As such, trade credit is found in the accounts receivable for suppliers and accounts payable for buyers.

Suppliers may still use the trade credit/account receivables as collateral for bank-issued credit—albeit at a discount. This arrangement of using open account contracts and factoring is often referred to as “supply chain” finance. (Hurtrez and Salvadori 2010)



### *How common is trade credit?*

Trade credit is well documented as an important source of short-term financing for firms around the world. Surveys by the World Bank have revealed that firms typically finance about 20 per cent of their working capital through trade credit, and *Worldscope* has found that trade credit is more important than bank credit for short-term financing in 60 per cent of its covered countries (Escaith and Gonguet 2009; Raddatz 2010).

In the United States, trade credit represented half of all corporate short-term liabilities in 2004 (Boissay 2006). SMEs frequently use trade credit as collateral for bank credit. In the United States, approximately 25 per cent of all bank loans in 1998 were secured by accounts receivable. In Italy, such credit lines represented 22 per cent of all bank loans and 54 per cent of all short-term loans in 2002 (Omiccioli 2005).

#### **12.1.3 Credit chains**

Supply chains embody flows of information, capital, goods and labour through firms (Mentzer 2001). Kiyotaki and Moore (1997) presented landmark work modelling the credit linkages found between firms in a supply chain, what they termed the credit chain. In their work, they postulate that suppliers are forced to extend trade credit to buyers in order to remain competitive, allowing the buyers to receive goods without payment for some agreed amount of time. The supplier, already limited in funds, then seeks trade credit from his or her suppliers.

Thus, in conceptual terms, firms in a supply chain can be seen as having a dual nature as a lender to buyers and borrower from suppliers. The initial buyer's demand for trade credit triggers successive demands for trade credit upstream, resulting in the formation of a "credit chain" (Kiyotaki and Moore 1997; Battiston et al. 2007). This phenomenon will be explored in detail below.

### *How do credit chains come about?*

There are a number of motivations for the use of trade credit; eight of which are summarised here. First and foremost is the competitive pressure for a firm to offer attractive purchasing terms to the buyer. This is particularly prevalent if the firm is in a position of weak market power and the buyer is in a position of strong market power (Kiyotaki and Moore 1997; Fabbri and Klapper 2008).

Second is to signal a supplier's confidence in its product quality. By extending the payment period, suppliers are effectively letting buyers "try before they buy" the received assets (Klapper, Laeven, and Rajan 2011; Lee and Stowe 1993; Long et al. 1993; Antras and Foley 2011). A third possible reason is the establishment of trade credit as an industry culture/norm between buyers and suppliers (Lee and Stowe 1993). Fourth is the use of trade credit as a form of price discrimination that can signal favouritism to an important buyer (Klapper, Laeven, and Rajan 2011; Wilner 2000; Fisman and Raturi 2004; Van Horen 2005; Giannetti, Burkart, and Ellingsen 2011).

Fifth, while offering credit inevitably involves risk, a supplier may actually be in a better position to offer credit to a buyer due to leverage. In the case that the buyer does not pay, the supplier may withhold the remaining delivery of supply. The supplier may also have better knowledge of the buyer than a bank or other third party financier. Additionally,



suppliers often offer riskier buyers discounts for early payment to limit the non-payment risk (Kiyotaki and Moore 1997; Klapper, Laeven, and Rajan 2011; Smith 1987; Brennan et al. 1988; Petersen and Rajan 1997; Biais and Gollier 1997; Burkart and Ellingsen 2004). Sixth, even while a supplier may offer a buyer trade credit, that supplier may access bank credit – albeit at a discount – using the accounts receivable trade credit as collateral (Klapper, Laeven, and Rajan 2011; Battiston et al. 2007; Burkart and Ellingsen 2004).

Seventh, trade credit may be cheaper and/or more available than bank credit for buyers. During periods of monetary tightening or financial crisis, trade credit has been shown to act as a substitute for bank credit (Himmelberg et al. 1995; Choi and Kim; 2005; Love et al. 2007). In developing economies that have weak formal financing channels, trade credit can serve as an informal source of financing (McMillan and Woodruff 1999; Johnson McMillan and Woodruff 2004; Allen, Qian, and Qian 2005; Cull, Xu, and Zhu 2007). Indeed, in the sample analysed by Fabbri and Klapper (2008), 20 per cent of firms surveyed found trade credit to be cheaper than bank credit. Large, high quality suppliers may have an advantage in obtaining outside finance, and could pass on this advantage to smaller, credit constrained buyers (Klapper, Laeven, and Rajan 2011; Boissay and Gropp 2007). Or, large suppliers can act as liquidity providers, insuring buyers against liquidity shocks (Cunat 2006).

Finally – and possibly most importantly for the formation of credit chains – firms that extend credit to buyers might demand it from suppliers. Also valid is the opposite situation; when suppliers extend credit, buyers may extend credit as well to improve their competitiveness. Fabbri and Kalpper (2008) found that access to bank financing and profitability are not significantly correlated to trade credit supply. Rather, firms are more likely to extend trade credit if they have received trade credit, with the aim of “matching maturity” between payables and receivables. This suggests a correlation between the decision to supply trade credit to buyers and demand trade credit from suppliers.

## **12.2 Research areas**

The prevalence of trade finance and trade credit, and the ramifications of the concept of credit chains, presents opportunities for research on their role in the international economy. Among the literature surveyed, a number of primary areas of research emerged. The most cited and most recent is the body of literature on trade finance, trade credit and credit chains in the context of the 2008-2009 global financial crisis. While there was prior research on the role of trade finance in financial crises – particularly after the 1997 Asian financial crisis – this latest global crisis has produced an unprecedented level of interest.

The next area falls under operations research, and focuses on the modelling and optimisation of operations under varying trade credit conditions. This literature dates back to the 1960s, but has been rising in prevalence, in correlation to the rise of supply chains and supply chain management.

Finally, a third body of literature is identified in the role of trade finance in developing countries. Due to the unique benefits of credit chains and supply chains, trade finance is perceived as an enabler of economic development by providing sources of informal financing in a weak infrastructural setting.

### *12.2.1 Trade finance and the financial crisis*

The global trade collapse during the Great Recession of 2008-2009 caused significant alarm in the international community for its magnitude, suddenness, and globally synchronised nature. Global trade fell 30 per cent relative to GDP and at a faster pace than seen during the Great Depression in the 1930s.

Trade fell in almost every OECD country, with half experiencing declines of greater than 20 per cent. The fourth quarter of 2008 saw a drop in exports of 18 per cent for Germany, 20 per cent for the United States, 25 per cent for France, and 32 per cent for China. Altogether, the collapse in trade was unprecedented in post-World War II history (Eaton et al. 2011; Cheung and Guichard 2009; Bénassy-Quéré et al. 2009; Haddad, Harrison, and Hausman 2010; Gregory et al. 2010).

In response, the international research community hastened to understand the drivers of the trade collapse, of which four have risen as probable causes: (1) a contraction in global demand; (2) restricted access to trade finance; (3) amplification through supply chains/credit chains; and (4) rising protectionism.

#### *The role of demand contraction*

There is general agreement that the contraction in global demand during the Great Recession caused the majority of the trade collapse (Cheung and Guichard 2009; Eaton et al. 2011; Escaith 2011; Haddad, Harrison, and Hausman). Eaton et al. (2011) finds that 80 per cent of the drop in trade to GDP ratio can be explained by a drop in spending on manufacturers, particularly in durable goods.

However, there is a portion of the trade collapse, estimated to be between 10 to 20 per cent, that is not attributable to demand-side contractions (Eaton et al. 2011; Cheung and Guichard 2009). One of the most commonly cited causes for this is trade friction from the restricted availability of trade finance.

#### *The role of restricted trade finance*

Trade finance plays a critical role in enabling trade and providing short-term financing for firms. The importance of trade credit is even greater in developing countries, where weaker financial infrastructure makes firms more reliant on trade credit of imports and exports (Menichini 2009).

The Great Recession and its ensuing liquidity squeeze are estimated to have created a gap in the availability of trade finance in the range of 25 to 500 billion US dollars (Chaffour and Farole 2009). In light of this shortage and trade finance's significance in enabling trade, serious concerns were voiced that further restrictions could deepen and prolong the recession (Chaffour and Farole 2009; Auboin 2009; Ellingsen and Vlachose 2009).

Chaffour and Farole (2009) discuss two types of trade finance market failures that can be brought about by a financial crisis: supply shortages and overpricing. Supply shortages are brought about by the deleveraging and risk-adjustment process that accompany a financial crisis. The demand for liquidity means that trade credit lines, which typically have terms of less than 180 days, are amongst the first credit lines cut. In addition, collapse in inter-bank trust and hoarding of cash result in an increase in strategic

defaults. Furthermore, those who typically offer trade finance may be temporarily unable to calculate risk due to the international and opaque nature of the trade finance market. Finally, the international nature of trade finance becomes a lower priority relative to domestic financing, given the domestic political pressure and general national interests that rise during times of crisis.

Overpricing of trade finance is also prone to occur during financial crises. First, the upward price adjustment of credit products occurs faster than the relatively “sticky” price of products in the real sector. This means firms depending on trade finance have little room for passing on these higher costs. Secondly, Basel II regulations overprice trade finance, due to their calculation of risk along geographic instead of performance measures. Lastly, the process of market recalibration can result in trade finance overshooting equilibrium prices temporarily.

There is abundant empirical evidence on the scarcity of affordable trade finance during the crisis. World Bank surveys of banks, global buyers, and firms documented constrained operations due to the lack of trade finance and the substantially higher costs of trade finance compared to costs before the crisis.

Of the firms surveyed, SMEs and exporters in emerging markets were affected the most (Malouche 2009). A joint survey by the Banker’s Association for Trade and Finance and the IMF in 2009 similarly documented an increase in the price of trade finance and a drop in trade finance flows to developed countries (IMF and BAFT 2009).

In addition, the historical performance of markets during crises show that trade finance tends to be vulnerable, such as seen during the 1997 Asian financial crisis. However, Chaffour and Farole (2009) found that trade volumes declined about four times faster than trade finance volumes between October 2008 and January 2009. While the condition of the trade finance market likely amplified the short-term trade response and certainly poses barriers towards recovery, its contribution to the immediate trade collapse, itself, should not be overemphasised.

### *The role of supply chains and credit chains*

In addition to demand contraction and restricted trade finance, the trade collapse is hypothesised to be driven by propagation of the crisis through the supply chain/credit chain (Chaffour and Farole 2009; Cheung and Guichard 2009; Escaith and Gonguet 2009; Bénassy-Quéré et al. 2009; Raddatz 2010; Escaith 2011; Menichini 2009). The rationale for this mechanism is fairly straightforward. Firms tend to both extend and receive trade credit, creating credit linkages that are often found in supply chains. In a credit chain with little “slack” in liquidity, the failure of credit linkage can set off a cascade of failures across the chain, resulting in a multiplier effect, one that might explain the scale and synchronicity of the trade collapse.

Anecdotal evidence points to the relevance of this mechanism. Raddatz (2010) cites several studies revealing non-payment by customers as a major cause of financial distress and bankruptcy in US firms, and the tendency of firms to delay payment to their trade creditors when faced with late payment from their own customers.

However, the ability to investigate this mechanism has been hampered by lack of data on inter- and intra-firm trade credit activities (Cheung and Guichard 2009; Raddatz 2010). In-

stead, attempts have been made using more aggregate level input-output data and general equilibrium modelling.

Escaith and Gonguet (2009) combined concepts from international input-output analysis and the monetary circuit to model interactions between the real and financial sectors in a global value chain. When banks operate at the limits of their capital adequacy ratio and when assets are priced to market, they find a statistically significant resonance effect that amplifies signals between the real and monetary circuits.

Raddatz (2010) approached the challenge by examining if an increase in trade credit linkages between two industries also increases their output correlation. Raddatz's regression analysis across 378 manufacturing industry pairs in 43 countries finds that an increase in trade credit linkages between two industries significantly increases their output correlation.

While these studies have done much to examine and test the existence of this hypothesised trade credit multiplier transmission channel, its impact on the trade collapse has been found to be relatively minor.

Bénassy-Quéré et al. (2009) directly assessed the significance of the chain multiplier effect in the trade collapse through a multi-region, multi-sector CGE model, and found that the double-digit drop in global trade during the fourth quarter of 2008 and the first quarter of 2009 was not significantly explained due to the disruptions of supply/credit chains. While the multiplier effect's insignificance in driving the magnitude of the trade collapse is now general consensus, its role in the speed and global synchronicity is still subject to speculation (Escaith 2011; Cheung and Guichard 2009).

### *The role of protectionism*

The trade collapse also stoked fears of protectionism and its potential rise during the crisis. The spread of trade liberalisation resulted in a situation where many countries were well within the tariff boundaries set by the WTO, and had ample room to increase tariffs if they so wished – particularly true for those who joined the WTO early on. The political situation introduced significant worry that a demand for protectionism in order to protect domestic markets could increase trade barriers with the onset of the 2008-2009 global financial crisis (Gregory et al. 2010).

These fears, however, never became reality, as the trade restrictions that did arise covered a very small share of global trade, and further restrictions did not arise. As Escaith (2011) summarised, "seen from the mid-2011, the 2008-2009 trade collapse looks like a standard – yet outsized – effect of a fall in the demand for durable goods and postponed purchases of intermediates drawing down inventories. Eventually, supply-side disruptions – caused by a shortage of trade finance, the interruption and breaking-down of international supply chains, and the increase in tariff and non-tariff trade barriers – played a minor role."

### *12.2.2 Trade finance and operations research*

A second area where supply chains and trade finance overlap is within the field of operations research; more specifically, on the subject of inventory management. Harris (1913) presented foundational work on his economic order quantity (EOQ) formulae. These EOQ

models provided business managers with a means for determining optimal inventory practices, such as optimal pricing and inventory cycle times.

In the century since, Harris' basic EOQ model has been expanded to cover a plethora of new scenarios. These efforts have factored in multiple suppliers/buyers, multiple warehouses, product depreciation, economic inflation, shortages, and varying demand patterns, amongst many others (Huang and Hsu 2008). There have also been attempts to modify traditional EOQ methodology to simplify the mathematics involved and ease operational implementation (Cárdenas-Barrón 2007) or to swap out cost minimisation motives for discounted cash flow (Chen and Chuang 1999).

The first of these efforts to adapt the EOQ model to factor in supply chains and trade finance was the seminal work of Goyal (1985). Goyal's model consisted of a single supplier and a single buyer, and accounted for trade credit in the form of a permissible delay in payments. This model has been used as a foundation to expand into accounting for various other factors, including a trade credit strategy that also incorporates discounting for early payment, batch shipping strategies, multiple warehouses, and product deterioration.

As successive research efforts have sought to build on previous results, these models have advanced in both context specificity and complexity. At the same time, complexity has been, on occasion, reduced through efforts to simplify the mathematics involved for potential end-users managing firm operations. A selection of the advances made in these models is presented in Table 12.1. This is by no means comprehensive, but serves to indicate the general expansion seen in EOQ modelling over recent decades.

**Table 12.1: A sample of the extension of EOQ models over time**

Study	Scenario
Goyal (1976)	establishes single supplier, single buyer, single item inventory model for optimal ordering quantity
Goyal (1985)	incorporates trade credit as a permissible delay in payment
Banerjee (1986)	incorporates batch shipping strategy
Aggarwal and Jaggi (1995)	incorporates product deterioration and permissible delay
Jamal, Sarker, and Wang (1997)	incorporates inventory shortages with product deterioration
Hwang and Shinn (1997)	incorporates permissible delay in payment to find optimal pricing and lot size for buyer
Sarker, Jamal, and Wang (2000)	incorporates inflation with shortages, deterioration, and permissible delay in payments
Ouyang et al. (2002)	incorporates 2 component trade credit: (1) a permissible delay in payment, (2) discount for early payment
Abad and Jaggi (2003)	incorporates both trade credit and batch shipping strategy

This particular body of literature is notable for its immediate prescriptive use by the business manager. The research findings here tend to translate directly into business practice, and can inform optimal pricing, ordering, and shipment policies. The results do indicate trade credit as enabling cost savings and thus an increase in profits for both buyers and suppliers, although post-earnings redistribution of profits may be required (Ho, Ouyang, and Su 2008; Sarmah, Acharya, and Goyal 2008; Sarmah, Acharya, and Goyal 2007). In addition, trade credit can potentially act as a mechanism for demand

management, given the positive correlation between the trade credit period offered by the supplier and order size from the buyer (Huang and Hsu 2008; Huang 2007).

### *12.2.3 Trade finance and development*

Trade finance is perceived to play a key role in helping developing countries integrate into the global economy. However, two barriers increase the cost of trade finance for developing country firms relative to their developed country competitors. The first is the underdeveloped financial infrastructure in developing countries. A World Bank (2005) study found that banks surveyed in Africa lacked expertise and resources for managing trade finance instruments. In addition, surveys across multiple African countries have found that risk averse behaviour by banks and a lack of public trust in the effectiveness of the banking sector further restricts trade finance. Instead, firms rely on trade credit, international financing, or informal financing such as by friends and family (Malouche 2009; Auboin 2007; Bénassy-Quéré et al. 2009).

Auboin (2007) posits a second source of barriers in the growing technology gap that contrasts the ease of access to trade finance between developed and developing countries. E-banking capabilities have reduced transaction costs and increased access to information associated with trade finance. Firms in developing countries that lack the information infrastructure required to effectively integrate into global e-banking systems find themselves at a competitive disadvantage. In other words, the gap in trade finance capabilities not only exists, but is also growing due to technological advances. Banking sectors face increasing minimum expectations in providing trade finance for entry into the global economy.

Two solutions are found in the literature. The first is through multilateral financial institutions, regional development banks, and export credit agencies. These parties not only supplement the supply for trade finance to developing country firms, but also provide technical assistance to improve banking sector capabilities. Malouche (2009) finds that export credit agencies and development banks effectively buffered the effects of the global financial crisis in developing countries. The second solution lies in the trade credit extended by buyers in the supply chain. Bénassy-Quéré et al. (2009) find that sub-Saharan textile subsidiaries relied more on trade credit from the parent company than on financing from domestic banks. Trade credit has also been found to be more effective than government financing, as was found in the ability of dairy processors to provide access for small farmers across Central and Eastern Europe (Escaith and Gonguet 2009).

## **12.3 Future directions**

Credit chains offer a compelling concept that has proved valuable in investigating the financial crisis, modelling operations, and understanding development. However, little concerted work has been seen in further developing a theory of credit chains since Kiyotaki and Moore's landmark work in 1997.

Significant utility is foreseen in integrating the concept with other aspects of supply chain theory, such as those areas reviewed in previous chapters, in order to add the financial dimension of supply chain realities to theoretical considerations. For example, we can point to a specific opportunity for investigation in applying the EOQ models of trade credit

conditions to scenarios representative of a financial crisis. In this manner, the operational research work on trade credit can be utilised for stress testing and can contribute tools for financial/credit chain risk management in the greater body of literature on supply chain risk management.

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