

Part I
Supply Chain Perspectives



Chapter 1

Supply chains in the economics literature

Abstract

Many unskilled labour-intensive production tasks began to be offshored by advanced country firms to developing countries, where low-cost but relatively unskilled labour imparted a comparative advantage, essentially in final assembly operations, combined with institutions that could absorb firm-specific technological know-how. This profitable international production fragmentation became feasible with the onset of the information and communications technology (ICT) revolution, which enabled the coordination of spatially dispersed complex tasks at a relatively low cost. The growth of global supply chains has changed the distribution of incomes across countries. Participation in these supply chains, initiated by the successful completion of low value-added manufacturing tasks, contributed to industrialisation and high rates of economic growth in several Asian developing economies. The process of catch-up with developed economies is likely to get stronger as many of these countries seek to move up the value chain through their exposure to advanced technologies (made available by the offshoring process) and build up human capital. At the same time, the continued exclusion of several developing economies from global supply chains, such as those in Africa, means that the gap among countries in the developing world could widen. The international fragmentation of production has also affected the distribution of incomes within countries. In advanced economies, the direct, negative effect of production fragmentation on employment and wages for low- and semi-skilled workers is the primary concern. In developing economies, production fragmentation is likely to create jobs for a large pool of unskilled labour. However, because a relatively unskilled activity in a developed economy may be a relatively skilled one in a developing economy, offshoring may increase the demand for (and returns on) skilled labour among developing economies. These distribution effects, both across and within countries, are likely to affect trade policy, and consequently, the evolution of supply chains.

1.1 The evolution of global supply chains

1.1.1 *A brief history and some useful definitions*

In the pre-globalised world, poor transportation technology meant that each community produced most of what it consumed. The steam revolution, which powered railways and steamships, reduced trade costs dramatically, thereby making it feasible to spatially separate production and consumption (Bairoch 1990).

Comparative advantage and economies of scale made the separation profitable. The "Industrial Revolution" began in Britain around the same time, providing it with a significant cost advantage in manufacturing production. This made it an importer of agricultural and industrial raw materials from developing countries, and an exporter of finished manufactured goods.

Countries in Continental Europe and the United States industrialised soon after, around the middle of the 19th century, and adopted similar international trade patterns (Baldwin 2012).

The result was a self-sustaining cycle of specialisation, large-scale production, and innovation and income gains that made further innovation profitable in Europe, North America and Japan.

At the same time, the displacement of manufacturing activity from developing countries in Asia, Africa and Latin America destroyed incentives for innovation. Industrialisation in the "North" and de-industrialisation in the "South", especially in India and China, led to massive income divergence across country groups (Pritchett 1997).

The separation of production and consumption, described as "globalisation's first unbundling" by Baldwin (2006), increased the importance of proximity in the production process. By enabling international trade, the transport revolution provided an incentive for large-scale production, which involved bringing together goods, technology, people, training, investment, and information.

Proximity lowers the costs and risks of coordinating such complexity, and hence trade resulted in the bundling of all stages in individual factories, often clustered locally in industrial sectors.

Historically, international trade involved the exchange of finished products between countries based on comparative advantage, as determined by differences in technology (Ricardo) or differences in factor endowments (Heckscher-Ohlin).

Extensive intra-industry trade among industrialised countries was explained by the fact that participation in international markets provided firms with an opportunity to achieve economies of scale (Krugman 1980). Intra-industry trade often included the sale and purchase of parts and components by firms located in different countries. It is therefore argued that in this context, global supply chains have long existed among advanced economies. Trade between the United States and Canada in the auto industry and intra-EU trade in machinery are two prominent examples (Baldwin 2012).

Most of such international sourcing was driven by firm-level specialisation and excellence. For instance, in the case of air conditioning systems for automobiles, the French firm Valeo dominated its product market through excellence. In principle, Swedish, Italian and German automobile firms could each manufacture their own air conditioners. But

economies of scale and the “learning-by-doing” effect meant that it was cheaper for them to import this auto part from France (Baldwin 2012).

The emergence of firms as regional champions in the production of different parts and components was central to this “horizontal” internationalisation of supply chains among high-wage, advanced economies. More recently, the international exchange of final goods between developed and developing economies, especially in Asia, (Ozawa 1995; Ando and Kimura 2003), as envisaged by the traditional trade models of Ricardo and Heckscher-Ohlin, has become less important.

International production fragmentation, in which manufacturing or services activities done at home are combined with those performed abroad, has now taken centre stage. This represents a major point of departure from the so-called “Fordist” production system – exemplified by the American automobile industry – where all economic activity was organised within a single firm located on one site or in close proximity (Feenstra 1998).

Increasingly, firms across advanced and developing countries add value along these global supply chains by completing a specific task associated with the production of a finished product and then exporting it. This may be an important part or component required in the production of a good. It may even be a service that is a vital intermediate input in further production.

Grossman and Rossi-Hansberg (2008) introduced the term “task trade” to describe this finer international division of labour. Others refer to it as “vertical specialisation”, “offshoring”, “outsourcing”, “production sharing”, “slicing the value chain” and “delocalisation”.

Trade in tasks can be carried out through arm’s length contracts between firms in different countries, through foreign direct investment (FDI) or through a range of intermediate arrangements that combine the two.

In the case of FDI, investors such as multinational firms, with their headquarters based in one country, will establish operations under their ownership and managerial control in another country. A large part of such “vertical” FDI represents investment by advanced economies’ firms in developing countries.

A multinational firm is likely to internalise its activities in a foreign country through FDI in a subsidiary if the internalisation cost is lower than the cost associated with an arm’s length contract¹ (Helpman 1984).

1.1.2 Conceptual underpinnings

So why did firms in advanced economies find it profitable to increasingly offshore tasks or parts of the production process to developing economies? And does international trade theory need a new framework to study this phenomenon of global supply chains?

The gain from dispersion is associated with differences in the factor intensity of different production stages and differences in relative factor prices across countries. Vast absolute differences in unskilled labour wages between developed and developing economies, driven by differences in factor endowments, made cross-border production sharing profitable.

This stays true to the concept of comparative advantage, as defined by the Heckscher-Ohlin model of trade – countries specialise in the production and exports of “tasks” which use

its relatively abundant factor of production relatively intensively. For example, a relatively unskilled, labour abundant developing economy would complete and export the relatively unskilled labour intensive tasks involved in the production of goods, say final assembly. Similarly, a relatively capital or skilled labour intensive country would export intermediate products, such as capital goods and design and research and development services.

However, while the Heckscher Ohlin model of trade is highly relevant to understanding the evolution and shape of supply chains, it does not provide the whole story. Unskilled labour costs in developing countries might not be nearly so low as the differences in wages suggest because differences in aggregate total factor productivity (TFP), resulting from differences in technology and institutions also play a part.

For instance, a key issue in the context of offshoring is whether developed country firms can take their “Northern” technology with them. If they cannot because the institutions in a developing country are so weak or disruptive that efficient production is simply not possible, then offshoring is unlikely. If the technology is portable, then wage differences do translate into labour cost differences and off-shoring is profitable. This outcome is as representative of the Ricardian model of trade as it is of the Heckscher-Ohlin model.

Traditional trade theories make extreme and contradictory assumptions about international diffusion of technical knowledge. The Heckscher-Ohlin model of trade argues that technology is freely available across countries and hence comparative advantage is determined by relative factor endowments.

In contrast, the Ricardian model of trade stresses differences in technology as the basis of international trade – countries tend to specialise in activities about which their inhabitants are especially knowledgeable. An intermediate position which seems more relevant to global supply chains is that knowledge can move from one country to another, but only at a price, such as with payments of royalties – explicit or implicit in transfer prices – or the salaries of foreign experts (Markusen 1997; Anderson et al. 2006).

The Heckscher-Ohlin model is highly relevant when explaining supply chains for developing countries whose aggregate TFP is closer to that of advanced economies, in other words, emerging markets. In developing countries where aggregate TFP is significantly lower than in advanced countries, the sector-specific transfer of “Northern” technology creates a Ricardian comparative advantage in the goods or sectors concerned.

Comparative advantage, whether defined in a Heckscher-Ohlin or Ricardian sense, is naturally relevant in the formation of global supply chains because location decisions for firms revolve around efficiency, specifically, placing each stage of production in the lowest cost location. This cost calculation trades off direct factor costs with “separation” costs. The former include wages, technology, capital costs, subsidies and other policy-related incentives. The latter comprise transmission costs, transportation costs and increased risk. Hence, a firm in Japan, Germany or the United States is likely to offshore the unskilled labour intensive stages of producing a manufactured good to its low-wage neighbors so long as the cost advantage it receives outweighs the costs associated with the process of offshoring.

The location decision may also be influenced by local spillovers or potential patterns of complementarity between tasks (Grossman and Rossi-Hansberg 2008). In some sectors, proximity between designers and consumers may be critical. In others, certain production stages may be made cheaper, faster and more effective when co-located with certain other stages. For example, the tasks performed by a nurse during surgery are most

valuable when the surgeon is nearby. It is also possible that stages and sectors could be characterised by strong technological complementarities that make production clustering or agglomeration beneficial (Healey and Ilbery 1990).

Importantly, exploiting the potential benefit of international production fragmentation became feasible with the information and communications technology (ICT) revolution around the mid-1980s, which enabled the coordination of complex tasks at distance, at a relatively low cost (Batra and Casas 1973; Dixit and Grossman 1982; Jones and Kierzkowski 1990, 2001). Another key enabling factor of production fragmentation was the proliferation of standards, which enable the modularisation of production processes through mechanisms for verifying complex information on quality.

FDI directed at developing countries began to grow substantially during the 1990s. For example, non-OECD economies accounted for about 38 per cent of outward FDI from the US in 2004 and about 46 per cent of outward FDI from Japan in 2005 (Forte 2004).

Baldwin (2006) termed this as “globalisation’s second unbundling” – production stages previously performed in close proximity began to be dispersed geographically. Most of the unskilled labour-intensive production tasks began to be offshored by advanced country firms to developing countries with a comparative advantage in completing these tasks, being those with low unskilled labour wages as well as institutions that could absorb their technological know-how.

1.1.3 Some salient features

It is worth noting that 21st century global supply chains are different from those that existed among advanced economies in the 20th century. Today, they are much more than extra trade in parts and components. FDI is an integral part of these networks and hence investment in production capacity assumes greater importance. The same holds true for infrastructure services, including telecommunications, transport and logistics.

Long-term business relationships also lead to cross-border flows of know-how such as formal intellectual property (technology) and more tacit forms, such as managerial and marketing expertise.

The export orientation of the host country, usually a developing economy, is greatly enhanced by FDI and long-term business relationships of other kinds. By providing access to capital, skills, technology and market knowledge, it enables firms to manufacture products that meet world-market specifications with regard to technological content, quality and design (Helpman 1984). It is also important to highlight the fact that most global supply chains, including already significant “North-North” ones, are largely regional.

Baldwin (2012) identifies “Factory Asia”, “Factory North America”, and “Factory Europe” as blocs with a strong supply-chain relationship. Within these blocs, there is a hub-and-spoke asymmetry in the dependence of factory economies on intermediate imports from the region’s “headquarter” economy.

For example, Baldwin (2012) finds that the US shows little dependency on imports from Canada and Mexico, but that these countries show considerable dependence on the US and very little on each other. The same is true for Factory Asia where Japan is the “headquarter” economy, although the asymmetries are far less defined than they are for NAFTA. Germany is the hub in Factory Europe.

1.2 The distribution of income across countries

1.2.1 *Value-added along a supply chain: manufacturing and services activities*

In their research on global supply chains, economists have focused on the manufacturing sector. This is attributable to the fact that traditionally, any item that could not be put in a box (such as services) or was too heavy to ship (such as houses) was thought of as non-tradable in international markets. But with rapid advances in ICT, packets of digitised information play the role that boxes used to play, thereby implying that many more services, such as software, call centres and business process outsourcing, are now tradable.

Of late, economists have been paying increasing attention to upstream service activities, such as R&D and design. The same cannot be said for downstream services, such as distribution and marketing, involved in the supply of goods to consumers (Wood 2001).² The role of services in supply chains needs to be studied in more detail, given that their costs often account for a larger share of the final price of a good than the costs of their manufactured components.

The economics literature, in fact, alludes to a non-linear relationship between the stage of production in a global supply chain and its contribution to total value-added. In particular, there is a U-shaped relationship, referred to as the “smile curve” by Stan Shih – Acer’s CEO in the early 1990s; it suggests that upstream activities such as R&D and product design together with downstream activities such as branding and advertising services constitute a large share of value-added, but the intermediate production stages as component manufacturing and final assembly do not.

This suggests that value-added is less for the tasks along the supply chain that are usually offshored. The obvious explanation relates to cost accounting. When a stage’s cost is reduced by offshoring, its share in value-added falls, since a stage’s value-added is based on cost. This basic cost-accounting effect can be amplified by two factors: technology transfer and relative market power (Baldwin 2012).

As explained earlier, if a firm moves its advanced technology to the offshore location, it is likely to reduce the cost of the offshored task even further. Consequently, this increases the relative value of non-offshored tasks. Moreover, offshored tasks tend to be activities where entry barriers – and hence economic rents – are low. They can be carried out in many developing economies and thereby become homogeneous. Non-offshored stages, however, are likely to comprise tasks, which represent the core competency of lead firms, where they have market power due to product differentiation and where rents are high.

1.2.2 *Upgrading*

A country’s position in a global supply chain, in terms of stages of production, is generally correlated with its comparative advantage. Developing countries complete low value-added unskilled labour intensive tasks because they have a relatively abundant supply of unskilled labour. It is advanced economies, where the skill- and capital-intensive tasks are completed, which capture most of the value-added.

Some advantages are “natural”. Several countries sit atop massive deposits of oil, while others do not. In modern economies, however, comparative advantage is often man-made. So

it is possible for a country which has a comparative advantage in unskilled labour intensive tasks today to have a comparative advantage in high technology-intensive tasks tomorrow.

For example, the United Kingdom had a comparative advantage in textile manufacturing following the Industrial Revolution. Then that advantage shifted to the United States. It shifted once again – this time to the south in the United States (Blinder 2005). At present, the comparative advantage in textile manufacturing resides in China and other low-wage developing economies. Hence, the concept of “dynamic comparative advantage” or “kaleidoscopic comparative advantage” (as defined by Bhagwati and Dehejia 1994) is critical to understanding global supply chains. It is worth noting that shifts in comparative advantage are not always the default position and are often shaped by government policies and business decisions.

In Asia, several firms in Japan offshored unskilled labour intensive manufacturing tasks to South Korea, Chinese Taipei, Hong Kong and Singapore, starting in the 1970s (Baldwin 2012). Hence, these countries entered global supply chains by specialising in component manufacturing and product assembly. As they industrialised, they began to manufacture sophisticated intermediate inputs, which they earlier imported from advanced economies. These newly industrialised countries also expanded into the design and distribution of goods, and hence captured more of total value-added.

The availability of technology played a crucial role in upgrading (Wood 2001) and global supply chains have made technology internationally more mobile by offshoring firms’ specific technical know-how, especially via investment in the establishment of subsidiaries overseas. At the same time, it is important to highlight the fact that investment in human capital and the resulting capability of firms to absorb technology is also crucial to supply chain upgrading (Lall, 1992).

The transfer of technology and knowledge facilitated through trade in intermediates and FDI made it possible for developing countries, such as Hong Kong, South Korea, Singapore, and Chinese Taipei to move up the product ladder in terms of capital intensity and quality. At the same time, industrialisation in these countries or territories produced rising wages, which, in turn, triggered offshoring of unskilled labour intensive tasks to China, Thailand, the Philippines, Indonesia and Malaysia after 1990.

Similarly, Mexico and Poland were favoured offshore locations for unskilled labour intensive manufacturing tasks in North America and Europe respectively (Baldwin 2012). For China, there is already some evidence of deepening productive capacity and a move up the ladder – it has begun to produce sophisticated intermediate goods that previously would have been imported.

The potential transition of developing countries to completing high value-added tasks can affect the distribution of income between advanced and developing economies. The global sourcing of services, which account for a large share of global value-added, may have similar effects.

1.2.3 New entrants

Along with the supply chain changes mentioned in the previous section the distribution of income between developing countries has also been widening. Development at different speeds in Asia relative to Africa is attributable, in part, to the exclusion of African countries from global supply chains for manufactured goods and services.

Why did this happen? For one, African countries traditionally had a comparative advantage in commodity exports. For another, their industrialisation strategies were based on trade policy instruments, such as tariffs and quotas, for import-substitution. After countries in Asia seized the initiative, breaking into global supply chains became difficult for several African countries despite their departure from import substitution, because of externalities and economies of clustering.

The more chains a country is already involved in, the easier is it to become involved in additional chains, because there are economies of scale in the supply of infrastructure, skilled labour, support services, and information (Wood 2001).

So how can African countries enter the network of global supply chains to diversify into manufacturing production? It is likely that as surplus labour gets absorbed in developing countries, such as China, Mexico and Poland, wages will rise there (and that is already happening in China). This is likely to widen the supply chain base for completing unskilled labour intensive manufacturing tasks. African countries would thus have an opportunity to diversify into industrial production. But so too would other low-wage nations, including India, Vietnam and Bangladesh, hitherto less involved in supply chain activity (Baldwin 2012; UNESCAP 2011).

In order to compete for inclusion in global supply chains, African countries and others have to remove institutional barriers to trade, such as red tape, customs procedures, laws, finance and personal security, and improve basic infrastructure. They will also need to invest in innovation systems and skills development as well as maximise linkages to commodity exports.

1.3 The distribution of income, jobs and welfare within countries

International production fragmentation is conducted based on firms' decisions to enhance their competitiveness. Increased offshoring directly enhances the productivity of the factor whose tasks are moved offshore. This results in a more efficient resource allocation of resources, which is likely to push up the overall efficiency and productivity in the headquarter economy.

At the same time, the offshoring of tasks based on comparative advantage implies that certain jobs are likely to be transferred from developed to developing countries. Hence, just as in the Heckscher-Ohlin model of trade, there could be distributional implications of offshore outsourcing via changes in the demand for skilled and unskilled labour. The owners of a country's scarce factor are likely to lose, either by seeing a decline in their return or being rendered redundant, when the costs of offshoring their task falls. In fact, according to Feenstra (1998), in a world where trade in intermediate inputs accompanies trade in final goods, the impact of globalisation on employment and factor returns is relatively large.

1.3.1 *Advanced economies*

Grossman and Rossi-Hansberg (2008) provide a basic framework to study the effects of this new international organisation of supply on resource allocation, factor prices and welfare. Skilled labour is relatively abundant and thus relative cheap in advanced economies. Unskilled labour, in contrast, is relatively scarce and thus relative expensive. The result is a spatial sorting of skill intensive stages to developed economies and unskilled labour-

intensive stages to developing economies, thereby resulting in an increase in the returns to skilled relative to unskilled labour in developed economies.

Wood (2002) and Anderton et al. (2006) show that the development of supply chains may have affected not just the wage gap between the majority of skilled workers and unskilled workers in developed countries, but also the wage gap between a tiny minority at the top of the income distribution and everyone else. They provide the following explanation. In the “North”, the initial effect of a decline in transport costs and co-operation costs is to widen the gap in wages (or with rigid wages, in unemployment rates) between unskilled and all skilled workers, a la Grossman and Rossi-Hansberg (2008). By retaining the more skill-intensive activities, both highly-skilled and medium-skilled workers benefit. Subsequent falls in co-operation costs shift more production to developing countries, but the activities which leave developed economies become increasingly skill-intensive, and that transfer eventually lowers the demand for more medium-skilled workers. However, as the relative wages of highly skilled workers continue to rise, wage inequality among skilled workers increases. Anderton et al. (2006) argue that it is therefore also possible that beyond a certain point, the wage gap between moderately skilled and unskilled workers shrinks rather than widens in developed countries.

Of principal interest in policy circles is the direct, negative effect of production fragmentation on employment and wages for low-skilled manufacturing workers in the “headquarter” economies.

Evidence suggests that increased outsourcing to developing countries of manufacturing activities, such as clothing production and electronic assembly within global supply chains, has eliminated jobs in advanced economies (Spence 2011). In the case of the Japanese manufacturing sector, for example, Fukao and Amano (2004) find a negative effect of outward FDI on domestic employment.

As a result, much of the unskilled labour in advanced economies is now being absorbed in the non-tradable services sector, such as in road transport and personal services. Jobs in these sectors are relatively low-paid.

As the domain of tradable services expands with constant improvements in ICT and the increasing standardisation of services trade through mutual recognition agreements, for instance, it is possible that many service sector workers in advanced economies will also have to compete for jobs with emerging economies. This could involve semi-skilled activities, such as call centres and book-keeping, as well as highly skilled tasks, such as design and R&D, so long as these services can be delivered electronically over long distances with little or no degradation in quality (Blinder 2006). It is worth noting that by eliminating jobs or reducing wages for skilled workers, offshoring of skill intensive tasks may potentially reduce income inequality in advanced economies.

Offshoring brings about overall improvements in productivity. For instance, Kimura and Kiyota (2004) show that Japanese firms globalising their activities perform better than those staying in Japan.

If the resulting impact on factor prices is not too large, all domestic parties can share in the gains from improved opportunities for offshoring. In fact, if the positive productivity effect outweighs the negative relative factor demand or factor price effect, it is possible to prevent an inevitable conflict of interests through redistribution, albeit difficult in the short run.

Hence, governments in advanced economies must adapt to new realities. Social safety nets are likely to be important in the short-run. Education systems would be crucial for making the necessary economic and social adjustments in the medium to long run. But this does not mean that simply providing more education is all that is needed. According to Blinder (2006), the critical divide in the future may be between work that is easily deliverable remotely with little or no diminution in quality, and work that is not. And this divide does not correspond well to traditional distinctions between high-skilled and low-skilled work.

For example, it is unlikely that the services of either taxi drivers or airline pilots will ever be delivered electronically over long distances. The second has significant educational requirements, while the first does not. Hence, the real challenge would be to develop an education system, which imparts skills (including vocational training) that would make people employable in a range of different occupations.

1.3.2 Developing economies

From the standpoint of developing economies, international production fragmentation has a positive effect on employment because it creates jobs for unskilled labour in offshore locations (Grossman and Rossi-Hansberg 2008). By increasing the demand for unskilled labour, it may even increase their wages, thereby reducing income inequality.

Using a more general framework, Wood (2002) explains that integration into value chains could push wage inequality between moderately skilled and unskilled workers in developing countries either way. According to him, the outcome depends on whether or not the fall in “cooperation or coordination costs” (that depend on ICT, travel costs and institutions) is accompanied by a fall in transport costs and on the initial conditions prevailing in those countries.

For example, if a poorly educated developing country started with little production of world-quality goods, a fall in co-operation costs would raise wage inequality, because the activities transferred from the developed “North” would be more skill-intensive than those in which workers were currently employed. It is for this reason that the services offshoring, in the case of business process operations, may have contributed to the worsening distribution of income in developing countries. A fall in co-operation costs would have a different effect if the country had a better educated workforce. Activities shifted from the “North” would initially be less skill-intensive than other production in the country, resulting in a decline in wage inequality. Eventually, however, offshored activities would be likely to become more skill-intensive, which would cause wage inequality to rise (Wood 2002).

Trade in intermediates, facilitated by FDI, are also likely to be associated with capital inflows and technology transfers, thereby having strong positive effects on the productivity growth of domestic firms.

Kimura (2005), for instance, shows that international production networks in East Asia have positively worked for fostering local firms, at least in some sectors. In a study on Indonesia, Amiti and Konings (2007) find a positive impact of intermediate goods trade on a firm’s productivity.

At the same time, other research expresses concern about the possible negative effects of inward FDI on the development of local firms and hence on employment, especially in the context of special economic zones or enclaves with minimal linkages to the rest of the

domestic economy. It is also argued that the transfer of labour saving-technologies associated with trade and FDI has resulted in insufficient job creation for a large pool of unskilled labour in developing economies.

1.4 The role of trade policy

Historically, countries used infant industry protection policies to build a strong industrial base before becoming competitive in international markets. Present day advanced economies such as the United States, Germany and Japan followed this path. So did several developing economies such as China, India and Brazil. Certain aspects of industrial policy, such as import substitution, FDI restrictions and local-content restrictions, made it difficult for countries to participate in global supply chains.

After the ICT revolution, however, many developing economies dropped the policy of infant industry protection to attract offshored manufacturing jobs and investment. In fact, given that cross-border relocation of different stages of production can happen through international trade in intermediate inputs, trade liberalisation greatly enhanced production sharing (Damuri 2012).

Industrialisation through joining global supply chains became a new development paradigm (Baldwin 2012). This new “industrial policy” changed the political economy of trade liberalisation. Emerging economies unilaterally liberalised tariffs and embraced pro-business policies to attract factories and jobs.

This change in policy stance can also be seen in countries’ willingness to embrace disciplines on (behind-the-border) non-tariff measures in “deep” regional trade agreements with their key supply chain partners. Starting in the mid-1980s and accelerating sharply in the 1990s, countries signed agreements with new disciplines in the areas of investment, services and intellectual property. As multilateral progress on these issues stalled during the Doha Round, the number of 21st century disciplines in regional trade agreements (RTAs) exploded in the 2000s.

The major trade policy issue looking forward is how the international “harmonisation” of regulations can enhance trade within global supply chains (Feenstra 1998; Bhagwati and Hudec 1997; WTO, 2011). Another issue is a growing trend for governments to adopt trade regulatory measures, such as export restrictions on raw materials, in order to maximise domestic value-added.

1.5 Future directions

Much of the recent boom in supply-chain trade was attributable to the ICT revolution that reduced the costs and risks of combining developed economy technology with developing country labour. A remarkable reduction in policy barriers to trade in goods, especially tariffs, also played a crucial role, as did efficiency improvements in transportation and logistics (such as containerisation) and increased standardisation. Further improvements in ICT will facilitate more and longer-distance trade in parts and components.

Tariffs cannot fall below a bound rate of zero and hence further tariff liberalisation is unlikely to provide a boost to future supply chain unbundling. But, given the political economy that accompanied the recent growth of global supply chains, further reductions in non-tariff barriers to trade, especially in the context of “deep” regional integration agreements, are likely to bring down the costs of moving goods, back and forth, across borders.

Trade costs, however, could still rise with policy changes, geopolitical uncertainties and oil prices. If oil prices, for example, do rise substantially, the geography of supply chains will be affected. It would favour “near-shoring” and supply chains would become even more regional than they are today. Growing uncertainty and shorter production cycles may also contribute to the increased regionalisation of supply chains.

What about the distribution of income across countries? The offshoring of unskilled labour-intensive stages of manufacturing, greater international mobility of technology and economic reforms produced rapid growth and industrialisation in developing economies, starting in the early 1970s, with a significant pick up in the 1990s.

This, often described as globalisation’s “second unbundling” led to, at least in part, the reversal of the big income divergence of the late 19th and early 20th century. Going forward, it is possible that new technologies, such as 3D printing and robotics, will eliminate routine, low-skilled tasks that are easier to computerise and robotise.

At the same time, the more intensive use of sophisticated production machines will make the remaining tasks more skill-, capital- and technology-intensive. This will favour production in high-wage advanced economies.

Hence, for this reason as well for upgrading their position in global supply chains to capture more of the value-added, developing economies would need to move up the ladder of skills, capital and technology.

Of course, their ability to upgrade is likely to be a function of the availability of skilled labour, their own “learning-by-doing”, and knowledge transfer from advanced country firms with their interaction being facilitated by offshore outsourcing. Growth in offshore outsourcing itself, however, may be curtailed by growing concerns of job losses in advanced economies.

There is also the question of global supply chains leading to development at different speeds within the developing world. The rapid industrialisation of the “South” in recent times has been driven by excellent performances of just a dozen nations – all of them heavily involved in international supply chains, and most of them in Asia.

The performance of Chinese manufacturing alone accounts for much of the reversal. The ability of countries, especially those in Africa, to diversify into manufacturing and services production, would be significantly influenced by the possibility of their firms entering global supply chains and, based on this increased participation, to maximise linkages with the rest of the domestic economy.

1.6 Endnotes

1. This is indicative of high transaction costs.
2. Studies analysing the role of global supermarkets in retail trade are an exception.

1.7 References

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Chapter 2

Supply chains in the business literature

Abstract

Changes in the structure of 20th century international industrial organisation that have incited research interest among economists have also driven a significant body of work in the business literature. Indeed, many of the factors driving the changing industrial structure are derived from business. Examples include the innovation and implementation of assembly lines, scientific management, modularisation, lean manufacturing, and just-in-time production. While the economics literature has produced terminology such as “task trade”, “vertical specialisation”, and “production sharing”, the business literature tends to emphasise “supply chains”. This is in conjunction with terms from political economists and development theorists that include “value chains”, “global commodity chains”, and “global production networks”. Of these, the supply chain provides the most relevant perspective for the business practitioner. Networks of firms are viewed from a focal firm perspective, and the supply chain ontology adopts various dimensions to orient a firm with its network surroundings (for example, direct-extended-ultimate supply chains, horizontal tiers or degrees of separation, and vertical structures within each tier). Further functionalising the supply chain concept is the field of supply chain management (SCM). Born from multidisciplinary roots that include logistics, marketing, management, and sociology, SCM has developed into a distinct field of study over the past fifty years. SCM theory has only recently reached a state of maturation where it produces operationalisable concepts and tools, but progress is being made in advancing both the overarching field of SCM and the specific issues that fall under the SCM umbrella. This chapter will review the overarching field, while Part II and its chapters will address the specific issues.

2.1 Defining supply chains

2.1.1 The blind men and the elephant

The realities addressed by supply chains reflect phenomena arising from the changing nature of the international economy during the latter half of the 20th century. As such, the same phenomenon is documented and researched from multiple fields, resulting in a

plethora of terms fundamentally pointing to the same reality. However, these terms embody perspectives from their respective fields to characterise this new reality.

We review a sample of the most common terms encountered when discussing this phenomenon. The list is by no means exhaustive, but should provide cursory overviews for the majority of terms encountered in the literature. They include supply chains, value chains, *filière*, global commodity chains, and global production networks.

Supply chains

Supply chains emerged when issues related to materials flow were first introduced. Since the 1990s, however, the term showed an exponential rise in popularity, along with its corresponding concept of supply chain management, introduced by consultants in the 1980s (Arshinder and Deshmukh 2008; Chen and Paulraj 2004). Among its many origins, Chen and Paulraj (2004) point to five, in particular, when explaining this trend:

- (1) the quality revolution;
- (2) notions of materials management and integrated logistics;
- (3) a growing interest in industrial markets and networks;
- (4) the notion of increased focus; and
- (5) influential industry-specific studies.

The term “supply chain”, in contrast to “value chain”, has remained a relatively unified term in use with few nomenclatural variations.

However, it has been confusingly associated with multiple definitions in its usage. Common among these definitions is the existence of an input-output structure covering a range of value-adding activities (Gereffi et al. 2001). The use of the term “supply” also carries a more specific denotation than “value”, and Sturgeon (2001) thus suggests that supply chains be confined to the set of activities that are driven by a lead firm (or firms), while value chain refers to a greater set of activities.

Value chains

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.

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 into economic geography, beginning with the works of Peter Dicken (1986), who integrated value chains into a territorial context, 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 the 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. Global commodity chains add yet another contributing “chain” based concept, which in turn was built from the legacy of world-systems theory.

Many of these multiple concepts, terms, and their respective practitioners came together at a conference in 2000 in Bellagio, Italy to communicate and unify their research under the value chain umbrella (Bair 2005). Since then, the value chain field has seen significant advancement from the works of Gary Gereffi, Timothy Sturgeon, Raphael Kaplinsky, John Humphrey, and Hubert Schmitz in the areas of industrial organisation and economic sociology (Kaplinsky 2000, 2004).

With the consolidation of value chain efforts, the definition of value chains found in the literature has been very consistent over the past decade. A value 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). Furthermore, when these value chains span enterprises in more than one country, they are termed “global value chains” (Kaplinsky 2000).

Global production networks

Henderson et al. (2002) define global production networks as “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, clusters, and actor-network theory.

The most recent and relevant of these is Gereffi’s concept of the global commodity chain. The “Manchester School” of researchers, 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. Together, 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 done 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: 1).

Global commodity chains

Global commodity chains (GCCs) are defined as “sets of inter-organizational networks clustered around one commodity or product, linking households, enterprises, and states to one another within the world-economy. These networks are situationally specific, socially constructed and locally integrated, underscoring the social embeddedness of economic organization” (Henderson et al. 2002; Gereffi 1994). GCCs are distinct from the early value chain concept in their explicit international dimension and focus on governance structure within the chain. Governance in GCCs is characterised as either producer-driven or buyer-driven, and acknowledges the significant influence that lead firms exert on the structure and operations of the rest of the chain (Gereffi et al. 2001; Kaplinsky and Morris 2002).

The GCC concept was developed in the mid-1990s by Gary Gereffi and Miguel Korzeniewicz, along with Dieter Ernst, John Humphrey, and Hubert Schmitz, among others. The concept was heavily influenced by Wallerstein’s world-system framework and the structuralist and dependency paradigms of the 1970s and 1980s.

GCCs are an attempt to render these paradigms operational in order to understand modern forms of industrial organisation. In taking a global network approach, GCCs include a comprehensive range of organisations and elements significant to economic and social development. By rising above state-centric analysis to recognise the significance of inter firm networks and corporate power, GCCs have enabled analysis that reveals previously unrecognised restrictions on firm development and, by correlation, economic and social development.

The studies have provided insights into a wide range of issues, including upgrading, market expansion, and trade patterns, as well as industries, such as footwear, garments, electronics, horticulture, and tourism. Furthermore, the analysis produces prescriptive results that hold value for policy formulation (Henderson et al. 2002; Hess and Yeung 2006; Gereffi, Humphrey, and Sturgeon 2005).

The GCC concept does encounter some criticism, particularly from global production network research, which attempts to build on the GCC concept. First is the high level of aggregation found in GCCs, both in geography, which is split between core and periphery, and governance, which is split into buyer-driven and producer-driven chains. In addition, the latter split is acknowledged to be representative of some empirical realities, but is not necessarily universally applicable. Secondly, the emphasis on the role of inter-firm governance is seen to come at the expense of overlooking the significance of institutions and other external governance factors in GCCs. Thirdly, GCCs do not take into account path dependencies and firm ownership in their analysis. Finally, the perspective carried forth in GCCs attribute firm trajectories largely as a result of the exogenous network environment, and gives little credit to independent, endogenous firm efforts (Hess and Yeung 2006; Henderson et al. 2002).

Filière

Filière, meaning “thread” in French, is a concept very similar to value chains that originates from the French literature. The concept analyses production as the flow of goods and services across a system of agents (Kaplinsky and Morris 2002; Henderson et al. 2002).

The concept was first developed by French scholars in the 1960s and 1970s to understand the economic processes within production and distribution, and to map commodity flows across agents and activities. Early studies focused on the structure of French agriculture, and were applied to agricultural policy and then industrial policy in the 1980s. More recent work integrates an element of political economy in its considerations of public institutions. (Kaplinsky and Morris 2002; Gereffi et al. 2001).

Kaplinsky and Morris (2002) and Henderson et al. (2002) identify some differences in the *filière* concept, in that the time and international dimensions are lacking, being focused on static domestic scenarios, with its emphasis on the role of large firms and state institutions (if this infers a critique based on the lack of SME coverage, much the same could be said about SCM, too).

2.1.2 The firm perspective

Among the many descriptions referring to the interconnected nature of firms today, we choose to proceed with “supply chains” for two reasons: (1) it best represents the firm’s perspective in the complex system dynamics of the international economy, and (2) it is the term of choice for the majority of business-relevant research, such as management science and operations research.

In their seminal paper, Mentzer et al. (2001) merges preceding definitions of a supply chain to produce the following: “a supply chain is defined as a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.” For the purposes of this chapter, this is also the definition we adopt moving forward.

2.1.3 Conceptualising supply chains

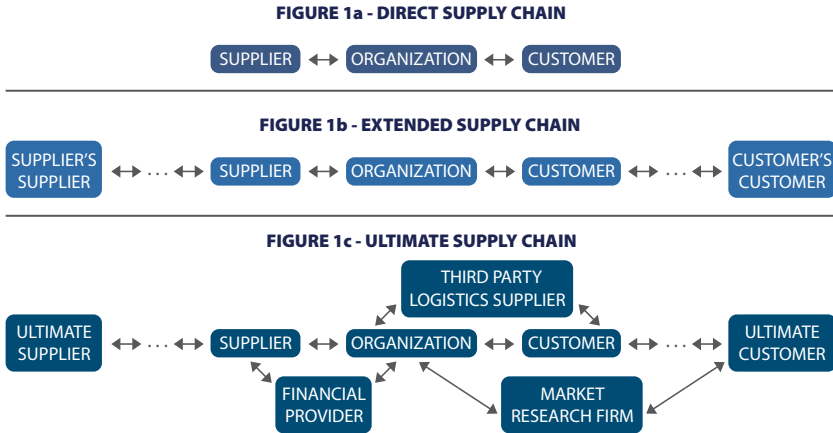
In studying the supply chain, one constantly encounters the methodological challenge of defining boundaries among the many interconnections of a network. Mentzer’s definition is purposefully open-ended in allowing as many actors as may exist in between the focal firm and the ultimate source/consumer.

Whereas early conceptions of the supply chain focused on the flow of goods from supplier to manufacturer, distributor, and end user, supply chains are now recognised as covering the dirt to dirt source of earliest supply to end consumption (Cooper, Lambert, and Pagh 1997). Furthermore, Mentzer et al. (2001) point out that “any one organization can be part of numerous supply chains. Wal-Mart, for example, can be part of the supply chain for candy, for clothing, for hardware, and for many other products. This multiple supply chain phenomenon begins to explain the network nature that many supply chains possess. For example, AT&T might find Motorola to be a customer in one supply chain, a partner in another, a supplier in a third, and a competitor in still a fourth supply chain.” In order to handle such complexities, some basic typologies of supply chains have been proposed. These typologies classify supply chains according to either organisational or functional scope.

The organisational scope of supply chains begins by classifying according to degrees of separation from the focal firm (Figure 2.1). A “direct supply chain” encapsulates the focal firm and its immediate suppliers and customers. An “ultimate supply chain” includes all the organisations involved upstream and downstream relative to the focal firm until the

ultimate supplier(s) and ultimate consumer(s) is reached. Anything in between the direct supply chain and ultimate supply chain in scope can be referred to as an “extended supply chain” (Mentzer et al. 2001).

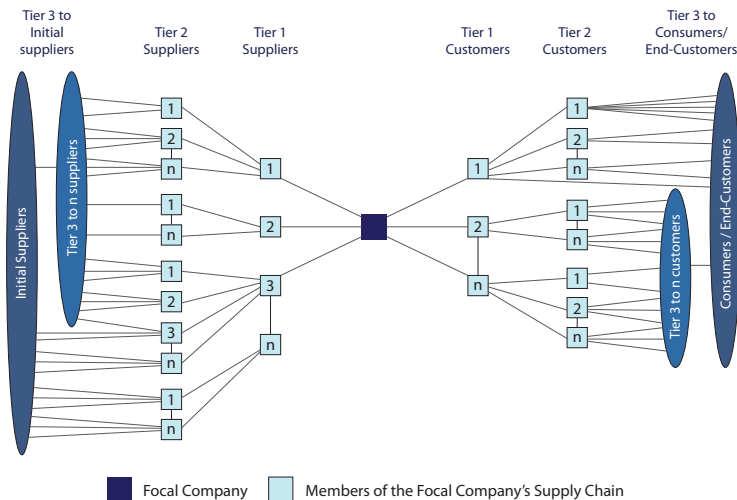
Figure 2.1: Classification of the organisational scope of supply chains



Source: Mentzer et al. (2001)

The nature of the organisation is also classified as either primary or supporting. Primary organisations directly add value to the specific output to be consumed. Supporting organisations add value indirectly by supporting the primary organisations. In addition, organisations can be grouped according to the number of degrees of separation from the focal firm, such as the “Tier 1” and “Tier 2” groupings in Figure 2.2.

Figure 2.2: Organisational tiers based on degrees of separation in the supply chain



Source: Lambert and Cooper (2000)

The number of tiers describes the horizontal structure of the supply chain, which may be long or short. The vertical structure of the supply chain refers to the number of organisations within each tier. These allow some orientation of the organisation within the supply chain, such as in describing the horizontal position of the focal firm relative to the ultimate supplier or customer (Lambert and Cooper 2000).

The supply chain also has a functional scope. This covers the business processes that span the supply chain, and can cover functions as varied as marketing, product development, customer service and operations (Arshinder and Deshmukh 2008; Cooper, Lambert, and Pagh 1997).

Whereas no standard template of business functions is found, the processes undertaken can be classified as one of four types: a managed process link, a monitored process link, a not-managed process link, or a non-member process link.

A managed link is critical to the focal firm, whereas a monitored link may only require auditing or little intervention. Not-managed links are not critical enough to require attention and/or are trusted by the focal firm to independently deliver. Finally, non-member process links are with organisations in other supply chains that still influence the performance of the supply in question, such as when a supplier works with the focal firm's competitor (Lambert and Cooper 2000).

2.2 Supply chain management

2.2.1 A brief history

Birth of the idea

The origins of supply chain management are not exactly known, but there is general reference to its introduction by consultants in the early 1980s. In the decades since, it has received considerable attention, initially starting within the business community. From the early 1990s, academic research started following supply chains and tried to establish some theoretical structure (Cooper, Lambert, and Pagh 1997; Lambert and Cooper 2000; Croom, Romano, and Giannakis 2000).

SCM's antecedents

Part of the reason the start of supply chain management is difficult to pin down is because of its many antecedents. These include channels research in the 1960s on managing inter-organisational operations, systems integration research in the 1960s, and information sharing in the 1980s.

Forrester is commonly cited for introducing key ideas on industrial dynamics, physical distribution, and transportation in the late 1950s and early 1960s (Mentzer et al. 2001; Croom, Romano, and Giannakis 2000; Cooper, Lambert, and Pagh 1997). In fact, Mentzer et al. (2001) start their paper with the following citation from 1958 that very much foreshadows supply chain management today: "Management is on the verge of a major breakthrough in understanding how industrial company success depends on the interactions between the flows of information, materials, money, manpower, and capital equipment. The way these five flow systems interlock to amplify one another and to cause change and fluctuation

will form the basis for anticipating the effects of decisions, policies, organizational forms, and investment choices.” (Forrester 1958, p. 37).

Drivers

This variety of antecedents and approaches is not surprising, however, as the 1960s and onwards witnessed significant shifts in industrial organisation in the international economy. Many fields were documenting the phenomenon that we now refer to as supply chains. Before examining the variety of fields, however, we look at the drivers of this structural shift.

The introduction of Manufacturing Resource Planning in the 1970s drove a transition from the economies of scale and mass production philosophy to the superior just-in-time (JIT) and flexible specialisation production philosophy. JIT is a demanding philosophy to implement, however, with rigorous requirements on speed, minimal inventory, and consistency. Furthermore, international labour arbitrage through global sourcing enabled lower costs but introduced firms to a new world of operational challenges. Faced with the challenge of coordinating an increasingly complex influx and outflow of materials, firms began to realise the importance of buyer-supplier relationships.

Concurrently, intense global competition in the 1980s expanded the new competitive requirements in cost to time and quality, as well. This necessitated improved downstream coordination with suppliers and distributors, and spurred research efforts in integrated transportation and logistics management. Combined, these factors gave rise to the popularity of supply chain management and its establishment as an academic discipline (Mentzer et al. 2001; Tan 2001).

Plurality of disciplines and terms

Efforts to research the rising supply chain phenomenon came from a plethora of firm-oriented disciplines. In an effort to categorise these, we distinguish between function-oriented and organisation-oriented disciplines. Amongst the function-oriented disciplines are purchasing and supply literature, logistics and transportation, and marketing. In the organisation-oriented disciplines, we find industrial organisation, transaction cost economics, institutional sociology, and systems dynamics, among others (Croom, Romano, and Giannakis 2000; Tan 2001; Melo, Nickel, and Saldanha-da-Gama 2009).

As a result, a wide variety of terms relating to the supply chain concept have also arisen over the past few decades. These include network sourcing, supply pipeline management, demand chain management, value chain management, and value stream management. They can be found in discussions amongst academics, consultants, or business management. (Croom, Romano, and Giannakis 2000). Of these, the purchasing/supply and logistics/transportation literature were the most prevalent with business, and out of the many terms, supply chain management rose in recognition.

Consolidation

The rise of supply chain management by the late 1980s and its embodiment of so many concepts resulted in a problem of definitions in the 1990s. Literature from this period laments

that the term is used so often that the meaning is lost (Tan et al. 1998a; New 1997; La Londe and Masters 1994; Tan 2001; Davis 1993; Ross 1998; Mentzer et al. 2001).

Moreover, SCM was only increasing as a concept of real relevance and as a popular topic (Cooper, Lambert, and Pagh 1997; La Londe 1997; Mentzer et al. 2001). The late 1990s gave rise to the recognition that clear definitions and conceptual frameworks on SCM were needed (Saunders 1995, 1998; New 1995; Cooper, Lambert, and Pagh 1997; Babbar and Prasad 1998; Croom, Romano, and Giannakis 2000).

This period saw much consolidation and maturation of SCM as a theoretical construct. For example, whereas the Council of Logistics Management viewed SCM as a type of inter-firm logistics in 1986, they revised their definition in 1998 to declare logistics management as a subset of SCM.

Other fields, such as operations research, may have started their investigations of the supply chain phenomenon independently, but then merged their efforts into SCM afterwards (Lambert and Cooper 2000; Melo, Nickel, and Saldanha-da-Gama 2009). This consolidation culminated by the late 1990s and early 2000s with the seminal works of Cooper, Lambert, Mentzer, and their associates (Cooper, Lambert, and Pagh 1997; Lambert, Cooper, and Pagh 1998; Lambert and Cooper 2000; Mentzer et al. 2001).

2.2.2 The supply chain management framework

SCM as a management framework is now at a stage where the definitions, subject, purpose, and perspective are largely unified. These common grounds emerged from the multidisciplinary sources of SCM, and researchers have leveraged these commonalities to consolidate the plurality of frameworks on SCM. However, there is still variance when it comes to the operational concepts and, correspondingly, the operational implementation of SCM. We review some of the most widely cited unifying frameworks of SCM.

Stadtler (2005) and Mentzer et al. (2001) both present definitions of SCM that integrate the many found in their respective literature reviews:

“Supply chain management (SCM) is the task of integrating organizational units along a SC and coordinating materials, information and financial flows in order to fulfil (ultimate) customer demands with the aim of improving competitiveness of the SC as a whole.” (Stadtler 2005).

“...supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.” (Mentzer et al. 2001).

These definitions and their predecessors view the target subject of SCM as the supply chain, consisting of two subcomponents: (1) the organisations that make up the structure of the supply chain, and (2) the processes that make up the flows across the supply chain. The purpose of SCM is to increase competitiveness of the supply chain through improved customer service. The perspective is unequivocally network-based, attaching significance not only to the firm’s “nodes” that compose sectors of the international economy, but also to the relationships between those nodes.

As Burgess, Singh and Koroglu (2006) note, the operational concepts in SCM tend to be classified into general categories or constructs. We present our selection of these classifications in reverse chronological order in order to start with a recent example and then show the patterns of inheritance across predecessors (Table 2.1).

Table 2.1: Classification of operational constructs for supply chain management

SCM operational constructs		
Burgess, Singh, and Koroglu (2006)	soft constructs	<i>leadership</i>
		<i>intra-organisational relationships</i>
		<i>inter-organisational relationships</i>
	hard constructs	<i>logistics</i>
		<i>process improvement orientation</i>
		<i>information systems</i>
<i>business results and outcomes</i>		
Stadtler (2005)	integration of organizational units	<i>choice of partners</i>
		<i>network of organisations</i>
		<i>leadership</i>
	coordination of flows	<i>information and communication technology</i>
<i>process orientation</i>		
		<i>advanced planning</i>
Chen and Paulraj (2004)	environmental uncertainty	
	customer focus	
	top management support	
	supply strategy	<i>competitive priorities</i>
		<i>strategic purchasing</i>
	information technology	
	supply network structure	
	managing buyer-supplier relationships	<i>supplier base reduction</i>
		<i>long-term relationships</i>
		<i>communication</i>
<i>cross-functional teams</i>		
	<i>supplier involvement</i>	
logistics integration		
supply chain performance measurement	<i>supplier performance</i>	
	<i>buyer performance</i>	
Mentzer et al. (2001)	integrated behavior	
	mutually sharing information	
	mutually sharing risks and rewards	
	cooperation	
	the same goal focus on serving customers	
	integration of processes	
	long-term relationships with partners	
Lambert and Cooper (2000)	physical and technical components	<i>planning and control</i>
		<i>organizational structure</i>
		<i>product flow facility structure</i>
		<i>information flow facility structure</i>
	managerial and behavioral components	<i>management methods</i>
		<i>power and leadership structure</i>
		<i>risks and rewards</i>
	<i>culture and attitude</i>	

Underlying the various classifications is a fundamental body of operational issues that is closely shared across the classifications. Variance is found, however, in the terminology and framing of the issues. The true test, then, of the validity of the varying classifications will be in their explanatory ability in the academic setting or their prescriptive utility in the operational setting. For this, further empirical studies are needed to test and refine the various operational constructs proposed.

2.3 Future directions

While supply chains and supply chain management have made significant progress in maturing as its own field or paradigm of thought, the state of the literature is in need of empirical research to test and refine the new theories born in the past decade. As Lambert and Cooper (2000) note, supply chain management theory tends to follow, rather than inform, business practice. Empirical research would enable progress on the prescriptive works that will ultimately define the literature's utility to the business practitioner and narrow the divide between theory and application.

Figure 2.3: Articles concerning the supply chain

	PRESCRIPTIVE	DESCRIPTIVE
THEORETICAL	6%	11%
EMPIRICAL	27%	56%

Source: Croom, Romano, and Giannakis (2000)

In terms of the specific paths of theoretical development, two approaches have been observed and are expected to continue.

The first is to fragment the breadth of supply chain management issues into more manageable portions, and then to develop theory in relation to that specific issue. Examples of this can be seen in the emergence of sustainable supply chain management (SSCM) and supply chain risk management (SCRM).

The second approach is to retain a broad conceptual stance and to integrate the theories being developed from many different perspectives. This is the approach taken in Mentzer

et al. (2001) and Lambert and Cooper's (2000) foundational works. Both will be required to recursively drive the theoretical development of supply chain management.

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