Managing financial risk in supply chain networks

By Thomas K. Dasaklis

- Introduction
- Pricing and revenue management in supply chain
- Financial risks in supply chain networks
- Managing financial risk in supply chains
- Case study: Hanjin's Bankruptcy

Introduction

The loss of supplier capacity (sourcing risk) due to undetected financial problems that result in a bankruptcy filing is a substantial threat to supply chain effectiveness.

Since interactions among supply chain members on material, information and capital are becoming increasingly intensive, financial status of a firm in a supply chain depends not only on its own management, but also on the decisions and business behavior of the rest of the supply chain members.

Pricing and revenue management in supply chain

- Revenue management is the use of pricing to increase the profit generated from a limited supply of supply chain assets
- Supply assets exist in two forms: capacity (production, transportation, storage) and inventory (product availability)
- Revenue management may also be defined as the use of differential pricing based on customer segment, time of use and product or capacity availability to increase supply chain profits
- The most common example is airline pricing

Pricing and revenue management in supply chain

The Sales-Cost Saving Connection

For example, if cost is 90% of sales, and the profit margin is 10% of sales, a $100 cost saving is equivalent to sales of $1,000.

Sales = Cost Saving (profit) ÷ Profit Margin

Sales = $100 ÷ 0.10

Sales = $1,000

Pricing and revenue management in supply chain

- A firm should first use pricing to achieve balance between supply and demand and only then invest in or eliminate assets
- For example, a transportation company could:
  - Charge a lower price to customers willing to commit their orders well in advance and higher price to those looking for transportation capacity at the last minute
  - Charge a lower price to customers with long terms contracts and higher price to those looking for transportation capacity at the last minute
  - Charge a lower price during periods of low demand and higher price during high demand
- American Airlines vs. PeopleExpress
- The case of Amazon

Pricing and revenue management in supply chain

Conditions Under Which Revenue Management Has the Greatest Effect

- The value of the product varies in different market segments (Example: airline seats)
- The product is highly perishable or product waste occurs (Example: fashion and seasonal apparel)
- Demand has seasonal and other peaks (Example: products ordered at Amazon.com)
- The product is sold both in bulk and on the spot market (Example: owner of warehouse who can decide whether to lease the entire warehouse through long-term contracts or save a portion of the warehouse for use in the spot market).

Pricing and revenue management in supply chain

Revenue Management for Multiple Customer Segments

- If a supplier serves multiple customer segments with a fixed asset, the supplier can improve revenues by setting different prices for each segment
- Prices must be set with barriers such that the segment willing to pay more is not able to pay the lower price
- The amount of the asset reserved for the higher price segment is such that the expected marginal revenue from the higher priced segment equals the price of the lower price segment

Pricing and revenue management in supply chain

Revenue Management for Perishable Assets:

- Any asset that loses value over time is perishable
- Examples: high-tech products such as computers and cell phones, high fashion apparel, underutilized capacity, fruits and vegetables
- Two basic approaches:
  - Vary price over time to maximize expected revenue (dynamic pricing)
  - Overbook sales of the asset to account for cancellations
- Dell uses revenue management (cycle of two weeks)

Pricing and revenue management in supply chain

Revenue Management for Perishable Assets:

- Overbooking or overselling of a supply chain asset is valuable if order cancellations occur and the asset is perishable
- The level of overbooking is based on the trade-off between the cost of wasting the asset if too many cancellations lead to unused assets and the cost of arranging a backup if too few cancellations lead to committed orders being larger than the available capacity

Pricing and revenue management in supply chain

Revenue Management for Seasonal Demand

- Seasonal peaks of demand are common in many supply chains
- Examples: Most retailers achieve a large portion of total annual demand in December (Amazon.com)
- Off-peak discounting can shift demand from peak to non-peak periods
- Charge higher price during peak periods and a lower price during off-peak periods
- Hotel industry: the goal is not only to shift demand but to increase demand during low-demand periods by attracting price-sensitive customers (the case of Marriot Corporation).

Pricing and revenue management in supply chain

Revenue Management for Bulk and Spot Customers

- Most consumers of production, warehousing and transportation assets in a supply chain face the problem of constructing a portfolio of long-term bulk contracts and short-term spot market contracts
- The basic decision is the size of the bulk contract
- The fundamental trade-off is between wasting a portion of the low-cost bulk contract and paying more for the asset on the spot market

Financial risks in supply chain networks

- Price and cost risk
- **Financial strength of supply chain partners**
- Financial handling and practice
- **Exchange rate risk**

Financial risks in supply chain networks

- Supply chain disruptions are significant events for any firm.
- A study investigated the long-term stock price effects and equity risk effects of supply chain disruptions based on a sample of 827 disruption announcements made during 1989-2000.
- Over this time period the average abnormal stock returns of firms that experienced disruptions is nearly -40%.
- Much of this underperformance is observed in the year before the announcement, the day of the announcement and the year after the announcement.
- Furthermore, evidence indicates that firms do not quickly recover from the negative effects of disruptions.
- Equity risk (volatility) of the firm significantly increases around the announcement date (Hendricks and Singhal, 2005).

Financial risks in supply chain networks: Exchange rate risk

Although offshore outsourcing can provide significant cost reduction opportunities, it also exposes supply chain firms to foreign exchange risk.

For example, a study conducted by The Economist, which surveyed 500 global company executives with responsibility for risk management, showed that in 2009 exchange rate uncertainty was ranked as the second most important risk factor next to demand uncertainty due to the economic recession (Liu and Nagurney, 2011).

Financial risks in supply chain networks: Exchange rate risk

Despite rising sales revenues, BMW was conscious that its profits were often severely eroded by changes in exchange rates.

The company's own calculations in its annual reports suggest that the negative effect of exchange rates totaled €2.4bn between 2005 and 2009.

BMW did not want to pass on its exchange rate costs to consumers through price increases. Its rival Porsche had done this at the end of the 1980s in the US and sales had plunged (Financial Times, 2012).

Financial risks in supply chain networks: Exchange rate risk

The strategy:

- BMW took a two-pronged approach to managing its foreign exchange exposure.
- One strategy was to use a “natural hedge” – meaning it would develop ways to spend money in the same currency as where sales were taking place, meaning revenues would also be in the local currency.
- However, not all exposure could be offset in this way, so BMW decided it would also use formal financial hedges. To achieve this, BMW set up regional treasury centres in the US, the UK and Singapore.

Financial risks in supply chain networks: Exchange rate risk

How the strategy was implemented:

- The natural hedge strategy was implemented in two ways. The first involved establishing factories in the markets where it sold its products; the second involved making more purchases denominated in the currencies of its main markets.

- BMW now has production facilities for cars and components in 13 countries. In 2000, its overseas production volume accounted for 20 per cent of the total. By 2011, it had risen to 44 per cent.

- The company boosted its purchasing in US dollars generally, especially in the North American Free Trade Agreement region. Its office in Mexico City made $615m of purchases of Mexican auto parts in 2009, expected to rise significantly in the following years.

Financial risks in supply chain networks: Exchange rate risk

The lessons:

- By moving production to foreign markets the company not only reduces its foreign exchange exposure but also benefits from being close to its customers.

- In addition, sourcing parts overseas, and therefore closer to its foreign markets, also helps to diversify supply chain risks.

Financial risks in supply chain networks: Financial strength of supply chain partners

- The selection of a purchasing strategy is a core activity in risky environments.
- Single sourcing, a powerful approach in a stable environment, can amplify a firm's exposure to risk (e.g., supplier's default) in the presence of uncertainty.
- Multiple sourcing, however, presents higher costs due to the management of more than one supplier.
- A correct evaluation from a risk management perspective is needed.
- Possible probabilistic advantages of adopting the multiple sourcing strategy in risky environments for a specific case (Costantino and Pellegrino, 2010).

Financial risks in supply chain networks: Financial strength of supply chain partners

	Single sourcing	Multiple sourcing
ADVANTAGES	• Partnership between buyers and suppliers allows cooperation, shared benefits and long-term relationship based on high levels of trust • Reduction of risk of opportunistic behaviour • Large commitment of the supplier that is willing to invest in new facilities or new technology • Lower purchase price resulting from reduced production costs, due to better knowledge of the manufacturing process by supplier and achieved economies of scale	• Alternative sources of materials in case of delivery stoppage by a supplier • Reduced probability of bottlenecks due to insufficient production capacity to meet peak demand • Increased competition among suppliers leads to better quality, price, delivery, product innovation and buyer's negotiation power • More flexibility to react to unexpected events that could endanger supplier's capacity
DISADVANTAGES	• Great dependency between the buyer and the supplier • Increased vulnerability of supply • Increased risk of supply interruption, especially for asset specific products	• Reduced efforts by supplier to match buyer's requirements • Higher costs for the purchasing organization (greater number of orders, telephone calls, records, and so on)

Financial risks in supply chain networks: Financial strength of supply chain partners

- With the increasing interdependence among supply chain members, bankruptcy of a supply chain member may be caused by operational decisions of other members.
- Firms should investigate how bankruptcy occurs and propagates in supply chain networks:
  - horizontal competition among retailers
  - order allocation strategies of retailers
  - wholesale price of manufacturers
  - characteristics of market demand and number of retailers
- Since many operational decisions of a firm are made under financial constraints, the linkage between firm's operational risks and financial decisions (e.g., the maximal risk of cash flow that a member is willing to take, and the up-front payment proportion of retailers in a two-period payment policy) should also be investigated.
- Experimental results reveal that operational interactions between supply chain members and operational decisions made by supply chain members are important causes of bankruptcy propagation, but impacts of these operational parameters and decisions depend on financial decisions. These observations indicate that supply chain members can moderately hedge their operational risk through financial decisions (Hua, Sun et al., 2011).

Financial risks in supply chain networks: Financial strength of supply chain partners

- Common ways to mitigate the detrimental consequences of supplier bankruptcies are to install redundancy and to pursue a multiple-sourcing strategy.
- This is based on the assumption that the adverse event of one supplier going out of business is largely independent from the default of other suppliers.
- However, this implicit assumption does not hold in all cases.
  - default dependencies among suppliers do often exist and can have significant consequences.
  - managers should analyze their supplier portfolios with respect to default dependencies and to take this phenomenon into consideration when making sourcing decisions (Wagner, Bode et al., 2009).

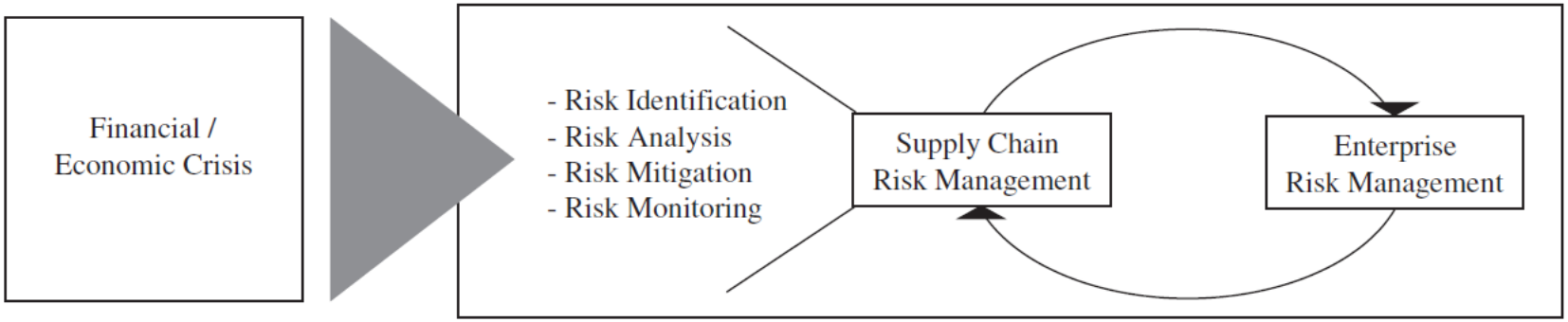
Financial risks in supply chain networks: Financial strength of supply chain partners

- A critical 105-year-old automotive interior supplier filed for bankruptcy, making General Motors' worst nightmare a reality.
- Clark-Cutler-McDermott (CCM), a Massachusetts-based GM supplier, makes approximately 175 parts for GM and relies on the automaker for more than 80% of its revenue.
- Fortunately, GM has lined up companies to replace CCM, but it will still take time to requalify a new supplier.
- Had GM not been able to quickly secure tooling and finished parts from another supplier, the bankruptcy would have left massive cost implications, with losses likely ending up in tens of millions.
- As the aftermath of CCM's bankruptcy filing continues to unfold, we can learn lessons for managing critical suppliers (Spend Matters Network 2016).

Managing financial risk in supply chains

- Diversify Suppliers
- Switch Suppliers
- Stock Up
- Pre-Pay
- Invest in the Supplier

Managing financial risk in supply chains



- Supply chain coordination
- Manufacturing firms have adjusted their SCRM to a larger extent in the financial crisis.
- One can observe that service firms are mainly influenced by the financial crisis on the demand side, whereas manufacturing firms are affected by the demand and the supply side (Blome and Schoenherr, 2011).

Case study: Impact of Hanjin Bankruptcy

Case study: Impact of Hanjin Bankruptcy

- **Hanjin Shipping Co. Ltd** was a South Korean integrated logistics and container transport company.
- This was seen as the largest de facto bankruptcy in the industry, as Hanjin was the seventh largest shipping line with a global capacity of 609,500 TEUs (twenty-foot equivalent unit) across 98 container vessels (with an estimated daily shipping of 25,000 containers).
- Hanjin served 60 routes in 35 countries, connecting more than 90 major ports and 6,000 destinations around the globe.
- Prior to it's financial demise, Hanjin Shipping was South Korea's largest container line and one of the world's top ten container carriers in terms of capacity.
- In August 2016, the company applied for receivership.

Case study: Impact of Hanjin Bankruptcy

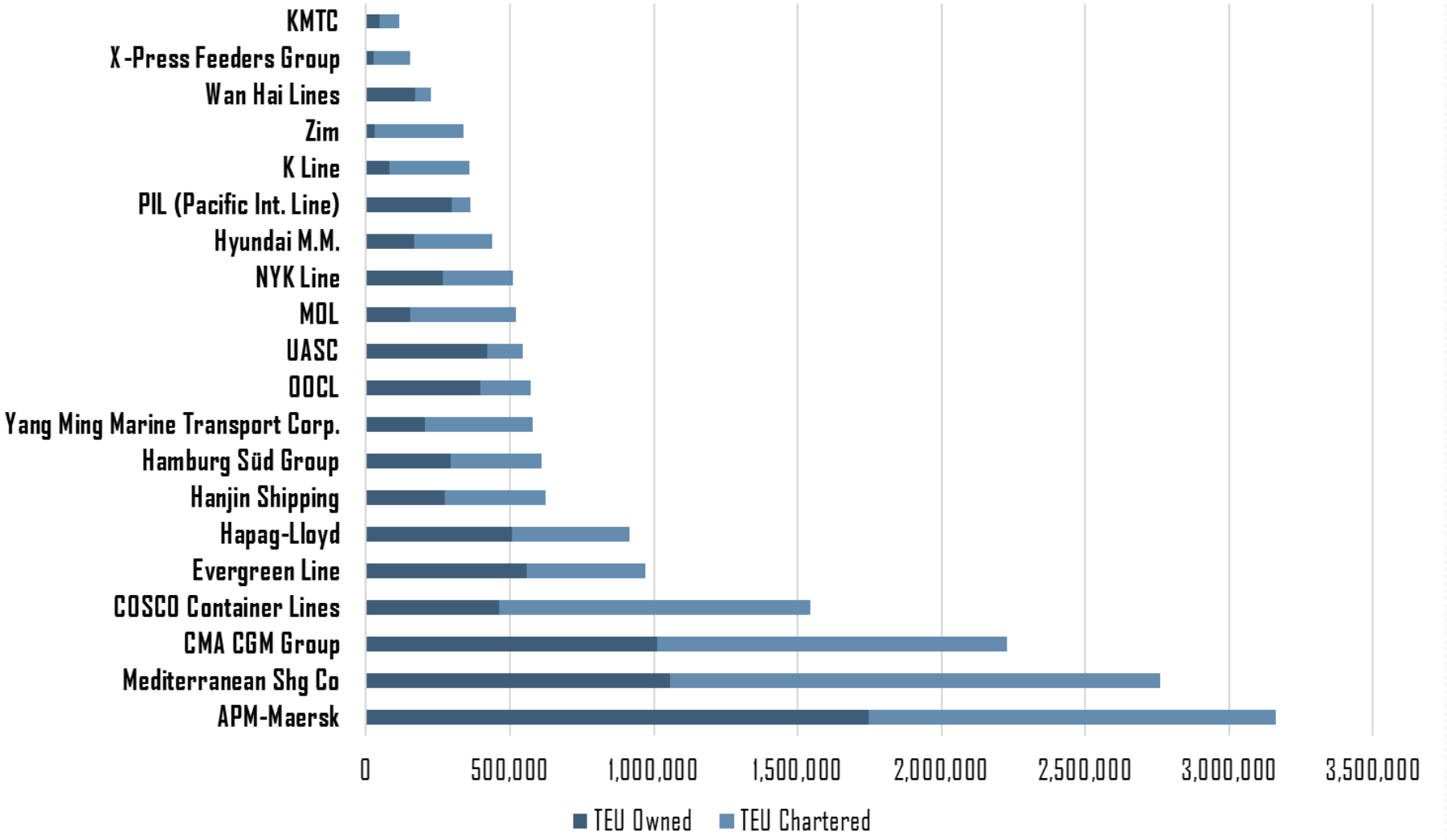
- On February 17, 2017, Hanjin Shipping Co. was declared bankrupt by South Korean courts
- In February 2017, SM Line, a new shipping firm formed by Samra Midas (SM) Group, purchased five vessels previously owned by Hanjin.
- In March 2017, SM Line acquired two of Hanjin Shipping's terminals in Korea, in the cities of Gwangyang and Incheon.
- In August 2017, a South Korean bankruptcy trustee which was appointed to manage the liquidation of Hanjin Shipping, reported that it had only collected 220 million USD from the sale of Hanjin's assets. This sum amounts to only 2% of the 10.5 billion USD total debt Hanjin owed to its creditors.

Case study: Impact of Hanjin Bankruptcy

Services:

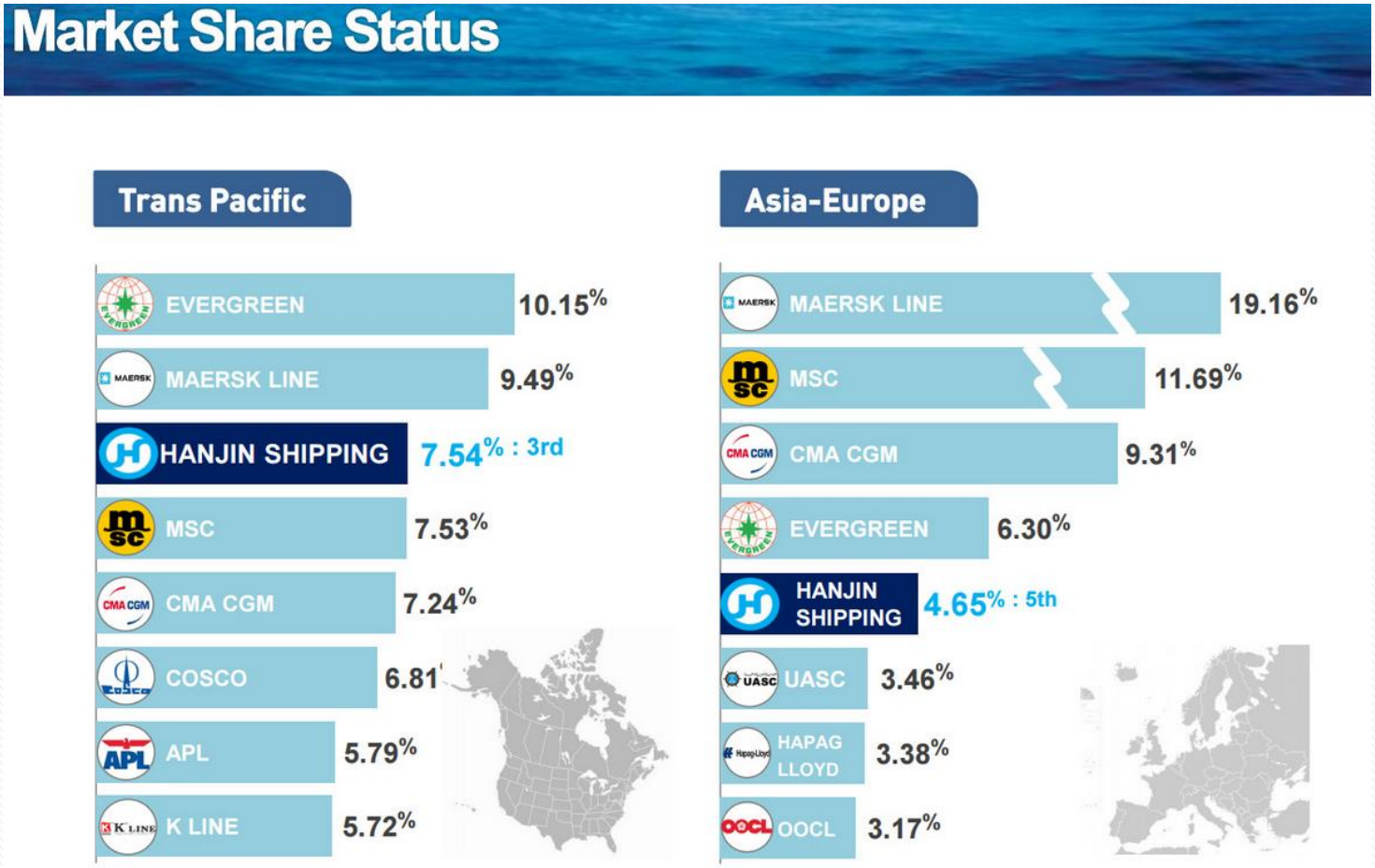
- **Container** – Transported approximately 3.7 million TEU containers a year. This service consisted of 24 container ships which allowed for this service to produce such an output per year. In 2010 the South Korean shipping company was the first to introduce a 10,000 TEU class carrier ship, which travels between Asia and Europe.
- **Bulk** - This division of the shipping company delivered a variety of resources and raw materials through its 'contract of affreightment' with other companies. The division's ships were LNG and VLCC ships which carried crude oil and chemicals.
- **Terminal** – The shipping terminals for this company were distributed internationally. There were fourteen dock yards that this company owned: four in Korea, two in the United States of America, two in Japan, and the rest in Spain, Taiwan, Vietnam and Belgium.

Case study: Impact of Hanjin Bankruptcy



Containership Capacity of the World's 20 Largest Shipping Lines, September 2016. Source: Alphaliner.

Case study: Impact of Hanjin Bankruptcy



Case study: Impact of Hanjin Bankruptcy

Port	Terminal (Annual Capacity in TEU)	Stake
Busan	Hanjin Gamman Terminal (700,000 TEU)	100%
Busan	Busan NewPort (2.5M TEU)	100%
Busan	Pusan Newport International Terminal (2M TEU)	40%
Gwangyang	Hanjin Kwangyang Container Terminal (600,000 TEU)	100%
Gwangyang	Korea International Terminal Gwangyang (2.4M TEU)	5%
Incheon	Gimpo Terminal (200,000 TEU)	100%
Incheon	Gyeong-In Terminal (300,000 TEU)	100%
Incheon	Pier 4 (150,000 TEU)	100%
Incheon	HanJin Incheon Container Terminal (1.2 M TEU)	100%
Pyeongtaek	Pyeongtaek Container Terminal (1M TEU)	25%
Kaohsiung	Hanjin Kaohsiung Container Terminal (1.5M TEU)	60%
Osaka	Hanjin Terminal (300,000 TEU)	60%
Tokyo	Aomi Container Terminal A-3 (500,000 TEU)	60%
Saigon	Tan Cang-Cai Mep International Terminal (1.1 M TEU)	20%
Algeciras	Total Terminal International Algeciras (1.5M)	30%
Long Beach	Total Terminals International (3.3M)	35%
Seattle (SeaTac)	Total Terminals International (500,000 TEU)	35%
Antwerp	Antwerp International Terminal (500,000 TEU)	14%
Rotterdam	Euromax Terminal (2.5M TEU)	12%

Container Terminals where Hanjin has a Stake (as of 2015) (Source: Adapted from Drewry Shipping Consultants)

Case study: Impact of Hanjin Bankruptcy

Chronicle of the bankruptcy

- In April 2016, Hanjin applied to its creditors for debt restructuring, in order to avoid formal insolvency proceedings.
- On August 31, 2016, Hanjin filed for bankruptcy protection at the Seoul Central District Court and requested the court to freeze its assets, after losing support from its banks the previous day.
- Hanjin vessels were experiencing access issues to ports globally. Ports and other firms were demanding arrears and prepayments before providing services to Hanjin vessels.
- On September 2 Hanjin Shipping Co. filed papers in U.S. Bankruptcy court in Newark, New Jersey that would allow its vessels to dock without its ships, cargo or equipment being confiscated by creditors.

Case study: Impact of Hanjin Bankruptcy

A snapshot of the crisis one week after the bankruptcy:

- 43 Hanjin ships were en route to scheduled destinations with no guarantees that they would be allowed to unload. 39 more were circling or anchored outside ports. Eight ships have been seized by creditors.
- Meanwhile, in addition to the stranded cargo, there were other more pressing problems: "Our ships can become ghost ships," said Kim Ho Kyung, a manager at Hanjin Shipping's labor union.
- "Food and water are running down in those ships floating in international waters." As a result, The company started providing food, water and daily necessities to crews on six Hanjin ships anchored at ports including Rotterdam and Singapore. About 70 container movers and 15 bulk ships were stranded at 50 ports in 26 countries, according to Hanjin. One Hanjin captain operating a ship in international waters near Japan said his vessel has been given permission to enter a Japanese port Wednesday to unload cargo, but was required to head back out soon after.

Case study: Impact of Hanjin Bankruptcy

Why the bankruptcy happened?

- The financial struggles of Hanjin Shipping are attributable to an ongoing downturn in the container shipping industry that is the result of numerous interrelated factors such as:
  - weak global GDP
  - overcapacity on container vessels
  - "bloated" US retail inventories
  - changing consumer spending patterns
  - Chinese economic slowdown
  - muted demand for container shipping.

- The downturn has dented profits and crippled the financial health for the majority of the top twenty ocean carriers (Wikipedia 2016).

Case study: Impact of Hanjin Bankruptcy

Overall stress on the industry:

- Overcapacity in the shipping industry is a looming concern as shippers are introducing larger post-Panamax ships to their fleets. In 2015, more than 200 ships were added, accounting for an expansion of 1.6 million 20-foot-equivalent unit (TEUs) containers.
- This was the largest expansion since 2008, when more than 400 ships and 1.5 million TEUs were added.
- As container capacity grew, global shipping demand slowed. In the first half of 2016, global container throughput grew only 1.2 percent over the previous year, while in the U.S., loaded inbound container volume grew 3.6 percent year-over-year—well below the robust 7 percent growth rate in 2015.
- Charter rates for medium-sized container ships had dropped from around $26,000 a day in 2010 to $13,000 per day in 2015. Container rates from Shanghai to the U.S west coast had more than halved since then, from around $2,000 per 40-foot container in January 2010 to $596 per 40-foot box in August 2015.

decline in the cost that shippers can charge to move a container

Case study: Impact of Hanjin Bankruptcy

Case study: Impact of Hanjin Bankruptcy

Initial response to the bankruptcy:

- temporary chaos in the global ocean container shipping sector, with dozens of Hanjin ships and many billion dollars' worth of cargo basically held up across the world over concerns about who will pay the bills to unload the containers.
- some Hanjin vessels were arrested or seized by the line's creditors and other Hanjin vessels were ordered to stay out at sea until various bankruptcy- protection measures would have been out in place in South Korea and other parts of the world for preventing the seizure of its ships and other assets at ports.
- (China Cosco Shipping Corp., "K" Line, Yang Ming Line, and Evergreen Line), announced that they would immediately pull Hanjin vessels and containers from joint operations on all rotations and set up sub- charter agreements to ensure charter vessels continue sailing.

Case study: Impact of Hanjin Bankruptcy

Legal background:

- The 37 containerships directly owned by Hanjin were subject to the full asset seizure by creditors under bankruptcy protection, but the matter was more complex for the 62 chartered ships.
- In theory, chartered ships fully belong to the leasing company and are thus not subject to seizure, only to declined services since a terminal operator may not get paid by the company under receivership. This is a risk that many are unwilling to assume.
- However, many chartering agreements are under “bareboat” conditions where the owner gives possession of a containership to the shipping line, who assumes all the operational costs, including crew, fuel, insurance and terminal charges.
- Such chartering arrangements can be used as a form of ship financing, which could lead to legal complications in terms of if the ship was truly leased or if the chartering arrangement is a sale in disguise.

Case study: Impact of Hanjin Bankruptcy

Impact on global supply chains:

- delays
- disruptions
- additional cargo handling
- additional costs incurred
- insurance claims
- change in rates

Case study: Impact of Hanjin Bankruptcy

Delays:

- Hanjin's bankruptcy came at a time when retailers were gearing up for the fall shipping season, the busiest time of the year in advance of the holidays.
- According to Wall Street Journal Asia-based freight brokers estimated that roughly 25,0000 containers cross the Pacific Ocean on Hanjin vessels on a daily basis
- Retailers' main concern were that there were millions of dollars worth of merchandise that needed to be on store shelves that could be impacted by the bankruptcy.
- Some of it is sitting in Asia waiting to be loaded on ships, some is already aboard ships out on the ocean and some is sitting on U.S. docks waiting to be picked up.
- It is understandable that port terminal operators, railroads, trucking companies and others don't want to do work for Hanjin if they are concerned they won't get paid.

Case study: Impact of Hanjin Bankruptcy

Disruptions:

- The first stage involved a “shock” for supply chains that were using Hanjin, since services were interrupted without prior notice.
- Cargo became stuck in transit as shippers (ports, transport companies) were refusing to handle Hanjin ships since they would likely not get paid for that service.
- This was highly disruptive for supply chains because of the scale involved. The Wall Street Journal reported that about $14 billion worth of cargo was caught in transit on Hanjin ships when bankruptcy was declared.
- The freezing of shipments meant millions of dollars of merchandise destined for retail shelves was held back at ports or at sea until a resolution was reached. Serious impacts on holiday merchandise, which is often shipped months in advance.
- Because a resolution could take several months, many retailers would explore alternative shipping arrangements (other shipping companies, air, etc.) to ensure shelves are fully stocked for the busiest shopping period of the year.

Case study: Impact of Hanjin Bankruptcy

Additional cargo handling:

- Esquel Group, a Hong Kong-based manufacturer for fashion brands including Nike, Hugo Boss and Ralph Lauren, hired truckers to move four stranded containers of raw materials to its factories near Ho Chi Minh City as soon as they could be retrieved from ports in China.
- Liaoning Shidai Wanheng Co, a Chinese fabrics importer and a supplier to Marks & Spencer Group, made alternative arrangements for shipments that were scheduled with Hanjin.
- Apparel, handbags, televisions and microwave ovens are among goods stranded at sea
- Supporting Hanjin's Chapter 15 US Bankruptcy Court petition, Samsung Electronics said in a court filing that about US$38 million of its goods were on board of two Hanjin vessels off Long Beach, California. Its visual display division has parts and finished goods in 304 containers meant for its factory in Mexico, while its home appliance unit has refrigerators, washing machines, dishwashers and microwaves in 312 containers.
- the company was forced to transport alternative parts by air to help meet contractual obligations at "great costs”

Case study: Impact of Hanjin Bankruptcy

Additional costs incurred:

- for recovering abandoned cargoes and for on-carriage
- for satisfying liens asserted on cargoes by unpaid vendors of Hanjin.
- for re-booking other ships
- for handling cargo in terminals and get the containers out
- sales lost
- cost of lost time

Case study: Impact of Hanjin Bankruptcy

Change in rates:

- Cargo owners had to renegotiate the transport of their cargo with new carriers, inducing a surge in rates on routes and ports where Hanjin was providing substantial capacity.
- This lasted about one month, with the involved supply chain gradually returning to normal as the stranded cargo were reclaimed and put back on its respective supply chains.
- In terms of rates, other carriers tried to take advantage of Hanjin's problems and raised rates to those shippers looking for another way to move their goods
- Spot rates on the Transpacific and Asia- Europe routes jumped by 25%-50% in the immediate aftermaths of the announcement of Hanjin's bankruptcy filing - though it should be noted that bump came off near record low levels.
- Since the industry is in a situation of overcapacity, this will put a downward pressure on rates rather quickly as shipping lines aggressively compete to gain market share. Within three months, the shipping industry completely substituted services that were offered by Hanjin.

Case study: Impact of Hanjin Bankruptcy

Insurance claims:

- the biggest class of claims came in the form of late deliveries
- the second biggest class of claims were from cargo owners who were transporting perishable goods. For example, Alaska seafood that was being shipped from the U.S. to Asia (or vice versa) is highly prone to spoilage, and these cargo owners inevitably looked to their insurers for reimbursement if said cargo was spoiled.
- the third class of claims came from cargo owners who were forced to bear additional transshipment costs (also known as “forwarding costs”) to get their cargo to its final destination.

References

- Sunil Chopra, Peter Meindl, Supply Chain Management. Strategy, planning and operations (3rd Edition), (2006).
- Blome, C. and T. Schoenherr (2011). "Supply chain risk management in financial crises—A multiple case-study approach." International Journal of Production Economics **134**(1): 43-57.
- Costantino, N. and R. Pellegrino (2010). "Choosing between single and multiple sourcing based on supplier default risk: A real options approach." Journal of Purchasing and Supply Management **16**(1): 27-40.
- Financial Times (2012). The case study: How BMW dealt with exchange rate risk. Carmaker moved production overseas. Retrieved November 12, 2016 from https://www.ft.com/content/f21b3a92-f907-11e1-8d92-00144feabdc0.
- Hendricks, K. B. and V. R. Singhal (2005). "An Empirical Analysis of the Effect of Supply Chain Disruptions on Long-Run Stock Price Performance and Equity Risk of the Firm." Production and Operations Management **14**(1): 35-52.
- Hua, Z., Y. Sun, et al. (2011). "Operational causes of bankruptcy propagation in supply chain." Decision Support Systems **51**(3): 671-681.
- Liu, Z. and A. Nagurney (2011). "Supply chain outsourcing under exchange rate risk and competition." Omega **39**(5): 539-549.
- Spend Matters Network (2016) "The Ripple Effect of Supplier Bankruptcy: Broad and Deep. Retrieved November 12, 2016 from http://spendmatters.com/2016/07/20/the-ripple-effect-of-supplier-bankruptcy-broad-and-deep/."
- Wagner, S. M., C. Bode, et al. (2009). "Supplier default dependencies: Empirical evidence from the automotive industry." European Journal of Operational Research **199**(1): 150-161.

References

- Wikipedia. (2016). "Hanjin Shipping. Retrieved November 12, 2016 from https://en.wikipedia.org/wiki/Hanjin_Shipping."