Global Operations Sourcing Strategy: A Chinese Perspective

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We report on a survey of global manufacturing sourcing decisions that were made by multi-national companies operating in China. Based on responses from Chinese managers, the survey explored explicit sourcing and technology company decisions. The analysis provided insights into what these firms are doing with respect to global sourcing and why they are doing so. Analysis of the responses also shed light on how these decisions were made. Our results tested the validity of various arguments that have been put forward to predict or explain the pattern of global sourcing shifts that is taking place. The key takeaways from this paper are 1) the observed pattern of decision making, which can be grouped into dominant flows, indicates that re-shoring to the developed economies is not happening on a large scale and that shifting in and out of and within China is occurring with direction and reasons dependent on the particular industry, and 2) insight into the fact that that firms are evaluating complex tradeoffs when making both technology and sourcing decisions and thus a single dominant driver, such as labor cost, does not adequately explain the observed patterns.

1. Introduction:

The world today is in the midst of a period of upheaval and re-structuring of global supply chains that is leading to new sources for manufacturing and distribution for many firms. There is confusion, however, as to what is actually happening, why it is happening and the potential impact of these changes. There is anecdotal evidence which indicates that some firms are re- or near- shoring, while others continue to outsource and many have adopted new technologies. Indeed many firms are making multiple and sometimes off-setting adjustments[1]. Predictions

[1] In an informal review of corporate public announcements made in 2010-2013, we found 19 cases of outsourcing, 9 cases of near-shoring and 19 cases of re-shoring. We also found 4 cases of investment in robotics and automation.

have been made that US domestic manufacturing industries will revive. Many theories to explain such expected changes have been suggested. Often these explanations are conflicting.

In addition to the strategic importance of sourcing at the firm level, there are significant policy issues that are impacted by the global supply chain decisions made by companies. Principal among them is the issue of employment. The sourcing of manufacturing leads to the transfer of jobs and wealth among countries. In the US, for example, there has been a major loss in manufacturing employment over the past 15 years, which some hope to see reversed through wide-spread re-shoring (see Figure 1). These issues have led to a wide range of incentives and restrictions, imposed by governments on companies that operate within their jurisdiction. These policies are targeted towards increasing the level of domestic manufacturing employment and can have a major impact on company sourcing decisions.

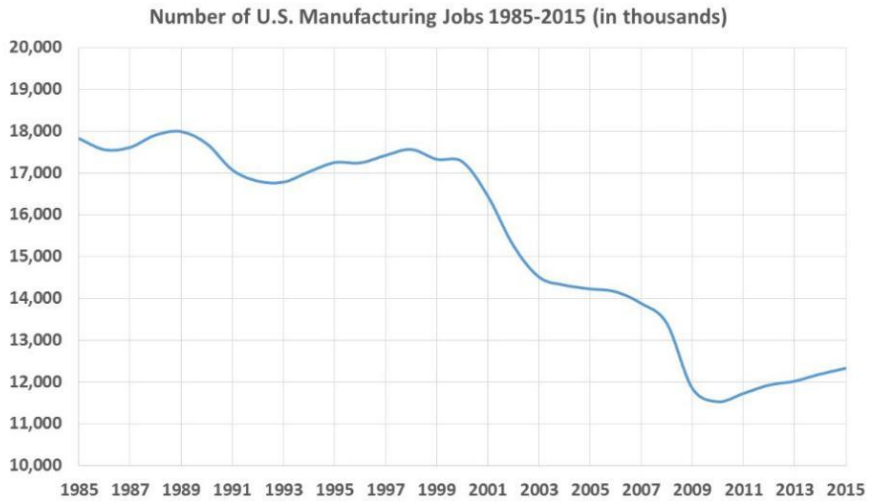

Figure 1: History of US Manufacturing Employment (Data Source: U.S. Bureau of Labor Statistics)

This paper reports on a benchmark study that was recently conducted in China to understand global supply chain sourcing and technology strategy from the perspective of companies that operate in China (both domestic and foreign headquartered). The unit of analysis in the study are the supply chain re-structuring decisions that companies have made or contemplated over the past three years. The combination of a regional (Chinese) focus and a decision specific perspective provided a detailed data base that enabled us to develop insights, into the following questions:

a. What global sourcing decisions have been made or are being contemplated?
b. Why are these decisions being made; i.e. what are the drivers of these decisions?

Analysis of the survey data also shed light on how firms are making the strategic choices associated with global sourcing and technology investment.

The principal findings of our survey as it relates to what companies are doing include the following observations:

1) Manufacturing continues to shift away from developed economies. In particular, Europe (EU 15) and North America are losing ground.
2) China is the biggest market as well as the biggest source for manufacturing in the world, and is attracting more companies who are moving into it for access to its growing market.
3) China is attracting more complex products (e.g. Equipment and Machinery and Automotive supplier industries) and is using more automation, while at the same time, China is giving up simpler, more standardized, labor intensive products, (e.g. Apparel). As a result, the net change of the number of manufacturing jobs in China, observed in our sample, surprisingly is negative.
4) Net increase in production in Central & South America and in East Europe & Russia.
5) The movement of manufacturing within China is happening selectively, i.e. only a subset of our sample reported movement of production from coastal to inland China.
6) Manufacturing jobs are not coming back to the U.S. Such jobs, however, remain in ASEAN countries (for labor-intensive, simple products) or in China (for more complex products).

Analysis of the pattern of responses to understand how and why these decisions were being made indicated the following:

1) Consistent with anecdotal evidence, firms are re-structuring their supply chains by making a wide range of sourcing and technology investment decisions.
2) Multiple and often conflicting reasons are given for making these changes which indicates that a comprehensive tradeoff and risk analysis is being carried out and that low labor cost is no longer the major reason for shifting production. In particular quality, market access and risk have emerged as important drivers.
3) Priorities on decision drivers were highly dependent on the specific choices, i.e. companies that shifted manufacturing from the EU to China indicated that labor costs, logistic costs and market access were the top 3 reasons for making this change, while companies that are shifting product out of China to other ASEAN countries stated that the top three drivers were labor costs, supply availability and product quality.

4) Overall, the pattern of sourcing changes that emerged is quite complex with significant variation observed by industry and by origin and destination of the production volume flow.

These observations support our conclusion that companies are solving the sourcing and technology choice puzzle in a manner which incorporates a wide range of global options, multiple tradeoffs and multiple resource and policy constraints.

The paper is organized as follows. Section 2 describes the benchmark survey design and methodology which is based on sourcing and technology decisions as the unit of analysis. Section 3 contains a review of the relevant literature on supply chain sourcing and strategy. Section 4 describes the sample and results at a firm / regional level and includes a discussion of current locations for manufacturing and markets. It also reviews two specific industry sub-samples to illustrate how industry results can differ from those generated at the firm level. Section 5 discusses the reported decisions to either increase or decrease production and identifies the major flow patterns that vary by source and destination. Section 6 then provides a more detailed analysis of the top 3 flow patterns and illustrates how results on drivers can vary significantly by flow. Section 7 describes results broken down by industry. Section 8 focuses on the observed internal flows within China and illustrates how our methodology can be applied to this particular geography. Section 9 reviews the results on technology investments and the impact on job creation. Conclusions are presented in Section 10.

2. Methodology and Survey Design:

To the best of our knowledge, our survey is the first study to adopt a *decision* focus within the context of a supply chain network model for global sourcing and investment. In particular we observe that global supply chains consist of a network of value adding facilities, connected by material, information, financial and decision flows. The survey asks companies to indicate if they have made any decisions (in the past 3 years), to increase or decrease the volume of production sourced from a specific geography at the particular stage within the value adding process that they are operating at. Responses can be summarized in terms of the net shift of manufacturing from one region to another. Framed in this way, we include decisions to re-shore, near-shore or off-shore on a global basis. We also asked firms to indicate if they have increased investment in automation and R&D. To conduct our analysis, we collected data at both the firm level and at the decision level.

The goal of a firm operating a global supply chain network, where the material, information and financial flows cross country borders, is to match supply with demand on a global scale. A typical objective could be to maximize global, after-tax profit or alternatively to maximize growth, market share or return on investment, (see Cohen and Lee (1989) for an example of a normative model formulation). Achieving such a goal involves a hierarchy of decisions that determine material flows, capacity and capabilities at each value-adding location. The cash flows and capital investments derived from these decisions determine the landed cost for every product/customer destination combination and impact the total cost of ownership to the customer for each product over its period of ownership and use. These costs ultimately drive market share and competitive performance for the firm.

The principal tradeoffs associated with the management of a global supply chain network include all fixed and variable costs, as well as revenues that drive global after-tax profit, along with metrics related to customer satisfaction, service and competitive position. There are multiple resource constraints based on capacity and capabilities of all value-adding processes, at all stages in the product life cycle (i.e. design, produce, fulfill, support) along with financial, trade and content restrictions imposed by each country where the firm operates as either a producer or distributor of products. Finally, there are significant risks (i.e. foreign exchange, markets, prices, suppliers, competitors, etc.) that are associated with the management of global supply chains. Indeed a primary goal of supply chain strategy is to mitigate such risks.

There is an extensive literature on modeling of global supply chains that optimizes capacity, location and technology choices that considers the factors noted above, (see Kouvelis and Su (2005) for a comprehensive survey of this literature). Based on this normative model perspective, we identified a wide range of possible drivers for re-structuring decisions that is based on tradeoffs, risks, incentives, constraints and environment factors. In particular we identified factors such as labor, transportation, material and overhead costs; market, supply and foreign exchange risk; technology; government policies; flexibility; and lead times.

Given the complexity and consequences of supply strategy decisions, we administered the survey to a sample of senior managers with an appropriate level of understanding and responsibility for supply chain strategy decisions within their company and geography. Our goal was to develop a picture of the decisions being made and the reasons for those decisions from a representative sample of global companies operating in China.

Figure 2 illustrates the overall structure of the survey instrument used in the benchmark study. We collected data both at the firm level and at the decision level which is associated with the specific supply chain decision(s) that have been made or are being contemplated. The decision level data includes characterization of the nature of the decisions that the response was based on, i.e. locations and magnitude of capacity shifts, new technology investment, etc.. We also collected data on a wide range of attributes associated with the products and processes associated with the particular decision(s). Finally, the survey gathered information concerning the firm's current supply chain structure and its competitive environment.

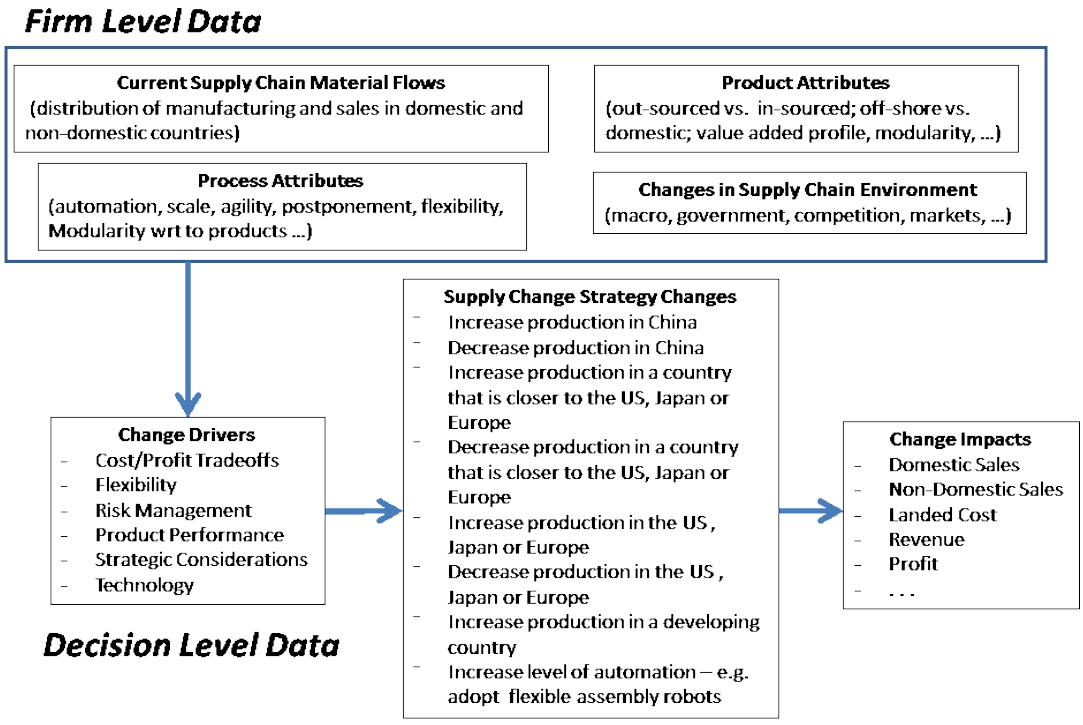

Figure 2: Survey Instrument

Our decision to adopt a decision focus in the survey was based on the following observations:

1) While firms may espouse a coherent global sourcing strategy, in fact the observed pattern of material flows, production volumes and capacity investments cuts across internal organizational boundaries and impacts multiple regional and country specific markets. As a result it is difficult to ask the question of "where are you sourcing" at the firm level. The actual sourcing policy is defined by a collection of decisions to locate and utilize sourcing options that are made by the firm for particular products and markets, e.g., Apple has re-shored some of its Mac production to the U.S., but keeps all iPhone assembly in China.

2) Global sourcing decisions are very complex and impact all facets of the company. They also have major, long-lasting strategic impacts. Thus it is typical for a business case analysis to be conducted to evaluate sourcing and strategy options based on predictions of their impact. This suggests that both drivers and expected results can be attributed to the decisions that have been made or that have been contemplated.

Our normative and decision specific perspective for evaluating the design and operations of a global supply chain gives rise to a wide range of possible drivers for the reported re-structuring decisions, that include tradeoffs, risks, incentives, constraints and environment factors. In particular we identified the following 22 possible decision drivers listed in Table 1.

Respondents were asked to rank each possible driver, on a 1 to 5 scale in terms of its impact on the particular global supply chain sourcing decision that the firm made. We note that drivers 1) through 5) correspond to different costs, drivers 6) through 13) relate to the firm's supply chain capabilities and drivers 14) through 22) can be associated with the competitive environment.

1) Labor costs	12) Time to launch a new product or re-design an existing product
2) Logistic costs, including inventory and transportation costs	13) Innovation and design capability
3) Raw material costs	14) Market changes, including growing or emerging markets and level of competition in the market, customer wishes etc.
4) Fixed costs, including costs associated with building factories, setting up production lines, and setting up robotic arms, etc.	15) Currency and foreign exchange rate volatility
5) Energy costs	16) Public infrastructure
6) Supply availability, including material resources, supplier base, etc.	17) Government incentives, including financial subsidies, tax and duty policies, free trade, local content requirements etc.
7) Quality and availability of labor inputs	18) Government regulations, including labor laws, environmental laws, local content requirements, WTO agreements, foreign currency control, etc.
8) Delivery lead-time, i.e. the time between order placement and product delivery	19) Intellectual property protection and risk
9) Supply chain flexibility, including flexibility of process to changes in product mix and scale	20) Automation and technology advances of the production process
10) Product quality, including product reliability and brand image, etc.	21) Management complexity with respect to people, information, processes, etc.
11) After sale service and support quality	22) Environmental sustainability

Table 1: Decision Drivers

Prior to administering the survey, we collected 40 cases of public announcements concerning changes in manufacturing location by well-known multinational companies. We then analyzed the main driving factors that were reported to have influenced the company production shifts. The results are listed in Table A in the appendix. We note that, 32.5% of the companies took labor costs into account. The second important factor was proximity to markets, which also was mentioned by for 32.5% of the companies. The third most mentioned factor was government incentives which occurred in 30% of the announcements. Finally the provision of service support is also an important driver, present in 17.5 % of the cases.

45% of the companies reported an increase of production in USA and the key drivers they mentioned were political incentives to increase employment and the cost of labor and transportation. All the companies that increased production in China considered the drivers of being close to the growing market in China, reducing logistics costs and facilitating the provision of support services. Companies that increased production in Southeast Asia and India, did so primarily because of labor cost. For example, Canon is no longer building or expanding factories in China, but is doubling its work force at a printer factory in Vietnam.

Several hypotheses are can be derived from these reports:

H1. Companies are shifting their production to China in order to gain access to the Chinese market.

H2. Companies are shifting their production to the USA due to government incentives.

H3. Companies are shifting their production to ASEAN because of labor cost.

H4. In general, labor cost, market proximity, and government incentives are the most important drivers for global supply chain sourcing decisions.

We note here that these hypotheses are also consistent with some of the more general findings that have been reported in the literature, which are discussed in the following section.

3. Literature Review:

There are multiple and extensive literatures that are relevant to global sourcing and global supply chain strategy that have considered the problem at a firm, industry or country level. Given the decision based perspective used in our survey, we will restrict our discussion here to a number of articles in order to provide a conceptual context for the normative modelling and empirical analysis of the question of where and how firms should source manufacturing.

Alfred Weber's work (1909) established the foundations of modern location theory, which deals with transportation and production costs (Badri, 2007). Product life-cycle theory, initiated by Vernon (1966), was first to explain the location of manufacturing globally. The theory suggests that as products mature both the location of sales and the optimal production location will change affecting the flow and direction of trade. The production location will move from the innovation country first to advanced countries and last to developing countries as products and market grow mature.

Krugman (1993) compared global manufacturing location and trade theories, concluding the two are quite similar because they ask the same basic question, i.e. who produces what goods in which locations. For example, the classical Heckscher and Ohlin model of comparative advantage in international trade theory, predicts that countries will produce and export goods that make intensive use of those factors that are locally abundant, while importing goods that make intensive use of factors that are locally scarce (Krugman and Obstfeld, 2006). Empirically, Rosen (2003) showed that China has comparative advantages over Mexico in the industries of leather, manmade woven fabric, office machines, computer equipment, electrical transmission equipment, motor cycles, and furniture.

Another closely related theory is FDI (foreign direct investment) theory, because a global location decision may lead the company make an FDI, such as open a subsidiary factory. For example, the famous eclectic paradigm of FDI theory (Dunning, 1988), analyzes international production relative to an OIL framework that includes Ownership, Internalization and Location Advantages. Empirical studies of OIL have suggested that market size, market growth, barriers to trade, production and transportation costs, political stability and regulations can be related to location decisions (Dunning, 1995). Sethi et al. (2003) developed a regression model and found that low wage rates and the liberalization of Asian economies were important factors for US-based international enterprises' FDI flow from Western Europe to Asia. Cantwell (2009) discussed the theory development of this field.

As Gray et al. (2013) stated, the re-shoring problem is a reversion of a prior offshoring decision, so the location decision is also related to the studies of manufacturing offshoring, which is the transfer of production, supply, and R&D activities from home grown to foreign locations. As stated by Davis and Naghavi (2011), "Off-shoring is seen chiefly as a cost-saving strategy for firms, who at times see it as their only means of survival". Firms have used

offshoring to reduce non-tradable production costs, particularly labor cost (Maskell etal.2007). Swenson (2004) uses data from the US Overseas Assembly Program and demonstrates country costs and sunk costs (such as entry costs) are factors in the offshore decision.

Vestring et al. (2005) suggested that "every country presents a different mix of strengths and weaknesses", and they identify several factors to decide where to offshore, include operating costs, regulatory environment, domestic markets, engineering talent, political stability, currency fluctuations, facility costs, infrastructure, and language skills. Firms may offshore to access knowledge or talent that may be difficult to find in the home country (Manning et al., 2008 and Berry and Kaul, 2015). Mann (2012) shows the important role of government trade-facilitation policies to attract locations for manufacturing.

Ellram (2013) describes the results of a survey that addresses questions of offshoring and reshoring to the U.S. Using a factor analysis, this survey identified product attributes, costs, labor, logistics, disruption risk, strategic access, country risk and government trade as drivers of location choice. Their results also indicated the increasing importance of supply chain factors in making location decisions, which is consistent with our observations. Da Silveira (2014) analyzes data from the fifth International Manufacturing Strategy Survey and indicates that design and supply offshoring effort is positively associated with the competitive importance of cost and on flexibility, but not delivery. We note, that these surveys were conducted at a firm level and thus are based on a more aggregate perspective compared to our decision focus.

As noted earlier, there is an extensive literature on normative modeling of the global supply chain design problem, (which includes plant location and product sourcing) reviewed in Kouvelis and Su (2005). A more recent discussion of this literature and a formulation of the general problem can be found in Cui and Cohen (2015).

Recently a number of competing theories have been put forward to explain and to predict how firms should make global sourcing strategy decisions. Table 2 presents a summary of these theories in terms of their basic rationale and expected impact.

Sourcing Theory	Rationale	Expected Impact
Landed Cost Serkin et al (2012)	Landed cost = fully loaded cost of producing and delivering a product to a specific end market	When landed cost advantage falls below a critical level, (i.e. the tipping point), manufacturers will re-shore to the US.

	Landed cost is a function of global supply chain strategy (sourcing of inputs, production & assembly, distribution)	China's advantage is diminishing due to the faster increase in labor costs in China. Availability of low cost energy in developed countries is affecting landed cost in energy intensive industries.
Cost of Ownership Cohen et al (2006)	Add cost of maintenance, after-sales support and disposal to the landed cost. Affected by service support strategy, warranties and product reliability.	As relative value of service over customer product life cycle increases, this cost will become more important. The delivery of service to customers may be more difficult under off-shore manufacturing.
Real Options Arnd Huchzermeier and M. A. Cohen, (1996) Kouvelis and Su (2007)	Investment in production and sourcing capacity in different countries is equivalent to the purchase of a real option. Sourcing, product mix and distribution decisions made in response to random contingencies (i.e. market demand, costs, foreign exchange, government regulation, etc.), is equivalent to the exercise of the option. The cost of acquiring the flexibility to enable switching sourcing locations is the cost of purchasing the option.	A combination of financial options and real options is required to mitigate the risks faced in a global supply chain.
Product Development and Innovation Pisano and Shih (2012)	The "Industrial Commons" is the set of common resources associated with production, R&D and support which are co-located at a particular location and which together support all firms at that location in being more productive and innovative (i.e. provides access to labor, suppliers, knowledge, etc.). All companies share the benefits and support the maintenance of the commons but none own it. Outsourcing by a firm to a different location diminishes the capability of the commons and affects all of the companies.	Outsourcing of manufacturing leads to loss of capability to develop new products & adopt new technologies

	This is especially relevant for industries where there is low level of "modularity" between manufacturing and development and where production processes are less mature	
Information Technology and Automation Brynjolfsson and McAfee (2012)	It is possible to replace direct labor for assembly with flexible automation and robots. Availability of massive data and connectivity has altered the potential for global coordination. Job opportunities for those with appropriate education and training are abundant.	Developments in information technology are driving sourcing decisions and make the impact of a labor cost advantage less important in making sourcing decisions.
Government Policy Decisions Roxburgh et al (2012)	Governments have the objective of maximizing the welfare of their citizens and wish to promote the availability of higher paid employment. Governments influence global supply chain strategy by impacting a firm's global, after-tax profit. The mechanisms available to government include tax rates and incentives, local content rules, import quotas, capital movement regulations, investment credits and investment funding, political pressure, etc.	Companies operating globally must conform to government policy requirements in every country in which they operate.
Supply Chain Risk and Disruption M. S. Sodhi, C. S Tang (2012)	A firm's capability to respond to supply chain disruptions (due to disasters, accidents or competitive actions) often require the development of new supply sources and investment in options to increase overall flexibility of the global supply chain.	The ability of a firm to mitigate supply chain disruptions is affected by a firm's global supply chain structure and capabilities and its sourcing strategy.
Developing Economies Deloitte et al (2013)	Majority of market growth is occurring in developing countries. These countries will be a major source of labor as demographic pressures continue in developed countries.	Localization of manufacturing in developing economies provides better access to these growing markets and must be included in a firm's supply chain sourcing strategy.

Table 2: Competing Theories to Explain Global Supply Chain Sourcing

4. Sample:

The survey was administered with the collaboration of the faculty at Shanghai Jiao Tong University and the Shanghai University of International Business and Economics, and was targeted to specific senior managers who have supply chain responsibility for their companies. All of the companies contacted operated global supply chains with both market and production facilities located throughout the world. The survey was conducted as a follow-up to a conference of managers that met to discuss their firm's global supply chain strategy for outsourcing, re-shoring and near-shoring. The conference was held in June of 2013 on the Shanghai campus of Jiao Tong University.

The survey was administered to each respondent either by mail or on-line. Data was checked for consistency and accuracy and there were considerable follow-up discussions with the respondents to clarify and clean the data. Respondents reported that it took about one hour for them to complete the survey, once all of the data required had been assembled. In many cases the data was provided from multiple sources within each company.

As noted that the complexity and consequences of supply strategy decisions are significant. As a result it was felt that the best approach was to consider the survey as a benchmark with a sample defined by access to senior managers who have an appropriate level of understanding and responsibility for supply chain strategy decisions. Indeed it is clear that there could be significant correlations across all categories of the data that was collected. Moreover many of the attributes of products and processes are endogenous. Thus identification of causal factors for the sourcing decisions of interest will be challenging. Our goal, as noted above was to develop an empirical picture of the decisions that are being made and the reasons for those decisions from a representative sample of companies operating in China.

We received a total of 49 company responses. A condition for participation in the benchmark was a guarantee of confidentiality and anonymity with respect to any reporting of results, i.e. it will not be possible to determine the identity of a specific company based on the reported results. As a consequence most of the data is presented in terms of percentages of the sample and where relevant for industry groupings whose definitions were broad enough to maintain confidentiality. We also note that many companies reported multiple relocation and sourcing decisions and as a result we observed a total of 89 sourcing "flows". We will elaborate on the definition of such flows in our discussion below.

The survey responses provided by the 49 companies came from 8 industries, and the surveyed companies typically were multi-nationals with diverse global headquarter locations (see Figure 3). Yearly sales revenue of these companies ranged from 3.3 Million to 100 Billion USD.

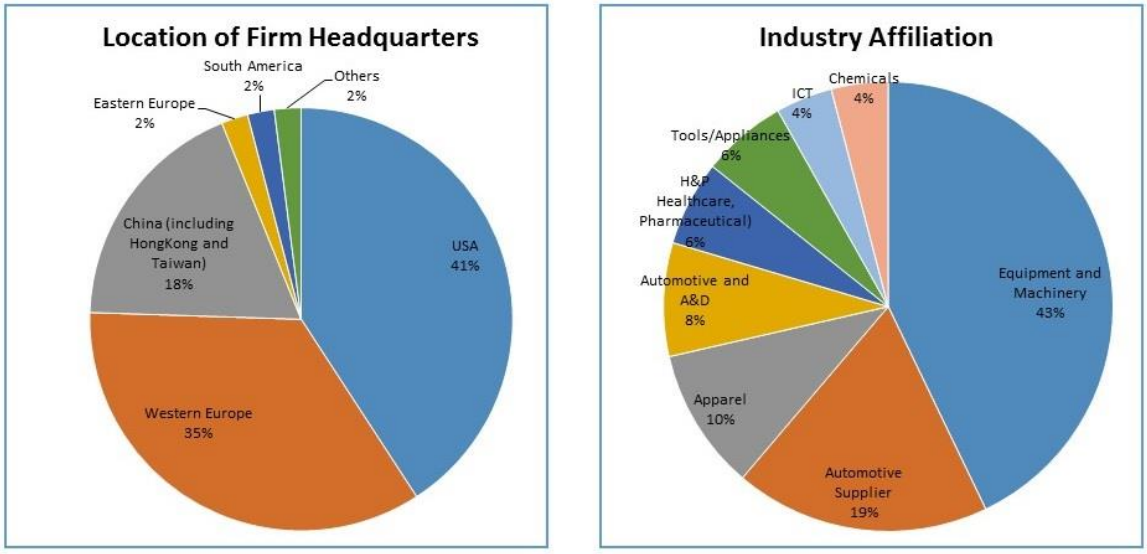

Figure 3: Survey Sample Composition

While the sample we obtained was not random, we believe that it is appropriate for a benchmark study that is directed towards providing a comprehensive picture of current global sourcing strategies used by leading companies in China. We believe, therefore, that the results are representative for identifying patterns and trends associated with current practice.

5. Balance of Trade for Production:

A further insight provided by the firm level data in our survey is concerned with the balance of trade for manufacturing. Figure 4 illustrates the distribution of assembly locations and sales revenue for the participating firms. It is not surprising to observe that for our sample, China, which is the largest source for final product assembly with the largest market is also the largest exporter with a net positive trade balance (production – sales). North America (US & Canada), which is the largest importer, along with Europe (EU-15) and Japan, however, have a net deficit with respect to production. These results are consistent with statistics from the Chinese Bureau of Statistics.

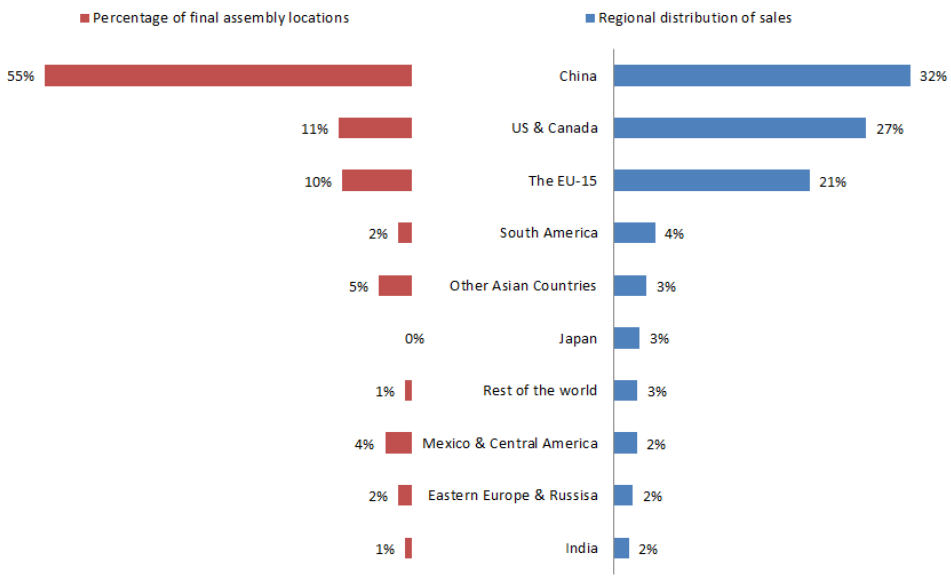

Figure 4: Balance of Trade for Production

It is interesting to examine the balance trade when we break down these aggregate results by industry. We illustrate the specific cases of the Apparel and the Automotive + the Aerospace and Defense industry segments in Figure 5. The trade surplus, as expected, is significant for both China and other Asian countries in the Apparel industry. There is much more balance however in the Automotive + Aerospace and Defense industry segment, which indicates that a more localized approach for manufacturing is being adopted in this segment.

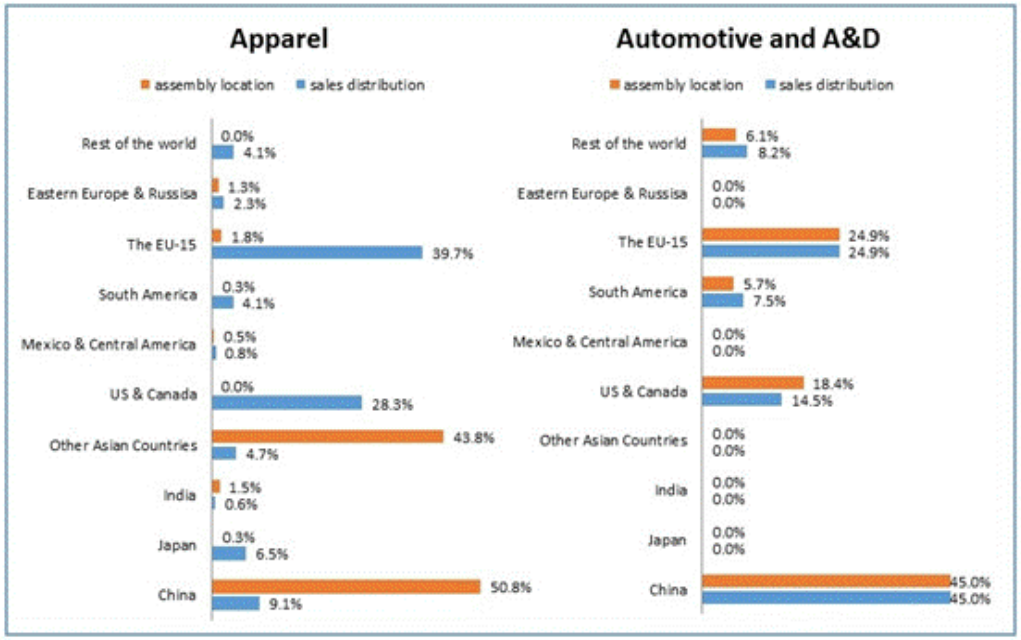

Figure 5: Balance of Trade for Production for Two Industries

48 of the 49 companies who completed our survey listed one product where one or more changes to that product's global supply chain manufacturing sourcing strategy had been considered and/or implemented in the last 3 years. Only one company answered that no changes were made, because their product is still in its test period.

Many of the surveyed companies reported multiple sourcing and capacity adjustments that occurred within various geographies. In particular, we asked companies where they increased or decreased manufacturing volume (see Figure 6). 75.5% of the companies in our sample reported increased production in China and 18.4% reported increased production in ASEAN countries for the past three years. Decreased production occurred in the EU-115 (32.7%) and North America (20.4%). We observed, however that both increases and decreases occurred in many of the geographies.

Figure 6: Recent Changes in Production Volume by Percentage of Companies by Region

These data suggest that China will continue to be the largest source for manufacturing since it is at the highest level currently and is experiencing the highest level of growth. As noted earlier, it has been stated by some business analysts and political leaders that the shift of manufacturing back to the US, Japan, Europe and/or other developed countries is a real and growing phenomenon which could revive domestic manufacturing and service industries. Our survey responses do not support this statement, (e.g. North America's net growth is +12.2% - 20.4% = - 8.2% and EU has a net growth of +2% - 32.7% = – 30.5%). Indeed the trend in US,

Europe, Japan is still dominated by the strategy to reduce domestic manufacturing. This is consistent with recent anecdotal evidence concerning the difficulty firms are encountering when they attempt to re-shore manufacturing to the US. (See Shih (2014) for a discussion of the experience of GE Appliances in this regard).

As we shall see, it is necessary however to explore changes in sourcing at a more detailed level and in a manner which captures the geographical dispersion of sourcing locations.

6. Pattern of Change:

Our analysis of the responses was based on observed "flow" patterns that captured the net adjustments made with respect to specific sources and destinations, which are displayed in Figure 7. Note that the top three patterns include i) 33% of the companies in our sample had flows from the EU to China, ii) 20% went from North America to China, and iii) 10% went from China to ASEAN countries.

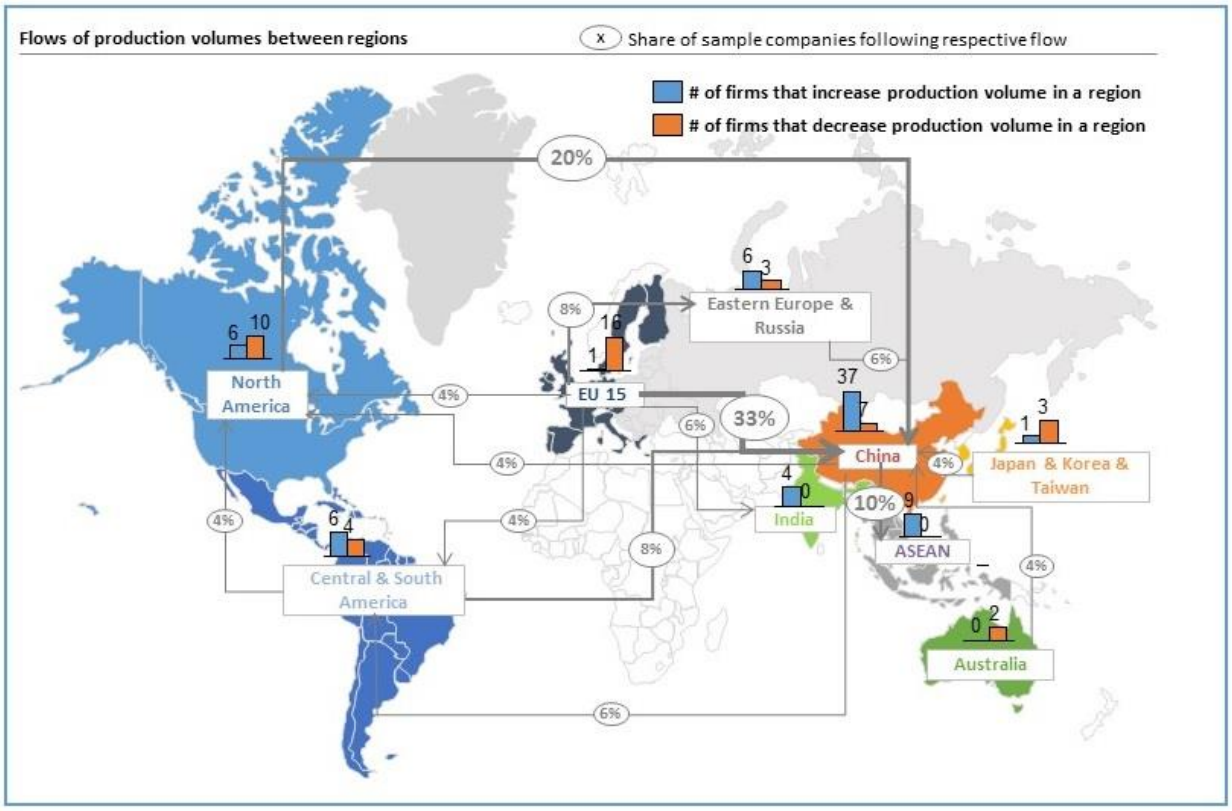

Figure 7: The Dominant Flows for Shifting Sourcing

The focus of our analysis is to identify relationships between these flow decisions and possible drivers along with other firm level factors. We discovered, in particular, that the top

drivers varied significantly by flow. Table 3 illustrates the top 10 drivers for the three flows that were reported with the highest frequency, i.e. from EU15 to China, from North America to China and from China to the ASEAN countries. For example, the companies who shifted from EU15 to China rated labor costs, logistics costs, market changes and supply availability as top drivers.

From EU15 to China	From North America to China	From China to ASEAN
Labor costs	Labor costs	Labor costs (T-1st)
Logistic costs (T-2nd)	Raw material costs (T-2nd)	Supply availability (T-1st)
Market changes (T-2nd)	Market changes (T-2nd)	Product quality (T-1st)
Supply availability	Logistic costs	Innovation and design capability (T-1st)
Raw material costs (T-5th)	Product quality	Currency and foreign exchange rate volatility (T-1st)
Supply chain flexibility (T-5th)	Delivery Lead time (T-6th)	Logistic costs (T-6th)
Delivery Lead time (T-7th)	Government incentives (T-6th)	Raw material costs (T-6th)
Government incentives (T-7th)	Supply availability (T-8th)	Quality and availability of labor inputs (T-8th)
Fixed costs	Intellectual property protection and risk (T-8th)	Supply chain flexibility (T-8th)
Quality and availability of labor inputs	Fixed costs/Quality and availability of labor inputs (T-10th)	Government incentives (T-8th)

Table 3: Top 10 Drivers for the Three Major Flows

It is interesting to note that labor costs which are the most important reason for companies expanding production in China from either the EU15 or North America is also the top driver for companies that are moving away from China to the ASEAN countries. This can be understood if we look at differences at a more detailed level.

For example, 16 companies reported that they had moved at least some production from EU15 to China. Interestingly, this move is also correlated with less labor-intensive products compared to the others (p=.088). This movement also has a significant positive correlation with their decision to increase the level of automation, e.g., adopt flexible assembly robots in their production (p=.005). Indeed, 13 of the 16 companies reported they increased their level of automation which suggests that automation is being used to replace labor.

More Apparel companies (p=.020) and less Equipment and Machinery companies chose the strategy of moving from China to ASEAN (p=.042) compared to the industry composition in other flows. (See Figure 8 for an industry breakdown for the top 3 flows.) This movement is strongly correlated with a more labor-intensive product (p=.003), a more standard product

(p=.059), lower unit cost (p=.080), and proximity to the end consumers (p=.096). This seems to be aligned with the story documented in "Travels of a T- Shirt in the Global Economy" by Rivoli (2014). As labor wages continue to increase at a much higher rate in China, ASEAN becomes the next destination for cheap labor.

Also note from Table 2 that Market Change is one of the top 3 drivers for companies moving to China, but is not in the top 10 for companies moving away from China. This suggests that China, which is the biggest market in our sample, is attracting production due to the growth of its market. Industries that are moving from China to ASEAN are more export oriented, (i.e. Apparel), and thus factors such as product quality, supply availability, innovation and design capability and currency fluctuations, all or which determine a product's value in global markets, are important.

Thus when a product is less labor intensive and uses more automation, labor cost differences can be the top driver for moving manufacturing to China (as opposed to moving to countries with even lower labor costs such as ASEAN) to supply the local growing market. It is not surprising, that, compared to others, the companies moving from EU15 to China expect significantly more Chinese Sales of the product (p=.002) and less US sales (p=.031). When the product is more labor intensive, then differences in labor costs can be the most important driver for moving away from China to ASEAN. These companies also expect significantly less China sales (p=.017) by moving out of China.

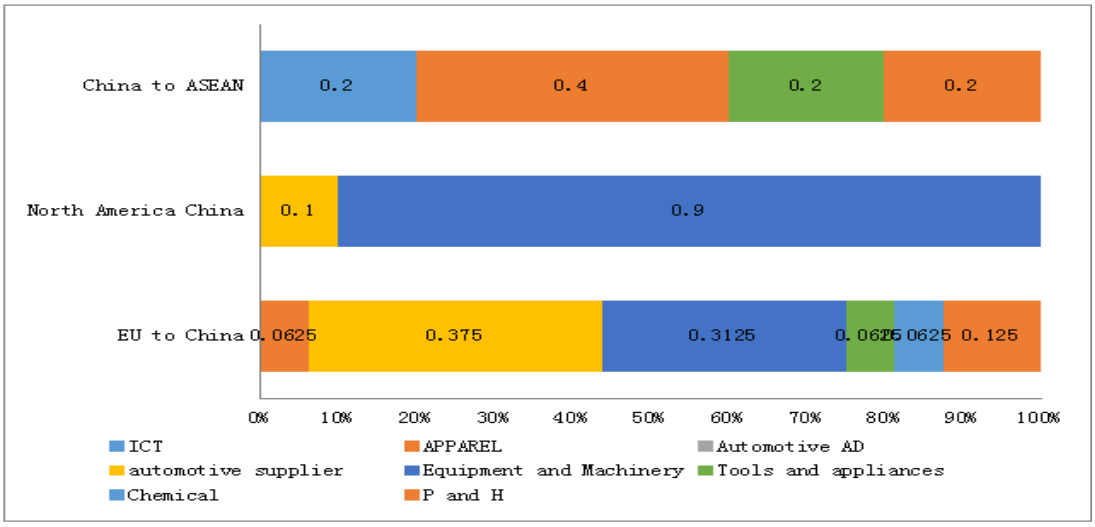

Figure 8: Industry Composition for the major movements

10 companies reported they moved their production from North America to China, and all of them are headquartered in USA. 9 of them are in the Equipment & Machinery industry. Again Figure 8 shows the industry decomposition of the three major flows. The overall industry composition suggests that China is attracting more complex products, (e.g. Equipment and Machinery and Automotive supplier) and is giving up simpler, more standardized, labor intensive products, (e.g. Apparel). These companies also expect significant less US sales (p=.037) and lower selling price of the product (p=.003) by moving production from the U.S. to China, compared to companies not moving from North America to China.

7. Industry Analysis:

We can break down analysis of our observations by industries in a manner similar to whatt we conducted in the previous section. We will focus on the 4 major industries observed within our sample. Table 4 lists the top 10 drivers, in rank order, for each of these industries.

It is interesting to note that labor costs are ranked first or second for the Equipment and Machinery, Automotive Supplier and Apparel industries, but was not in the top ten for the Automotive OEM & Aerospace and Defense industry. Market changes, on the other hand, were highly ranked for all of the industries, except for Apparel which as noted earlier, competes on a more global basis. Government incentives were noted in three of the four industries, but in the Automotive OEM & Aerospace and Defense industry it was tied for first place.

In the remainder of this section we consider the impact of product and industry attributes on the sourcing decisions.

Equipment and Machinery	**Automotive Supplier**	**Apparel**	**Automotive OEMs & A&D**
Labor costs	Market changes	Labor costs (T-1st)	Supply availability (T-1st)
Raw material costs	Labor costs	Product quality (T-1st)	Market changes (T-1st)
Market changes (T-3rd)	Environmental sustainability	Innovation and design capability (T-1st)	Government incentives (T-1st)
Product quality (T-3rd)	Delivery Lead-time	Supply availability (T-4th)	Quality and availability of labor inputs (T-4nd)
Innovation and design capability	Logistic costs	Quality and availability of labor inputs (T-4th)	Product quality (T-4nd)

Delivery Lead-time	Management complexity (T-6th)	Currency and foreign exchange rate volatility (T-4th)	Innovation and design capability
Logistic costs	Fixed costs (T-6th)	Government incentives (T-4th)	Raw material costs (T-7th)
Supply chain flexibility	Quality and availability of labor inputs (T-6th)	Supply chain flexibility (T-8th)	After-sale service and support quality (T-7th)
Government incentives	Supply chain flexibility (T-6th)	Time to market for new product introduction and product re-design (T-8th)	Time to market for new product introduction and product redesign (T-7th)
Fixed costs	Automation and technology advances of the manufacturing process (T-10th)	Delivery Lead-time (T-10th)	Government regulations (T-7th)
	Raw material costs (T-10th)	Market changes (T-10th)	Intellectual property protection and risk (T-7th)
	Product quality (T-10th)	Government regulations (T-10th)	Automation and technology advances of the manufacturing process (T-7th)
			Management complexity (T-7th)

Table 4: Top 10 Drivers for the Four Industries

7.1 Equipment and Machinery

Compared to the other industries, companies from the Equipment and Machinery industry reported higher ranking of their company size within the industry (p=.025). Their products are rated at a higher unit cost (p=.039) and enjoy a higher profit margin (p=.007).

We observed that this industry is decreasing production in North America (p=.000) and East Europe & Russia (p=0.040), because they are moving from North America to China (p=.000) and East Europe & Russia to China (p=.040). We note that these companies, however, are not moving from China to ASEAN (p=.042). As a result of the reported strategy changes/decisions, the companies in this industry expect significant lower average total cost (p=.034) and selling price (p=.014) per unit. Compared to the other industries, these companies also view Government regulations (p=.062) and Currency and foreign exchange rate volatility (p=.078) less important. Surprisingly, they are not increasing their level of automation (p=.072).

7.2 Automotive supplier

The automotive supplier industry has the highest level of customization (p=.065). They produce parts according to orders received from the automotive OEM industry sector. The products produced by respondents in this industry are rated at a lower profit margin (p=.003).

The companies in this industry reported that they are decreasing their production in EU15 (p=0.015) and increasing production in East Europe & Russia (p=0.033) and in the Coastal area of China (p=0.046). They also are moving from EU15 to China. As a result of these strategy changes/decisions, these companies expect significantly more China sales of their products (p=.043). Finally, they are increasing the level of automation (p=.017) and R&D investment (p=.001) and they view Environmental sustainability more important (p=.058) compared to the other industries.

7.3 Apparel

For the apparel industry, their products are rated at a higher level of labor intensity (p=.001) and standardization (p=.059). They also rated at a lower level of modularity (p=.014) with a lower unit cost (p=.080)

Companies in our sample from this industry are increasing production in ASEAN countries (p=0.000), decreasing it in China (p=.086), and as a result that they are moving from China to ASEAN (p=.020). They are not increasing their level of automation (p=.011) or R&D investment (p=.079), as was observed in the apparel industry. Compared to the others, these companies also viewed Currency and foreign exchange rate volatility to be more important (p=.022) as they supply to the global markets.

7.4 Automotive OEMs & A&D

The Automotive + A&D industry has the highest average % COGS from suppliers, and the lowest percentage internally sourced from the company (p=0.018). Their numbers are all around 80% and 20% respectively (compared to sample averages of 60% and 40%). This industry has high degree of localization, because all the OEMs reported that the distribution of final assembly locations was the same as the distribution of their markets. As a consequence, the companies in this industry are increasing their production in EU15 (p=.000), most likely due to the European demand. As a result of these strategy changes/decisions, they expect significantly higher average total cost (p=.037) and higher selling prices (p=.062) per unit. Their products also are rated at a

higher unit cost (p=.013). Finally when compared to the other industries, these companies view Government incentives to be more important (p=.031).

8. Changes within China:

Since our study has a regional focus of China, we took a more detailed look at the flow patterns for the companies that either have increased or decreased production in China (37 and 7 respectively). In this section we present a brief summary of the results.

The companies that increased production in China operate at a lower tier in the value chain (p=.087). They tend to pay less attention to after-sales service and support quality (p=.023), product quality (p=.059), time to market for new product introductions (p=.003), as well as to innovation and design capability (p=.009), and currency and foreign exchange rate volatility (p=.009). These companies also increased the level of R&D investment (p=.027). As for impact, the companies who increased production in China expect that sales in China will increase (p=.006), the selling price of their products will decrease (p=.018) and sales in US will decrease (p=.078).

Surprisingly, companies who decreased production in China have a higher level of labor intensity in manufacturing (p=0.002), and operate at a higher tier in the value chain (p=.035). Similarly, companies who did not increase in China have a lower level of value per unit of weight (p<.05). In contrast, companies who did not decrease in China have a higher level of knowledge intensity, and a higher profit margin (p<.05). All of these suggest that a shift of labor-intensive manufacturing from China to countries with even cheaper labor. As for impact, the companies who decreased production in China expect that their China sales will decrease. (p=0.005) and the selling price of their products will increase (p=.050).

We also observed some interesting results associated with shifts in sourcing to locations within China, i.e. from one Chinese location to another. In particular, one sixth of the companies in our sample reported a shift of production from coastal to inland China. This movement is correlated with products that have lower level of knowledge intensity (p=.039), higher modularity (p=.089), lower profit margin (p=.059), suggesting these companies are "going west" for simple and standardized products. These companies also care less about Innovation and design capability (p=.045). These results are similar to what we observed for companies moving from China to ASEAN countries.

9. Decisions Concerning Automation and R&D, Impact on Manufacturing Employment:

53% of the companies responded that they increased the level of automation in their production processes; 27% in their Chinese factories, 12% in USA factories and 14% in EU15 factories. 57% of the companies responded that they have increased investment in R&D; 39% in their Chinese cities, 8% in USA cities and 10% in EU15 cities. We also observed that a low product profit margin is positively correlated with an increase in the level of production automation (p=.082).

Consistent with our earlier observation on the positive balance of trade in China and other Asian countries, companies also reported that manufacturing jobs are not coming back to the U.S. It is also interesting but consistent with our other findings that in our sample, China also reported a net decline in the number of jobs created by the reported decisions, see Figure 9. The one region with a reported increase in jobs was in other developing countries, where the majority of the jobs created were at the low skill level of general labor.

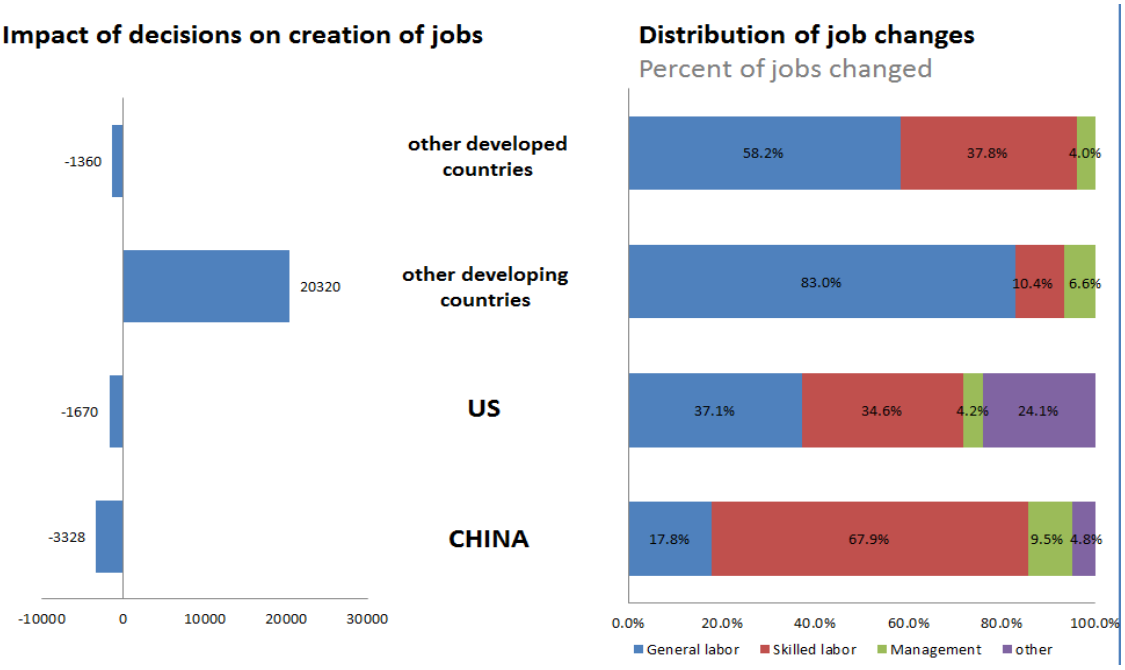

Figure 9: Impact of the Decisions on Job Creation

10. Conclusions:

As noted earlier, prior to administering our survey, we conducted an informal review of corporate public announcements made from 2010 to 2013 (see Appendix A) concerning changes

in manufacturing location by well-known multinational companies, and derived several hypotheses. We now discuss if our survey results support these hypotheses.

H1. *Companies are shifting their production to China in order to gain access to the Chinese market*.

Our sample supports this hypothesis in general by revealing that China is the biggest market as well as the biggest source for manufacturing in the world, and is attracting more companies who are moving into it for access to its growing market.

H2. *Companies are shifting their production to the USA due to government incentives*.

We found little evidence from our sample to support this hypothesis. In particular, our findings reveal that manufacturing continues to shift away from developed economies including Europe and the USA. It is even possible that the "re-shoring" news made by some of the US companies were motivated by public relations due to increasing political pressure from government leaders.

H3. *Companies are shifting their production to ASEAN countries because of labor cost.*

Our sample supports this hypothesis in general as labor cost is found to be the top driver for increasing production in ASEAN countries and that the shift is strongly correlated with product labor intensity. Production that moved into ASEAN countries mostly came from China, suggesting that China is losing (or strategically giving away) simpler, more standardized, labor-intensive products, (e.g. Apparel) to the ASEAN countries. On the other hand, China is attracting more complex/higher-profit-margin products (e.g. Equipment and Machinery and Automotive supplier industries).

H4. *In general, labor cost, market proximity, and government incentives are the most important drivers for global supply chain sourcing decisions*.

Our sample agrees that labor cost and market proximity are the most important drivers, however our results were less definitive for government incentives.

Our study was regional in terms of the companies and managers surveyed and was based on a decision specific focus. We can summarize the principal results of our benchmark study as follows.

1) We observed a complex pattern of movement of production sourcing that is consistent with a network model of the global supply chain. Multiple decisions were made by companies which reflected the fact that companies are currently engaged in significant restructuring and redefinition of the global sourcing and technology strategy.

2) These decisions were made for a variety of reasons and with a range of expected outcomes. The decision focus of our survey provided a rich and robust set of explanations for the observed patterns.
3) As a regional study, we looked at reasons that drove companies to move in and out of China. We found that companies increased production in China due to the importance of its local market, while companies decreased production in China in order to reallocate labor-intensive manufacturing to countries with even cheaper labor.
4) In our sample, we also found a trend of companies Going West within China, i.e., moving production from coastal China to inland China. (One sixth of the companies in our sample implemented such strategies.) Like going from China to ASEAN and other developing countries, the products whose manufacturing went west within China were simpler, more standardized, more labor intensive and less knowledge intensive.
5) We could not find support for the expectation that re-shoring to North America or the EU15 is taking place on a significant scale. Rather these regions continue to lose ground or at best are staying even.
6) There were significant differences by industry and product and market factors also were important.
7) A major policy question worth exploring further is whether China should be concerned about losing jobs due to its rising worker wages (e.g., 3,328 jobs were reported to be lost in China based on responses in our sample, see Figure 9). We believe, however that our results do not suggest that this will be a major problem in the future. It is evident from our analysis that although China is losing the manufacturing of simpler, more standardized, labor intensive products (e.g. Apparel or ICT), it also is attracting jobs for the production of more complicated / higher-profit-margin products (e.g. Equipment and Machinery and Automotive supplier industries). China remains the biggest source for manufacturing in the world. As a result, we predict that Chinese economy will continue to grow.

This survey is currently being replicated in a multi-country setting with participation of a wider set of industries and countries. We expect that ongoing analysis of such related data bases will provide further insights into the extensive changes in global supply chain sourcing and technology strategy that currently is occurring in multiple industries.

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Appendix

Table A. Sourcing Announcements (2010 – 2013)

Company	Flows		Drivers												
		labor cost	After sales service and support quality	political pressure to create jobs	product quality	managing the supply chain	building a global network	supply chain flexibility	government incentives	Innovation and design capability	energy cost	logistics cost	delivery lead time	exchange rate	market changes
1.Adidas	from China to Cambodia	✓													
2.Airbus	increase in USA		✓	✓										✓	✓
3.Apple	increase in USA				✓					✓					✓
4.Bosch and Siemens	increase R&D in China		✓												✓
5.Canon	increase in Vietnam	✓													
6.Caterpillar	increase in North America				✓							✓			
7.Changhong Electric	increase in Indonesia, Australia ,Czech, Korea	✓													✓

8.Coach	from China to India and Vietnam	✓													
9.Dell	increase in central and west China								✓						
10.Dow Chemical	increase in USA			✓						✓	✓				
11.Electrolux	from USA to Mexico	✓													
12.ET Water Systems	from China to USA				✓			✓		✓					
13.Foxconn	increase in Brazil						✓								✓
14.General Electric	increase in USA	✓		✓					✓	✓					
15.Global Foundries	increase in USA			✓					✓						
16.Google	increase in USA				✓	✓				✓					
17.Hanesbrands	increase in Thailand and Vietnam	✓					✓								
	increase Automation in China	✓													
18.HP	increase in central and west China	✓							✓			1			

19.Honda Motor	increase in USA and Canada													✓	
	increase in Mexico	✓													
20.Honeywell	increase in China and India	✓	✓							✓					✓
21.Hyundai and Beijing Motors	increase Automation in China	✓													✓
22.Intel	increase in USA	✓		✓											
	increase in Malaysia	✓		✓											
23. Kia Motors	increase in China														✓
24.Lenovo	increase in USA														
25.Master Lock	from China to USA and Mexico	✓	✓												✓
26.Michelin	increase in USA								✓						✓
27.Nissan	increase in Thailand														✓
28. Osram AG	increase in China		✓						✓						✓
29.Otis	from Mexico to USA									✓		✓			✓

30.Panasonic	increase in China	✓													✓
31.Rolls-Royce	increase in USA								✓	✓					
32.Shell	increase in China, India and Russia						✓								✓
33.Sleek Audio	decrease in China				✓										
34.Stanley Furniture	from China to USA				✓										
35.Texhong	increase in Turkey														✓
36.U.S.Block Windows Inc	from China to USA											✓	✓		✓
37.Vancl	from China to Bangladesh						✓								
38.Western Digital	increase in Malaysia					✓									
39.Whirlpool	from Germany to Poland														
40.Yaskawa Electric	increase in USA	✓	✓												✓