The attached educational project, by Ricky L. Dartez, entitled The Impact of SCM, Globalization, and SBTC on Wage Inequality, when completed, is to be submitted to the Graduate Faculty of the University of Wisconsin-Platteville in partial fulfillment of the requirements for the (MASTER OF SCIENCE IN INTEGRATED SUPPLY CHAIN MANAGEMENT) degree.

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Abstract

This paper investigates and attempts to define the relationship of modern supply chain management (SCM) to increasing wage inequality in the U.S. The majority of available literature does not illustrate or investigate a direct connection between SCM and wage inequality. The majority of research literature focuses instead on the effects of what can be considered drivers of SCM development and products of SCM upon wage inequality. In order to show the connection of SCM to wage inequality, this paper begins by first detailing the evolution of supply chain structures and their management. It then attempts to examine the effect of supply chain management’s increasing reliance upon new technologies to gain and maintain competitive advantage as they adopt integrative management philosophies and enter global markets. Of particular interest during this examination will be the emergence of e-commerce and its role in workplace reorganization. A causal and descriptive research was conducted based upon previous academic research conducted with regards to the evolution of contemporary supply chain structures, the advent of e-commerce and its effect upon supply chain management strategies, the resulting dependence upon SBTC (skill-biased technical change), and the impact of advanced technology adoption upon labor demands and wage inequality. An investigation of the research is conducted for the purpose of formulating theoretical assumptions regarding the combined effect of these factors with regards to growing income inequality and the resulting economic deterioration of the North American economic base.
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Introduction

The traditional supply chain structure viewed individual companies and their internal elements as separate units which represented functional entities within the supply chain (Nobilis, 2011). Each entity was isolated from the other entities within the supply chain and focused primarily on their own internal performance. Within these structures each individual department was focused on its own key performance indicators (KPIs) and objectives, often at the cost of efficiencies in another department or partner (Nobilis, 2011). This internal focus is known as the silo concept and is often found within the internal functional departments of many organizations. However, this concept also has external effects upon the other partners within a supply chain as functional silos often result in less than optimal efficiencies and a reduced ability to respond to customer needs due to conflicting objectives (Cutting-Decelle et al., 2007).

Beginning in the 1960s, an awareness of the cost of doing business in this manner began to emerge. The business community in concert with academia began to research the effect of segmentation within the supply chain in terms of cost and inefficiencies. Jay W. Forrester (as cited by Mentzer et al., 2001, p. 2) was the first academic to propose that “there will come general recognition of the advantage enjoyed by the pioneering management who have been the first to improve their understanding of the interrelationships between separate company functions and between the company and its markets, its industry, and the national economy”. This early concept of supply chain management is illustrated in the following quote from one of Forrester’s articles, Industrial Dynamics:

Management is on the verge of a major breakthrough in understanding how industrial 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).

Forrester’s article, “Industrial Dynamics”, was among the first to recognize “the
integrated nature of organizational relationships” (Mentzer et al., 2001, p. 1). Mentzer et al. (2001)
cite Forrester’s article as the original source that “identified key management issues and illustrated
the dynamics of factors associated with the phenomenon referred to in contemporary business
literature as Supply Chain Management (SCM)” (p. 2). During the time of Forrester’s article, before
the 1960s, logistics were primarily a military discipline and mainly involved procurement,
maintenance, and transportation of military facilities, material, and personnel. The majority of
commercial firms organized around these logistics activities were fragmented, which led to conflicts
among those responsible for logistics activities (Ballou, 2006). These traditional supply chain
structures viewed individual companies and the elements within the firms as separate functional
entities which focused on optimizing their own objectives to the detriment of the supply chain as
a whole (“Supply Chain,” 2011). The underlying foundations of this fragmentation were found to
be the “lack of understanding of key cost tradeoffs, the inertia of traditions and conventions,
areas other than logistics were thought to be more important, and the organization may have been
in an evolutionary state” (Ballou, R. H., 2006, pp. 333-334).

In the new supply chain structure, the functional approach was abandoned because, as
previously stated, it resulted in less than optimal efficiency and higher cost throughout the supply
chain. At the intra-organizational level, the functional approach may appear to create efficiency
by seemingly optimizing individual functional departments; but paradoxically, at the
organizational level, when individual functions such as purchasing source materials at the lowest
possible cost without consideration for high costs incurred as a result of the low quality material
produced, the resulting reduction in production efficiency, and work stoppages that may occur as a result, efficiency actually suffers ("Supply Chain", 2011). Similarly, when the macro perspective is adopted and examining inter-organizational relationships, the same dynamic exists externally between partner companies within the supply chain structure in a similar fashion to individual functional entities within the same company. More importantly, the functional focus of traditional supply chain structures does not address the need for customer centricity throughout supply channels. Focus on customer satisfaction requires communication and collaboration between upstream manufacturers/suppliers and downstream distributors. The development of competitive advantage in terms of customer satisfaction requires that the end-to-end process alignment should always consider the customer at the end of the process flow ("Supply Chain", 2011). The solution was found with the introduction of the internet and the development of e-business applications.

The adoption of e-business applications into supply chain management with the emergence of the internet has resulted in certain environmental differences—the increased speed at which business is conducted and the level of connectivity between partners in the supply chain—and those differences have manifested into new challenges—higher levels of uncertainty and structural changes from traditionally segmented systems to fully integrated systems (Golicic, McCarthy & Mentzer, 2002). These changes have shifted the paradigm of physical production and distribution strategy away from cost reduction towards optimization of processes at the inter-company level.

Malone et al. (as cited by Cagliano et al., 2005) argued that electronic communication along the supply chain resulted in "the reduction of both the costs of coordinating economic transactions and the costs of coordinating production. Additionally, Cagliano et al. (2005) cited
the “information transfer, the timeliness of information availability, and the openness and transparency of relevant business information are only a few of the benefits provided by the internet to support supply chain integration”. According to Stevens (as cited by Cagliano et al., 2005) e-business is important “as a consequence of the increasing need to integrate activities and information flows and to optimize the processes not only at the single company level, but also at the level of inter-company processes”. Further, Hakansson and Snehota (as cited by Cagliano, 2005) cited the need to manage the impact of company processes through integration mechanisms as increasing amounts of activities are externalized and becoming essential to maintaining superior performance.

In their commissioned report for the Department of Labor regarding the trends affecting the U.S. labor market, Lerman & Schmidt (1999) cite increased investment in technology by companies as a catalyst for the increasing demand for higher-skilled workers, especially in manufacturing jobs. Lerman & Schmidt (1999) point out that firms attempting to manager customer demand have invested heavily in information technology and have transformed their work organization practices in order to adopt customization strategies aimed at increasing customer satisfaction. At these companies the work is organized into self-directed teams which require workers to make decisions, assume multiple responsibilities, and increase the breadth of their understanding of the entire process and how it integrates within the supply chain as whole (p. 30).

The restructuring of work processes and the subsequent shrinking of the low-skilled labor market as a result of technological adoptions has meant that lower-skilled workers are increasingly being left out of the labor market entirely. The 2003 National Survey of Adult Literacy (Baer et al., 2009) found that 30 million adults were below basic prose literacy (p. 14).
Of these 30 million, 11 million of these adults were nonliterate. This finding suggests that nearly 14.5 percent of the 209 million estimated adult population in the U.S. do not possess the skills necessary to participate within the new work structures being developed and adopted as a result of technological advances and globalization.

Statement of the Problem

The evolution of SCM has provided U.S. organizations with competitive advantages over their domestic partners—the discovery of cost-saving, efficiency strategies, access to global markets, the internet and e-business tools needed to form the collaborative networks which enable long distance integration, and most importantly access to cheap labor abroad. However, the management of such vast supply chain networks required an unprecedented level of coordination and collaboration along supply channels and among supply chain partners. This required the adoption of increasing levels of skill-biased technology or skill-biased technical change (SBTC) in order to manage the flow of information and to coordinate processes at distance. As the influence of globalization spread, competition and access to technology also increased requiring the development of more skill-biased technology labor capable of operating efficiently within these skill-biased technical environments. As the demand for skilled labor increased, so did the wages employers were willing to pay. As a result, wages for low-skilled labor either remained stagnant or declined. While wages declined, so did demand as organizations, enabled by free trade agreements, relocated operations to locations with an abundance of low-skill labor and lower wage structures.

While there are a multitude of factors which contribute to the widening wage gap in the U.S., there is evidence that changing SCM strategies, globalization, and the resulting SBTC has had the most long-lived and steady influence upon the gap in wage inequalities. Many point to
the Great Recession of 2008 as the reason for the loss in middle-income wage jobs, and their assessment is likely accurate. However, the National Employment Law Project (NELP) points out that “The U.S. labor market was already in trouble before the Great Recession, the result of 30 years of growing wage inequality and shrinking numbers of good jobs” (NELP, 2012, p. 4). So, although the recession may have accelerated the loss of good paying jobs in the U.S., there are other drivers of the job loss which have had more consistent and lasting effects upon growing wage inequality. In this paper, I make the case that the evolution of SCM, globalization and the entrance of global competition, and SBTC are all such drivers.

**Purpose of the Study**

This paper will show how factors associated with SCM—methods, tools, and legislation in support of—have had the combined effect of initiating, sustaining, and increasing wage inequality in the U.S. labor market. By examining research literature regarding various factors surrounding previously mentioned factors surrounding SCM and establishing their links to labor market manipulation and segmentation and proving these factors to be the underlying foundation and ongoing causes of wage inequality, this paper will also prove that SCM, globalization, and SBTC are major drivers of wage inequality.

**Significance of Study**

While revealing the underlying causes of a societal issue does not immediately solve that problem for society, it does provide those in a position the primary tool necessary to begin addressing the issue and a direction in which to seek a resolution. To this purpose, this study will identify the societal actors involved in establishing the problematic environment and their areas of influence within society. Many of the solutions previously demanded and sought by society as a means to address the growing societal and political unrest associated with the issue of the
widening wage gap have been proven unsuccessful because they have not addressed these core issues. Boyer, Swink, & Rosenzweig; Christopher; Johnson & Pyke; Ketchen & Guinipero; and Ketchen & Hult (as cited by Alfalla-Luque & Medina-Lopez, 2009) cite a new business context in which “...competition is no longer firm against firm, but has moved on to a higher plane, with the generation of supply chain against supply chain competition” (p. 203).

Theoretical Perspective

This study adopts the theoretical perspective that the dysfunctional manner in which physical distribution was conducted and the segmented manner in which supply channels operated prior to 1960 were the cause of significant extra cost and inefficiency which resulted in considerable customer dissatisfaction. These conditions in conjunction with the introduction and development of the internet and e-business applications, provided the industry an opportunity to adopt new strategies along with new and powerful tools which granted access to global markets which were previously unreachable.

However, along with these opportunities also came the significant issues of increased external competition from those foreign organizations as they in turn accessed the U.S. markets. In order to mitigate the exposure to foreign competition, U.S. organizations were required to seek new methods and means to increase efficiency and decrease the cost of operating. Efficiency was addressed by adopting e-business tools such as e-commerce, e-procurement, and e-collaboration. Operating cost was addressed by adopting free trade legislation which allowed U.S. organizations to exploit low-wage labor in foreign countries and to leverage this ability towards lowering the majority of wages back home in the U.S. The adoption of e-business tools required the adoption of SBTC which in turn increased the level of skill premia and segmented the labor market.
Research Method

Due to the short-term nature of the research time available to prepare this paper, it utilizes a literature study as its method of research. Time-relevant literature is used to define the historical path taken by SCM from the period beginning from 1960 into the 21st Century, showing how the discipline has evolved and its current and anticipate future states. This paper shall draw relationships between factors which have been identified by the research as having a direct impact on wage inequalities and strategies associated with the modern SCM model. The time range for the sources used for the literature study from 1958 through 2014.

Literature Review

During the 1960s and 1970s an intensified study of physical distribution and logistics began to emerge as high logistics cost were being discovered. “In 1963, the National Council of Physical Distribution Management (NCPDM) was formed by a group of forward thinkers from industry and academia. It was the first time that physical distribution practitioners could assemble in a formal way to discuss strategies and tactics related to their profession.” (Stock, 2013). For example, research conducted by Lewis et al. (as cited by Ballou, 2006) for the airline industry looked at the competitive position of airline transportation, whose costs were substantially high in relation to other forms of transportation. Lewis’ research discovered that lower inventory-carrying costs for both shipper and receiver and the increased reliability of air transit times more than an offset the higher transportation cost incurred during air transport, resulting in a net benefit to the perspective airline system (Ballou, 2006). This results of this research lead in part to the adoption of a total cost perspective in the industry in place of the functional perspective which previously existed. However, it was Alderson (as cited by Stadtler et. al, 2015) who initiated this trend towards total cost perspective with his 1957 research into
channel research as a special field of marketing research. Through this research, Alderson applied the principles of postponement towards cost reduction strategies in physical distribution. It was these principles whose effectiveness were being illustrated through the research of Lewis. Further proof of the value of postponement was supported when Heskett et al. (1973) estimated that logistics cost in the U.S. accounted for 15 percent of the gross national product. Distribution costs were high in other countries as well. Stephenson (1975) found that these costs could be attributed to 16 percent of sales in the United Kingdom. Similarly, Koybayashi (1973) found that they were a whopping 26.5 percent of sales in Japan.

Recognizing that logistics takes place throughout the supply channel, from producer to the end consumer, Heskett et al. (as cited by Ballou, 2006) redefined physical distribution in terms of physical supply and physical distribution, relabeling it as business logistics. Schiff (1965) recognized the importance of the logistics cost trade-off as a key tool whose application to logistics decisions possessed “a full range of impact on transport, materials handling, materials holding, warehousing, packing, order processing, manufacturing, and sales” (Schiff, 1965, p. 111). This recognition of the value of logistics trade-offs signaled a transition to the third stage of supply chain evolution as illustrated in Figure 2. The period prior to 1960 is known as the “Dormant Years”, between 1960 and 1970 known as “Development Years”, between 1980s and 1990s known as “Take-off Years”, and the period after the 1990s are known as “Logistics Globalization” (Chira, 2014, p. 1660).

The Development Years
During the 1970s, companies’ focus was primarily upon making the internal changes—reduction of inventory levels and distribution costs, reduction of lead times in the production plants and from suppliers, and controlling safety stock—that would allow them to benefit from the adoption of a total cost perspective (Supply Chain, 2011). Also in the United States, during this time and into the 1980s, “the major transportation modes were deregulated through a series of legislative initiatives: The Airline Deregulation Act of 1978, Motor Carrier Act (1980), Staggers Rail Act (1980), and Shipping Act of 1984” (Stock, 2013). Additionally, in 1979, the first personal computers were becoming available as retail items. The introduction of computer technology revolutionized all aspects of business, in particular physical distribution and logistics (Stock, 2013). Organizations no longer needed to rely on expensive and bulky mainframes. Companies of any size were now able to manage their own operations and analyze data. Soon software with business applications were developed in the form of “enterprise resource planning (ERP), efficient consumer response (ECR), customer relationship management (CRM), transportation management systems (TMS), warehouse management systems (WMS), total quality management (TQM)” (Stock, 2013). In 1985 the NCPDM formally changed its name to the Council of Logistics Management (CLM) and its focus to logistics management (Stock, 2013).

The Takeoff Years

During the 1980s, although the term supply chain management had not yet been mentioned in most academic research, the concept began to develop as the importance of logistics as well as other activities and processes in serving customers began to be recognized by the middle of the decade. Stadtler and Kilger (2008) cite Oliver and Webber as being responsible for initial creation of the term Supply Chain Management. The two consultants believed that if
“...coordinating material, information and financial flows within a large multi-national firm is challenging and rewarding” then “...forming a supply chain out of a group of individual companies so that it acts like a single entity is even harder” and, as a result, logistics had to become a concern of top management because “...only top management can assure that conflicting functional objectives along the supply chain are reconciled and balanced...and finally, that an integrated systems strategy that reduces the level of vulnerability is developed and implemented” (p. 18). Because the effective management of supply chains is vital to organizational success, Ketchen Jr., & Hult (as cited by Ketchen Jr. & Hult, 2007) led the “...recognition that modern competition is being fought ‘supply chain versus supply chain’ rather than ‘firm versus firm’” Boyer et al., Ketchen and Guinipero (as cited by Ketchen Jr. & Hult, 2007) cautioned the industry that collaboration at such a high level required buy-in from top management at each partner organization within a supply chain in order to develop and maintain collaborative strategies like the information hub shown in figure 1. Bock, Lee & Whang (as cited by Lee & Whang, 2002) describe the information hub as a “node in the data network where multiple organizations interact in pursuit of supply chain integration. It has the capabilities of data storage, information processing, and push/pull publishing. The overall network forms a hub-and-spoke system with the participants’ internal information systems (i.e., ERP or other enterprise systems) being spokes (p. 5).
Figure 1 The Information Hub

Later that decade from 1986 to 1987, a study of papers from the Decision Science Institute revealed an increase in research in both purchasing and distribution. This new academic orientation began to manifest in the industry through better “intra-company coordination among traditional functional areas and inter-company collaboration and coordination with suppliers, vendors, and customers. The intra-company linkages that were established within organizations allowed synergies to develop among operations, marketing, accounting/finance, logistics, and other areas” (Stock, 2013).

By the beginning of the 1990s, interest in strategy, quality and service operations topics had increased, but research on supply chain issues were still rare (Alfalla-Luque & Medina-Lopez, 2009). However, Bragge et al. (2007) studied the strategy development process for multi
organizational collaborative teams and found five themes for the factors impeding cooperation: lack of history, conflicting goals, complex politics and power relationships, representatives may have multiple roles, and there may be difficulty identifying the client. In light of these barriers an emphasis on integration within the supply chain emerged as the internet and trade agreements began to drive the emergence of global trade. This integration is guided by the flow of three major items—product, information, and financial resources—in two directions, both downstream from producer to consumer and upstream from the consumer back to producer. This bi-directional flow among partner companies required the restructuring of supply chain channels away from the functional focus used in the traditional structure.

The origin of internet use and the restructuring of information channels can be traced back to the 1970s with the introduction of electronic data interchange (EDI) “which began to displace the traditional forms of data and information interchange” (Murillo, 2001, p. 370). EDI was limited to computer-to-computer communication which resulted in the development of complex internalized communication networks within organizations. A simple collaborative supply chain with demand-driven flow of goods and seamless flow of information is illustrated in figure 2. Kayabasi & Gümüş, (2012) cite that “…benefits of collaborative supply chain are given in revenue, decrease in cost, and transactional flexibility to overcome high demand uncertainties” and are invaluable towards fulfilling the main objectives of modern supply chains—the efficient fulfillment of customer needs and low cost operations (p. 3038). However,
prior to Bragge’s five barriers to multi-organizational cooperation, Lefebvre et al. (2003) developed three hypotheses regarding the effectiveness of e-collaboration tools:

H1: the relative efficiency of e-collaboration tools is positively related to the firm’s innovativeness, more specifically to the level of relational and process innovations;

H2: the relative efficiency of e-collaboration tools is positively related to the firm’s performance, more specifically in terms of input, output and flexibility measures; and

H3: relationships between the relative efficiency of e-collaboration tools and a firm’s innovativeness and performance are influenced by the company’s size and position on the supply chain (p. 160).

Figure 2 A Simple structure of collaborative supply chain. Source: Kayabasi and Gümis (2012)

These new networks directly addressed two issues not addressed in the traditional structure of supply chains: internal efficiency and customer service. This new focus on internal efficiency and customer service is the baseline objective of supply chain management.
philosophy. Burrows and Eckerson (as cited by Murillo, 2001, p. 370) explain that by the mid-1980s e-commerce, a sophisticated form of EDI based on a “truly worldwide network of digital communications” involving activities in different branches of commerce and among many different economic agents was becoming universally recognized and adopted by businesses. According to Murillo (2001) the civilian form of the Internet began merge and, in some cases, replace EDI as its worldwide manifestation became recognized around 1995.

**Logistics Globalization**

Johnson & Whang (2002) cite the internet as “…having a significant impact on how firms interact with each other and their customers. Past stumbling blocks for supply chain integration such as high transaction costs between partners, poor information availability, and the challenges of managing complex interfaces between functional organizations are all dissolving on the web” (p. 413). The efficiency of information transfer, the timeliness of information availability, the openness and transparency of relevant business information are only a few of the benefits provided by the internet to support supply chain integration. Golinska (2014) notes the prerequisite for building a competitive supply chain is “…closer collaboration between the parties involved, with interactions increasingly involving a common search for solutions, rather than competition” (p. 9). E-business in particular was seen as important for supply chain integration because of the increasing need to integrate activities and information flows and to optimize processes at the inter-company level as well as at the single company level in light of growing competition due to globalization (Cagiano et. al, 2005). Three categories of e-business applications—e-commerce, e-procurement, and e-collaboration—were identified as the major fruits of the marriage between the internet and supply chain integration (Johnson & Wang, 2002).
E-Commerce

Johnson & Whang (2002) explain that e-commerce makes it possible for supply chain partners to quickly respond to changing customer demands as captured over the internet. Since a speedy and accurate execution of transaction is a fundamental form in interaction of supply chain partners, a cross-enterprise system is required to track the status customer orders regardless of its origin within the supply chain. Lee, H. L., & Seungjin, W. (2001) identified five e-fulfillment strategies—postponement, dematerialization, resource exchange, leveraged shipments, and clicks-and-mortar models. Each of these strategies dependent upon the efficient capture and tracking of information within the system. The information hub offers a “...platform to capture the order, coordinate the activities, track the order status and deliver after-sales service” (Johnson & Whang, 2002, p. 6). In the early 2000s, Brynjolfsson and Smith concluded that although the internet has made e-commerce a “frictionless market” with lower product prices and less cost than traditional retail outlets, the resulting environment of this market’s development was “...fierce price competition, dwindling product differentiation, and vanishing brand loyalty” (p. 563).

E-Procurement

Johnson and Whang (2002) cite modern manufacturing as requiring “...flexibility due to stiff completion, fast changing customer preferences, shortening product life cycle and product variety proliferation and suggest that e-procurement allows the direct or indirect procurement of materials and value-added services (i.e. transportation, warehousing, payment, documentation, etc.) over the internet (p. 7). Because the actual procurement process extends beyond the enterprise and requires collaboration with suppliers, the information hub is still the perfect
strategy for the interaction of numerous buyers and sellers within a specified protocol (Johnson & Whang, 2002).

E-collaboration

Johnson and Whang (2002) point out that e-collaboration facilitates coordination of decisions and activities among supply chain partners to include customers over the internet. This greatly reduces the exposure to one of the most common threats faced by supply chains—the bullwhip effect, a phenomenon which results in large variances between what is ordered at the supplier and what is actually sold to buyers—and, depending upon who controls the information hub, supports cross-enterprise coordination beyond traditional ERP systems as one of three models—“e-Buyer”, “e-Supplier”, “market-centric”, or “company-centric” (p. 7-8). Nichols and Grant (as cited by Thun, 2010) “stress that certain developments in technology have brought information to the forefront of resources from which companies can generate competitive advantage” (p. 32). According to Evans and Wurster (as cited by Thun, 2010), “Information can be seen as the ‘glue’ that holds together the structures of all businesses” (p. 32). E-collaboration technologies enable supply chain partners to engage in product development, manufacturing, and marketing all at a distance (Bidgoli, 2012). Finally, Forrester and Lee et al. (as cited by Thun, 2010) declares that “The relevance of information for supply chain management becomes obvious when the Bullwhip effect is considered” (p. 32).

Structural Change

Caldwell (2013) cites that despite increased selling and interaction opportunities gained through the introduction of e-commerce, there are also certain risks specific to the technologies used involving individual firms and interaction with other firms. One of the most important perceived risks is that of “the looming risk of structural change—caused by e-business
enablement—of the shape of supply chains or networks. Change was predicted in who was in and who was out of the chain, of unheralded new entrants redefining the competitive landscape, and of intermediation and disintermediation.” (pp. 711-712). Because successful e-business implementation requires both a coherent set of different tools and relevant structural changes, Croom, Malone et. al and Sampler (as cited by Cagliano, 2005) submit that individual companies and the entire supply chain may be required to “take advantage of relevant structural changes concurrent with e-business adoption, such as streamlining, reduction in number of tiers, changes in power structure, etc.” in order to withstand intermediation into the supply chain by competitors (p. 1311). In response to structural changes that result from the internet’s influence, the concept of e-business strategy was introduced. E-business strategy, in the supply chain context, refers to the way internet tools are selected and used in relation to network integration requirements and to the alignment of these choices with other organizational and managerial tools used to integrate the company’s processes with those of partners within the supply chain in terms of specific aims, goals and context of application (Cagliano, 2005). Ballou (2006) predicted a shift in strategy resulting from structural changes—trends toward globalization, free trade, and outsourcing—away from cost saving efficiencies towards using the chain as a competitive weapon capable of demand generation, enhancing revenues and maximizing contribution to profit.

Bresnahan et. al. (2002) found that these structural changes and the need to gain a competitive advantage internally within the supply chain as well as externally within the global market has driven organizations to adopt a combination of three innovations—“1) information technology (IT), 2) complementary workplace reorganization, and 3) new products and services”—which constitute a “skill-biased technical change” (SBTC) which affects labor
demand and income disparities within the United States (p. 339). The shift towards more skilled and educated workers accelerated during the 1980s through the mid-1990s, a period of time aligned with the “Take Off Years” illustrated in figure 2.

There was, however, considerable disagreement at the beginning of the new millennium agreed regarding the impact or non-impact of these innovations upon wage inequality during the period between 1980 to 1990. Some researchers did not even consider the three together to represent SBTC as Bresnahan later believed through his research. However, the majority of researchers at the time agreed, to some extent, that skill-biased technical change was the major driver for wage inequality. Berman, Bound, and Griliches (as cited by Baldwin, 2000) concluded that shifts in trading patterns added to inequality but that skill-biased technological progress which favored higher-skilled workers was the major driver of inequality. Borjas and Ramey (as cited by Baldwin, 2000) found that increased international competition (globalization) was the main driver of wage inequality. Finally, Haskel and Slaughter (as cited by Baldwin, 2000) conducted empirical work which produced evidence that “more-extensive, skill-biased technical change in skill-intensive sectors were the dominant cause of the increased skill premia” (p. 580).

Discussion

The OECD reports that, although real disposable incomes increased 1.7% per year in OECD countries during the two decades prior to global economic crisis, the majority of increase has occurred for the richest 10% of households, contributing to the widening income inequality gap. Studies find that the richest 10% enjoy an average income that is nine times that of the poorest 10%. The household income inequality is largely driven by distribution of wages and salaries, accounting for 75% of all household incomes by working-age adults (OECD, 2011). A 2013 OECD study compared the skills of U.S. workers with those in other OECD countries.
They found “...the U.S. performance is weak on literacy, very poor on numeracy, but only a little worse than average on problem solving in technology rich environments” (p. 20).

In 2015 an OECD study found that the “…relationship between proficiency in problem solving in technology-rich environments and wages is more closely related to skills use than the relationship between wages and either literacy or numeracy proficiency” (p. 58). The same study also revealed that the average participation of adults with proficient problem-solving skills in a technology-rich environment was 90% compared to only 76% of adults who did not possess proficient skills in this category. Figure 3 shows that about 70% of U.S. adults failed an assessment of problem-solving efficiency in technology-rich work environments (p. 64).

Figure 3 Source: OECD, 2015
The OECD also found that a relationship existed between the level of a worker’s problem-solving proficiency within technology-rich environments and the level of their wages earned. The OECD found that “hourly wages for workers who perform at proficiency Level 2 or 3 are 26% higher than mean hourly wages for workers who perform below Level 1 (Figure 4).

**Figure 4 Source: OECD, 2015**

The magnitude of this widening wage gap is staggering and has recently begun to manifest itself in various forms of political and social conflicts within the United States. Having just endured what many consider it most contentious presidential election, the immediate question is how did we get here? What are the underlying causes of the growing wage inequalities plaguing the U.S. and, in fact, most of the industrial world? Does supply chain management play a role in this global dilemma? If so, in what capacity?

**The Underlying Cause**

While there is no literature that directly ties the evolution of SCM directly to wage and income inequality, we can show that at least one of the innovations—information technology
(IT)—which comprise SBTC reliance of most organizations and the exogenous and endogenous competition to which organizations have been exposed as a result of the globalization of supply chain evolution, while not the entire cause of wage inequality, are among the main drivers of wage inequality. The real problem is identifying the true underlying causes of income inequality and understanding their connection to the evolution of supply chain management and globalization?

Ghosh & Yamarik (2007) narrowed the list of primary causes of the widening wage gap to two causes: “increased competition from low-wage countries and skill-biased technological change from increased use of information technology” (p. 321). In order to appreciate the real effect of SBTC, we must investigate the origin of SBTC dependence for many organizations.

Integrating supply chain channels while adopting e-business strategies has given many organizations access to global markets and the ability to compete within those markets from extended proximities. However, integration and adoption have also exposed these same organizations to both exogenous and endogenous competition. Through review of relevant literature, both contemporary and noncurrent, this paper will seek to extrapolate an understanding of the emergence of and the relevant degree to which supply chain development and its requisite structural changes as well as its reliance upon SBTC has been a major driver of increased skill premia and wage inequality. Prior academic literature and research has investigated and revealed the underlying foundations for this phenomena—the realization that logistics cost represent a high percentage of GNP and that logistics decisions impact the entire supply chain from producer to customer (Heskett et al., 1973), the introduction of transportation deregulation during the 1970s and 1980s, the introduction of internet business applications in the 1980s, and in 1993 the passing of the North American Free Trade Agreement (NAFTA)
(Gerstanzang & Ross, 1993)—have laced businesses into a positions where they must transfer operations outside of the country and rely heavily upon SBTC in order to compete against foreign competition.

Some of the literature look to deregulation and globalization as the culprits in the rising wage gap. To a certain extent this is true but not to the extent that one could reverse deregulation laws and dissipate wage inequality.

**Deregulation**

The period of regulatory changes commenced in the late 1970s through to the early 1980s and certainly had an effect upon the real wages in all modes of transportation: truck, rail, and ship. However, deregulation’s affect upon wages differed for each segment of transportation depending upon the level of skill required within the industry as well as the level of union representation. Although all three transportation modes faced similar regulation and then deregulation, their labor markets had differing reactions to the effects of deregulation. According to Monaco and Brooks (as cited by Habermalz & Monaco, 2007) trucking experienced an initial decline in employment but later recovered. Rose, et. al (as cited by Habermalz & Monaco, 2007) found that wages dropped substantially between 10 and 30 percent depending upon the level of union representation within the segment. Trucking is comprised of two segments: TL (truckload) or LTL (less than truckload). Because of the lack of collective bargaining power, TL saw the consolidation of large carriers and the entry of many small firms. Also, many firms provided both TL and LTL services. This level of competition discouraged unions like the Teamsters and resulted in lower wage structures in the segment. In the LTL segment, unions were able to accept concessions regarding the size of work crews in order to maintain higher wages (Habermalz, & Monaco, 2007). Ocean carriers, on the other hand, were highly unionized prior to the
deregulation. The impact upon earnings was negligible after the Shipping Act of 1984 according to Talley (as cited by Habermalz & Monaco, 2007), but the increase in shipping volume after the Reform Act of 1998 did lead to an increase in jobs and wages. However, Talley does attribute some of this to the introduction of SBTCs as a result of containerization, which was introduced in the 1950s, and the increase in container size leading to certain “economies of density” (Habermalz & Monaco, 2007, p. 8). Moreover, increased demand for ocean shipping due to technology improvements and the increased efficiency of operations improve the strength and bargaining position of the ILWU (International Longshoreman’s Warehouse Union) and ILA (International Longshoreman’s Union) result in falling rail wages throughout the 1980s and 1990s (Habermalz & Monaco, 2007).

An interesting caveat of transportation deregulation is that managers and professionals were able to avoid wage declines as the skill premia for these positions increased with the industries’ reliance on SBTC. Even managers and professionals in trucking, which experienced the lion share of transportation wage declines, were able to maintain and eliminate the gap in wages with counterparts in other transportation sectors (Habermalz & Monaco, 2007). This gives a measure of credibility to the argument for SBTC and the corresponding skill premia rather than regulation playing the larger role in wage inequality, especially since operators within the trucking sector earned significantly less than their counterparts in rail and water transport (Habermalz & Monaco 2007).

**Free Trade Agreements**

Still other literature cites free trade agreements, especially NAFTA (North American Free Trade Agreement) and the cause for not only wage inequality but also the loss of substantial American jobs. Even before its passing in 1993, the agreement was under scrutiny. That year an
impassioned speech, almost a plea, was given before a congressional hearing by Texas businessman and billionaire, H. Ross Perot (as cited by McCleery & Imada, 1991) stating that:

“Our manufacturing base, which is the heart and soul of our job base and our tax base, is declining. These are our highest paying working jobs and the core of the tax base. Only in America would we export 2 million manufacturing jobs to Asia alone in the 1980’s.... The standard of living in our country has gone down for four out of five American families during the 1980’s.... Now let’s look at where we could be 10 years from now if we follow the policy we’re on now.... OK. We’re hit with a problem again. Here’s what we’ll have to do. We have to go to Europe and Asia and respectfully ask, could we have some steel? And then we go to Russia and say, may we have some aluminum? And then we go to the Middle East and beg for oil because you can’t fight a war without oil. Then we go to Asia and beg for integrated circuits because 19 out of 20 are made over there that we use here now. Then we go to Asia and south of the border, and this is interesting when you consider our history at Valley Forge, when our troops fought barefooted in the snow. We’ll be back over saying, would you make us some boots, and would you make us some uniforms because we shipped all those industries over to you. And finally, we’ll have to go to Puerto Rico and beg them for drugs and pharmaceuticals.”

The following month Thea M. Lee (as cited by House Committee on Government Operations, Employment, Housing, and Aviation Subcommittee, 1993) gave an accounting of the research conducted by her institute before another congressional hearing, stating, “...that
NAFTA will accelerate job loss in the United States and put downward pressure on wages and working conditions, while doing very little to alleviate poverty and unequal distribution of income in Mexico.” (p. 25).

The following year Gloria Johnson (as cited by Committee on Government Operations, Employment, Housing, Aviation Subcommittee, 1994), president of the Coalition of Labor Union Women, also testified before congressional hearing that:

“A preview of what is expected is already seen in the Maquiladora factories along the Mexican border…. I think what has happened along the border ought to affect or be of concern to all of us…. In 1970 there were 64 factories on the border. In 1980, 420. Today there are 1,750 U.S. corporations that have established on the border factories that for the most part have taken away or reduced the work force in the United States, and increased the production there.” (p. 81).

Despite the substantive and academically-endorsed testimonies given before these congressional bodies, proponents were able to sway the House and the Senate by offering what amounted to unsubstantiated opinion. Jeffery J. Schott (as cited by Committee on Government Operations, Employment, Housing, Aviation Subcommittee, 1993), Senior Fellow at the Institute for International Economics, gave the following statement the same day as Gloria Johnson:

“It is important to keep in mind one simple fact: NAFTA requires little change in existing US policies. Overall, the NAFTA provides significant benefits for the US economy. Increased trade with Mexico will continue to boost US income and employment. But it is important to emphasize that, over the long term, the main impact of larger US-Mexican trade will not be
a gain or loss of jobs per se, but higher incomes made possible by greater efficiency... By widening the scopes of the market and enlarging the range of available labor skills, the NAFTA enables North American firms and workers to compete more effectively against foreign producers both at home and in world markets” (pp. 54-56).

In November of 1993, the House of Representative approved NAFTA by a 234 to 200 vote (Gerstenzang & Ross, 1993). The Senate also approved the measure in the same month (Gerstenzang, 1993). Twenty years after the agreement was signed, Jeff Faux (2013, December 9), founder of the Economic Policy Institute, believes that “By establishing the principle that U.S. corporations could relocate production elsewhere and sell back into the United States, NAFTA undercut the bargaining power of American workers, which had driven the expansion of the middle class since the end of World War II. The result has been 20 years of stagnant wages and the upward redistribution of income, wealth and political power” (para. 2). NAFTA affected workers in the U.S. in four ways: loss of jobs, loss of collective bargaining power, dislocation of millions of Mexican workers and their families, and became the template by which the global economy would be forged. As production moved to Mexico, 700,000 jobs were lost mostly from states where there was a concentration of manufacturing. Immediately after the signing of NAFTA, employers began threatening to move operations to Mexico if workers and unions did not accept lower wages and benefits. South of the border, Mexican agriculture and small business sectors were economically destroyed by the influx of American businesses dislocating millions of Mexican workers and causing a dramatic increase of illegal immigration of workers into the U.S. labor market. Finally, “the U.S. governing class—in alliance with the financial elites of its trading partners—applied NAFTA’s principles to the World Trade Organization, to
the policies of the World Bank and IMF, and to the deal under which employers of China’s huge supply of low-wage workers were allowed access to U.S. markets in exchange for allowing American multinational corporations the right to invest there” (para. 3-4).

Review of the previous literature investigating the effects of deregulation and free trade agreements upon wage inequality indicates that deregulation did have some affect upon wage inequality but only to the degree of each transportation sectors’ ability to adapt to SBTC and to satisfy the resulting skill premia. Free trade agreements, which represent the foundation of the global economy and facilitated the restructuring of manufacturing bases, played a significant role in creating wage inequality. These two outcomes support the conclusions of Ghosh & Yamarik (see page 16) as we see those transportation sectors—ocean shipping and, to an extent, rail—able to maintain their wage levels for above that capable in transportation. This disparity can be directly attributed to SBTC and the requisite workplace reorganization it requires. Also, one of the principle effects of free trade initiatives such as NAFTA was the introduction, through relocation of manufacturing, of competition from low-wage countries.

**Skill-biased Technical Change (SBTC)**

Some argue that globalization is a product of SCM development, others argue that SCM development is a product of globalization. For the purposes of this paper, the relevant argument is whether or not globalization promotes poverty and, if so, to what degree and how that promotion is distributed among populations. Globalization proponents take the position support the position that experience adequate gain from international trade, while its detractors submit that most of the gain from international trade go to those who are not poor. Ravallion (as cited by Aradhya, Rahman & Seenivasan, 2007) that globalization can only be viewed as lowering poverty if one accepts the premise that trade does not affect inequality. This view is supported by
“the fact that access to new technologies favors skilled and educated work force rather than unskilled laborers” (Aradhya, Rahman & Seenivasan, 2007). Despite this fact, inequality in developing countries will experience declines due to the rise in demand for unskilled labor in those countries. However, in developed countries, such as the U.S., the opposite may be true. Since the majority of well-paying unskilled jobs are being moved to low wage locations which are typically developing countries where wages are lower and unskilled workers more plentiful. However, in developed countries, like the U.S., the effect of globalization has been increased skill premia. Acemoglu (1999) defines skill premia as the ratio between the technological requirements placed upon a labor market and the relative supply of technical skills possessed by labor within that market. Skill premia and SBTC are self-perpetuating phenomena because “Skill premia are determined by the relative supply of skills, the degree of skill bias in technology, and international trade. Skill bias is endogenous, determined by the relative profitability of developing different types of technologies. An increase in the number of skilled workers expands the market size for skill-complementary technologies, and induces skill-biased technical change” (p. 25).

Limitations of the Study

The findings in this paper are limited to speculation regarding the relative relationship between factors indicated by the research as having direct impact upon wage inequalities and their links to SCM. The findings of this study rely on the accuracy of the models and findings of the research of economists and academicians published within academic journals and government publications. By examination of this literature, we may make connections between the direct causes of wage inequality and those high-level drivers of these causes. However, we are not able to say without doubt that these drivers are capable of reversing the inequality trend
should they be reversed. We only present evidence from the research and present it for consideration as revealing the long-term drivers of wage inequality within the U.S. labor market.

**Conclusion**

This paper sets out with the intent to identify and explain the influences of SCM practices on the development and expansion of wage inequality. We first investigate the rationale behind the evolution from traditional physical distribution systems to the foundations of contemporary supply chain systems. Forrester’s (1958) early recognition of the importance of “the interactions between flows of information, materials, money, manpower, and capital equipment” was the impetus for intensified study of physical distribution and logistics (p. 37). The formation of the NCPDM in 1963 and its study throughout the 1960s and 1970s of strategies and tactics for logistics in physical distribution led to the adoption of a total cost perspective and a drive toward achieving efficiencies by organizations within the industry.

Deregulation and the introduction of the computer by the end of the 1970s saw companies of any size begin to focus on finding efficiencies throughout their organizations and within the extended supply chain. The period between the 1980s and the 1990s saw the introduction of the internet and free trade agreements which made it possible for globalization to accelerate. Organizations began to become multinational entities who outsourced functions and relocated operations in order to cut cost and achieve competitive advantages. The level of coordination required to integrate and maintain extended networks such as this required buy-in from top management at each partner organization within the supply chain and that competition had become “supply chain versus supply chain rather than firm versus firm” (Ketchen & Hult, 2006, p. 573). Such levels of coordination and collaboration required the use of e-business tools
(e-commerce, e-procurement, and e-collaboration) in order to integrate activities and information flows for the optimization of processes at the inter-company level (Cagliano et al., 2005).

As these e-business tools became more profitable, they required the development of more skill-based technologies which required a larger supply of skilled labor. As the demand for skilled labor increases, so does the skill premium. The cycle repeats as profitability levels rise as a result of the skill-biased technology inspiring still more SBTC and widening the wage gaps as skill premia increases again. Although they cite an individual’s exposure and adeptness with information and communications technology (ICT) as influential to that individual’s wage, Psacharopoulos and Patrinos (as cited by Smith & Fernandez, 2015) “conclude that at the individual level ‘it is established beyond any reasonable doubt that there are tangible and measurable returns to investment in education’” (p. 7).
References


