Abstract

DHANDHANIA, VEDANT ANOOPKUMAR. Comparison of Global Textile Manufacturing Cost. (Under the direction of Dr. William Oxenham).

Textile manufacturing had almost completely shifted to Asian countries in late 1990s because manufacturing of yarn and fabric in the US was not cost competitive. High labor costs and not enough government policies in favor of local manufacturers almost killed textile manufacturing in the US. Various trade agreements gave US consumers access to low cost textile goods from other countries. In the past few years, it is being found that opportunities to manufacture textiles in US once again does exist and it is slowly returning back after more than a decade.

This research compares the cost of spinning, weaving and knitting in US with other countries that include Brazil, China, Egypt, India, Italy, Korea and Turkey. It also compares the cost of raw material in various countries over the period of time, which might have contributed in the comeback of textile manufacturing back to US. This also led to findings that highlighted areas where there may be potential improvements, so that the total cost may be possibly further reduced, thus ensuring that the US can maintain its long-term competitiveness.

This research concluded that cotton spinning and fabric manufacturing has a good potential to be produced in US with great cost competitiveness. The biggest driver behind bringing this textile manufacturing back to US is the availability of cotton at inexpensive rates. Other factors like low cost and plentiful power provisions and automations in textile industries, which reduced the need of as much labors, contributed in making US capable to produce one of the most inexpensive rotor yarns in the world.

Comparison of Global Textile Manufacturing Cost

by
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Dedication

This thesis is dedicated to my parents, Abha and Anoop Dhandhania.

For their endless love, support and encouragement

Biography

Vedant Dhandhania comes from a small town of Ichalkaranji in India that consists more than hundred and twenty five thousand fabric manufacturing looms. He evolves from a Textile business family and his interest in Textiles has been since his childhood. His father is a yarn trader and Vedant used to discuss the yarn and fabric rates and its fluctuations on the dinner tables almost on daily basis. He completed his bachelor's degree in Textile Technology at D.K.T.E. Society's Textile and Engineering Institute, which is the premier engineering college affiliated to Shivaji University, India. From there, Vedant headed straight to Raleigh, North Carolina where he got an opportunity to work under Dr. William Oxenham on a topic which was directly related to his family business.

Vedant was also always interested in technical textiles and he successfully completed his internship at Apple Inc. He has a full time offer from them and plans on joining Apple on his graduation.

Acknowledgements

My sincere thanks goes to Dr. William Oxenham who not only provided me an opportunity to join his team but also permitted me to use my summer semester for an internship experience. I thank my committee members: Dr. Kristin Thoney and Dr. George Hodge for their insightful comments, encouragement and time. In particular I am grateful to Dr. Oxenham for enlightening me the first glance of research.

I would like to thank Mr. Rahul Diddi, owner of Diddi Capital Advisors Inc. for taking interest in my research all the time, which motivated me and made me realize the importance that my research holds in the industry.

Last but not the least, I would like to thank my family: my parents, my brother and sister-in-law, and my dearest fiancé for supporting me throughout the thesis. Without their precious support it would have become very difficult for me to complete this research on time.

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Chapter 1 - Introduction

This research has two different aspects to cover. One of them is the cotton price volatility and its reasons and effects. The other is the reason behind the return of textile manufacturing back to US. US was once one of the biggest producers and exporters of many textile products until the Asian countries took over in late 1990s. Many trade policies were introduced in order to maintain some textile businesses in the US. In recent years, the fluctuation in the prices of raw material and the changes components of in manufacturing costs have resulted in a lot of Textile Industries to consider US for its manufacturing. It is projected that the US total textile and apparel markets may touch $29.5 billion in 2015 which is a 21% increase compared to $24.3 billion in 2014. Both politics and industries are making efforts to move certain manufacturing back to US in order to create more 'Made in US' products as well as more jobs. Net profit from alternate crops like maize, soybean, wheat, sugarcane and rice also influences the choice made by farmer which affects the total cotton produced and its prices in that season. The effect of raw material price fluctuation on subsequent process is discussed in the paper. Existing market forces like rising wages, transportation costs, land prices, and strengthening Chinese currency in addition to rising raw material costs might influence the relocation of textile industries back to US. The goal of this research was to compare the textile manufacturing cost of various countries and find opportunities and challenges that US is likely to face in bringing textile manufacturing back to US.

Chapter 2 – Literature Review

The knowledge of the work already being done in this field is very important to answer the research question of this study. The review starts with the supply chain of Textiles industry around the world after a briefing on the history. This is followed by a review of the importance of cotton prices in textile processes and the effect of the 2011 price increase on subsequent processes. Next, the challenges and opportunities of US textile manufacturing is reviewed where trade agreements and their impact on manufacturing is also covered. Finally, the recent investments in textile industries in US is reviewed and listed.

2.1 History of US Textile Manufacturing

What helped an agrarian Great Britain to emerge as an industrial society was agricultural income from food, cotton and wool. This was in the early 19th century and soon this industrialization spread to others in Western Europe and North America (Hinshaw and Stearns, 2014). After the World War II, various forces like the employment act of 1946 were the reasons behind the development of Textile and Apparel supply chain because of the labor-intensive nature of the industry. US had become a big manufacturer of Textile and Apparel products but in the late 1980s, it started to shift to Asia. The life style of people in US had drastically improved over the period of time because of improved incomes and the social security of the people had become a major concern for the government, which resulted in strict environmental laws on noise, dust, and water and air pollution standards. It became difficult for those primitive textile industries to abide to these standards and this was one of the reasons, which restricted further development. There was a lack in any kind of Government support in the 1970s when only the tariff trade protection existed, which was

another reason that US Textile and Apparel firms were not able to survive anymore. In such circumstances, Copper says, only 25% of the firms survived (Copper, 2013).

In 1935, President Franklin Roosevelt examined the problems of imports of textiles and apparel and imposed restrictions on Japanese imports. America's focus was on World War II from 1940 to 1952 and problems associated with textile and apparel trade went unnoticed. Further in 1957 and 1971, negotiations on a lot of bilateral agreements with Japan, Hong Kong, Korea and Taiwan took place with a view to impose limitations on imports. With a view to assist textile trade, Multi fiber agreement (1973), Caribbean Basin Initiative (1983), Jenkins bill (1986) and several other agreements were passed. Conclusion of 1988 witnessed the establishment of free trade agreements (FTA) by U.S and Canada, which wiped out duties on most products traded. Later, in 1992, the President of US ratified NAFTA, which involved US, Canada and Mexico. By 1995, NAFTA and WTO took over GATT. In 2000 the Caribbean Basin Trade Partnership Act (CBTPA) and African Growth and opportunity act were approved. MFA was abolished by constitution of the agreement on Textile and Clothing (ATC), which consequently resulted in gradual termination of quotas based on bilateral agreement by 2005 (Glock and Kunz, 1995).

2.2 Textiles and Apparel Supply Chain

2.2.1 Shift in Textile Production

The implementation of NAFTA winnowed out thousands of U.S. jobs. Over last 40 years United States and its other counterparts have always tried to shield their domestic textile and apparel industry from the developing countries and their cheaper imports. Cotton, synthetic yarns and other garments such as t-shirts and sweaters were allowed to be imported

from 70 countries as a result of the quota system imposed through multilateral trade agreement. This resulted in the textile buyers to buy from wider array of countries where quota is available instead of simply buying from the ones with the cheapest labor. The quota system has been abolished and buyers can now source from member countries of WTO. However, each country is still subjected to targets that vary from country to country and is governed by bilateral and regional agreements (as cited by Burris, 2015 from Plunket Research, 2014).

2.2.2. Existing situation of Production, Marketing and Consumption

Designing, branding and marketing are the areas of focus of the developed countries like US, Europe and Japan in textile and apparel supply chain. Other emerging countries like Pakistan, India, China, Bangladesh; Vietnam and Indonesia are players in manufacturing sector. Countries like Hong Kong, South Korea and Taiwan sometimes play a unique role on global textile and apparel supply chain, which connect manufacturers to designers and traders from developed countries. China, European Union, India, Turkey, Bangladesh, Vietnam and US are the top seven in the list of textile and apparel exporters (WTO, 2014). However, U.S. free trade agreements have favored the U.S textile and apparel industry. Major US textile production is exported to western hemisphere nations that are members of NAFTA, CAFTA-DR or CBI. What might further support the US Textile and Apparel industry is the ongoing TPP and free trade agreement with Africa. The Trans Pacific Partnership agreement, if passed with the Yarn forward rule, will help the US cotton and yarn producers to connect with other TPP countries. The Yarn forward rule demands that the yarn and fabric used in the finished product should be manufactured in one of the TPP countries.

The increase in US textile exports will bring more textile manufacturing back to US which will generate some employment, as textile manufacturing is labor intensive in nature (Lu, 2015).

2.2.3 Expectations from US

98% of US consumer demand for textile and apparel in the US is satisfied through imports, which makes United States the 2nd largest importer of clothing, accounting for 19% of the world imports. US export textile products such as yarn or fabric, which are used as intermediate materials for products manufactured overseas. After the manufacturing is done, the final product is imported back to the United States for retailing. US exports include specialty and industrial fabrics, spun yarn and thread, felt, nonwovens etc. These accounts for nearly half of the total Textile and Apparel export from U.S. and its major market is North America, South America, and Caribbean countries. Mexico and Canada are the top two export markets for US textile and Apparel industries because of NAFTA (Lu, 2014).

CAFTA-DR and the CBI are the other free trade agreements, which provide incentives. Certain exports from FTA member countries may enter US markets duty free, provided they are made of textile yarn or fabric in the partner countries. Consequently manufacturers in Mexico and Canada are motivated to use yarns and fabrics made-in-US to manufacturer apparel, home furnishing and other textile products (Platzer, 2014).

It is projected that the US total textile and apparel market is to touch 29.5 billion in 2015, which is 21% increase, compared to 2014, which was 24.3 billion. Efforts are made by both politics and industries to move to certain manufacturing back to US in order to create more ‘made in US’ products as well as more jobs (Lu, 2015).

2.3 Cotton Price Volatility

Cotton Outlook publishes the cotton prices since five decades, which is called the Cotlook A Index. This publication indicates the international cotton price for Upland variety cotton. This index is calculated on everyday basis and is based on the prices offered to spinning mills. The past three seasons provided conditions of relative price stability for cotton, which had experienced shocks of price volatility in 2010/11. Many merchants incurred heavy losses due to this unpredictability. The prices of cotton fell drastically in a very short span of time. This resulted in many firms to go bankrupt or dissolve and some merged with other firms. Most of these firms included family businesses operated within the family or those dealing in single commodity. The biggest reason behind these losses to firms was speculation. The increase in prices of cotton till March 2011 gave them profits like never before. Speculation of cotton and yarn in large quantities at highest rates resulted into heavy losses to them when the prices of cotton started to fall (International Cotton Advisory Committee, 2015).

Cotton prices increased in 2010/11 reaching record levels of $2 a pound. Thus a drastic increase in cotton plantation was projected. But contrary to these projections, the world cotton area increased only by 8% in 2011/12, which was, less than in 2010/11. Factors like competition with other food crops, limited availability of resources and weather conditions played its role (Gruere, 2011).

2.3.1 The Influence of Cotton Price Fluctuations on Textile Processes

Given the multiple process involved in manufacturing of cotton apparel (i.e. spinning, fabric manufacturing, and apparel construction), the cotton supply chain is defined in terms

of fiber, yarn, assembled garment and retail stages.

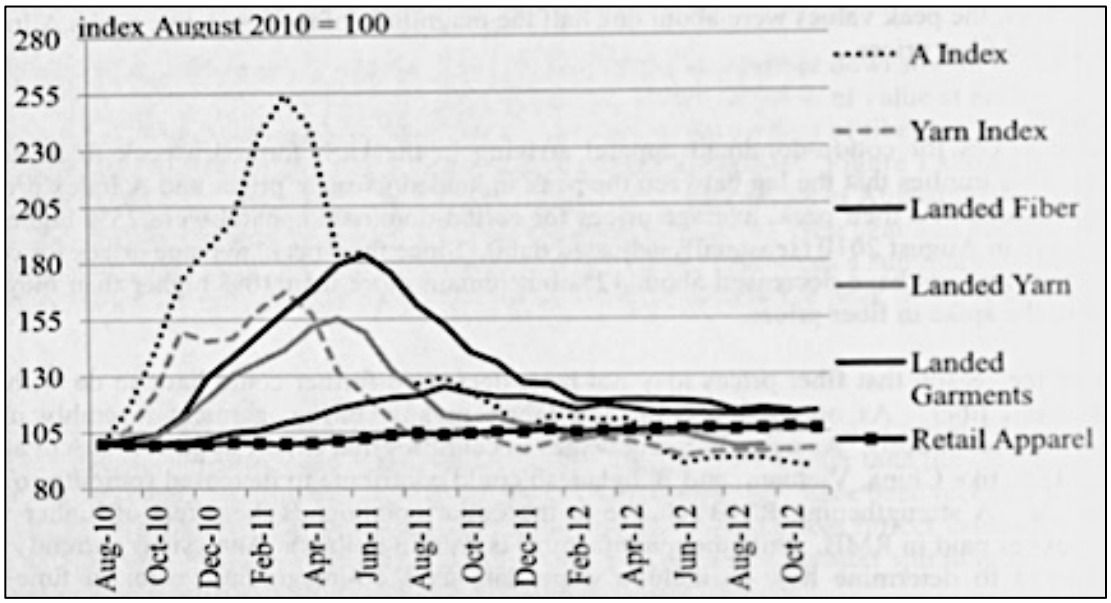

Figure 2.1: Graph of Changes in Prices Observed in the Cotton Supply Chain since August 2010. Source: (Devine, 2013)

	Month of Peak (in 2011)	Magnitude of Peak (versus Aug. 2010)	Lag of Peak Relative to A Index
Quoted Prices			
A Index	March	+154%	n/a
Yarn Index	March	+67%	Contemporaneous
Landed Prices			
Fiber	June	+84%	3 months
Yarn	May	+43%	2 months
Cotton Apparel	n/a	+25%	7 months

Figure 2.2: Changes in Prices Observed in the Cotton Supply Chain since August 2010. Source: (Devine, 2013)

Figure 2.1 and figure 2.2 indicate changes in prices of cotton observed in cotton supply between the period 2011 and 2012. It shows the impact of the cotton price rise of 2010/11 on the cotton supply chain. Due to increase in price of cotton, an effect on price throughout the

supply chain was observed. Statistics show that the volatility in 2011 had a direct impact on the spinning stage. However, the study shows that the effect of volatility kept on reducing at next supply chain level. It also had a lag (Devine, 2013).

2.3.2 Effect of Cotton Prices on cotton Production, Consumption and Exports

Globally, from 2001 to 2009, the prices of cotton began to rise, as there were major concerns that the cotton production would not be enough to meet demand. Following this trend the prices shot up from 60 cents per pound to more than $2 per pound in 2011. This resulted in a drastic reduction in demand of Cotton for some time. The use of cotton considerably reduced and US began to blend fibers replacing cotton with fibers like Polyester. This helped to normalize the cotton prices to a stable level in the following years after 2011.

After rising to an average of 91 cents/lb. in 2012-2014, cotton prices fell drastically by 23% to an average of 70 cents/lb. for the first six months of 2014/15. Contrary to this the prices of competing crops like maize and soya bean were steady compared to the previous year. Thus the farmers preferred cultivation of those crops to cotton crops.

The average world cotton yield was 803 kg/ha in 2013/14 and is projected at 783 kg/ha in 2014/15. The reason behind reduction in yield is probably drought issues in Texas. Figure 2.3 shows the US production, consumption and exports of cotton forecasted up to 2016 (Troy, 2013).

The projections of 2016 show a drop in production in figure 2.3. This might not hold true anymore because the textile industries are returning back to US and production is expected to rise.

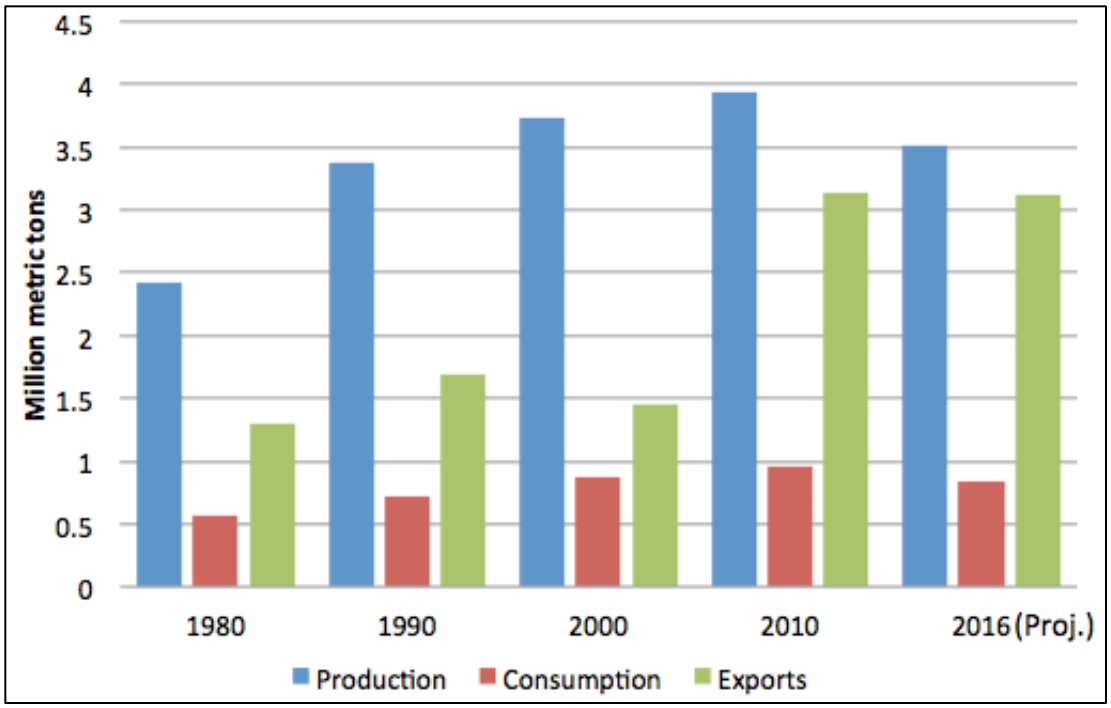

Figure 2.3: US Cotton Production, Consumption and Exports. Source: (Troy, 2013)

2014-15 proved to be a remarkable year for US cotton cultivation, which bounced by 31% to nearly 4 million hectares. The reasons behind this may be high prices for cotton at planting season and partial recovery from drought in Texas, the largest producing state. But in the spring of 2015, cotton prices have fallen which is resulting in farmers to shift to other substitutes of crop cultivation.

STAX is a new crop insurance program that guarantees a part of the expected revenue for a given year per farmer. Stacked income protection will be executed initially in 2015-16 in all the areas where US government crop insurance is currently available. Indeterminacy over size of yield in this new programme might also discourage the farmers to plant cotton in 2015-2016. Thus, Pandolph projects the area to decline by 10% to 3.6 million hectares (Pandolph, 2015). Figure 2.4 shows the world production and consumption of cotton, which

says consumption will exceed production of cotton in 2015.

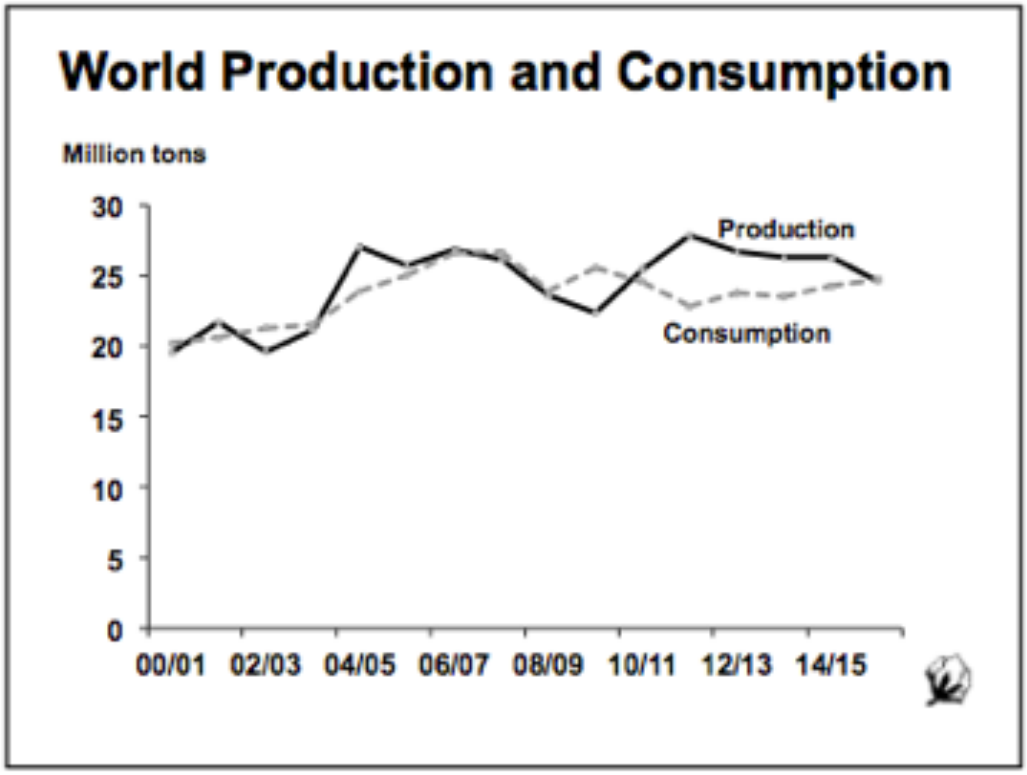

Figure 2.4: World Production and Consumption of Cotton. Source: (International Cotton Advisory Committee, 2015)

The master players, US and China, former being one of the largest exporters of cotton and the latter, one the largest producer of cotton in the world hold a power to control world cotton prices to a large extent. There is an innovation of STAX- Stacked Income Protection Plan which is supposed to provide premium subsidies to appraise cotton manufacturers to buy insurance policies that indemnify shallow revenue losses which is below the level generally covered by standard crop insurance policies. It is protection against loss of revenue due to an area level production loss, a price decline or a combination of both.

Sources have revealed that the Chinese government is busy setting up a target price

policy for cotton grown in Xinjiang. Due to ambiguity regarding the same, the cotton cultivation area outside Xinjiang is expected to fall in 2014/15 and China's overall cotton plantation area is expected to decline by 9% from the last season to 4.2 million hectares (Anonymous, 2014)

Increase in the consumption of cotton in Asian countries of Pakistan, Vietnam, Thailand, Bangladesh and Indonesia is expected in the next ten years. As the consumption of cotton in these countries has exceeded the production, they have a good potential for cotton to be exported into. Growing demand and consumption levels across the world as in figure 2.4 should lead to increased market opportunities for other cotton producing countries (Plastina, 2014)

According to the ICAC (International Cotton Advisory Committee), India and the US cotton cultivating areas have shown a monotonic increase by 5% and 29% respectively while the areas in China, Pakistan and Brazil have decreased. The fact that China is facing scarcity of labor, rising production cost and greater revenue from other competing crops has discouraged farmers from planting cotton (Huang and Kountcheva, 2015)

Pandolph predicts that the US exporters may recover 2.4 million tons in 2015-16 after two seasons of decline. For the first time in the last 5 seasons cotton consumption in US may reach over 0.8 million tons in 2015-16. Forecasts reveal that consumption of cotton will surpass production of cotton around the world by only 0.1 million tons as in figure 2.4. It is expected that consumption in China remains stable to about 8 million tons (one third of the world consumption) and India's consumption to be about 5.3 million tons and Pakistan around 2.4 million tons. Usage in Bangladesh, Vietnam, and Indonesia may be about 2.5

million tons together. Thus, the consumption cotton across the globe is expected to increase by 2% to 25.7 million tons in 2015-16 (Pandolph, 2015).

There has always been a significant correlation between cotton prices and area. If farmers see Cotton prices going up, the area of cotton plantation also goes up in the following season. But historic correlation could not be used to make any predictions. This is because of the fact that a 10% rise or fall in price in a given season is followed by a 3% increase or decrease in cotton area of cultivation. According to this law, what happened in 2011/12 could actually result in increase in world cotton area by about 33%. This actually did not take place because the price jump witnessed in 2010/11 was outside the range of year-to-year variation experienced over the last 3 decades (Gruere, 2011).

Also, in irrigated cotton production areas, availability and cost of water remained a constraint for increasing cotton cultivation area.

2.3.3 Cotton Vs. Man-made Fibers:

China cellulosic fiber output rose by 17.3% in 2012 after growing by 19.5% in 2011. Cellulosic fiber increased by 11% worldwide in 2011 compared to only 3.7% rise in global demand of fibers of all types. It increased by 12% in 2012 where world demand was still 3.7%. Clearly, it seems due to cotton volatility, few of its applications are been substituted by regenerated cellulosic, which is another reason why total acreage of cotton is falling. Man made fiber has always enjoyed higher growth rates than other fibers in the world market. The world fiber market advanced at a rate of about 2.7% where as manmade fiber enjoyed 4.7% and now takes 67% of total global fiber consumption. This might increase even further because of more applications being developed that require synthetic fibers (Engelhardt,

2014).

Bhattacharjee and Wahba say that the cotton price increment in 2011 left no other alternative for the US apparel retailers and brands but to move towards synthetic products. They also raised the cost of existing cotton apparels to compensate for the increase in cotton prices (Bhattacharjee and Wahba, 2011).

Research also indicated that the percentage of men's wear and women's wear containing cotton declined significantly from 2011 to 2012 as the use of synthetic fibers in both markets increase significantly. Though part of cotton was replaced by synthetic fibers in apparels, the average asking price for the end product still went up by 17% (Holmes and Cui, 2011) (Coates and Bastos, 2013)

2.3.4 Effect of Cotton Price Volatility on Decision of the Farmers

Net profit from alternate crops like maize, soybean, wheat, sugarcane and rice is one important point that influences the choice made by farmer. The graph of prices of maize, wheat and rice shows steep downfall in 2009/10 but rebounded back in 2010/11 and experienced sharp increase in the later half. The boost in cotton price during 2010/11 was so large that it outgrew growth in prices for most competing commodities, with an exception of wheat. The ratio of prices (Price ratio) of cotton to maize, cotton to soybean, cotton to rice and cotton to sugar calculated at planting time in Northern hemisphere (which accounts for almost 90% of world cotton production) rose in 2011. The price ratio of cotton to wheat increased very slightly. Price ration means the ration of price of one commodity to the price of other commodity (Gruere, 2011).

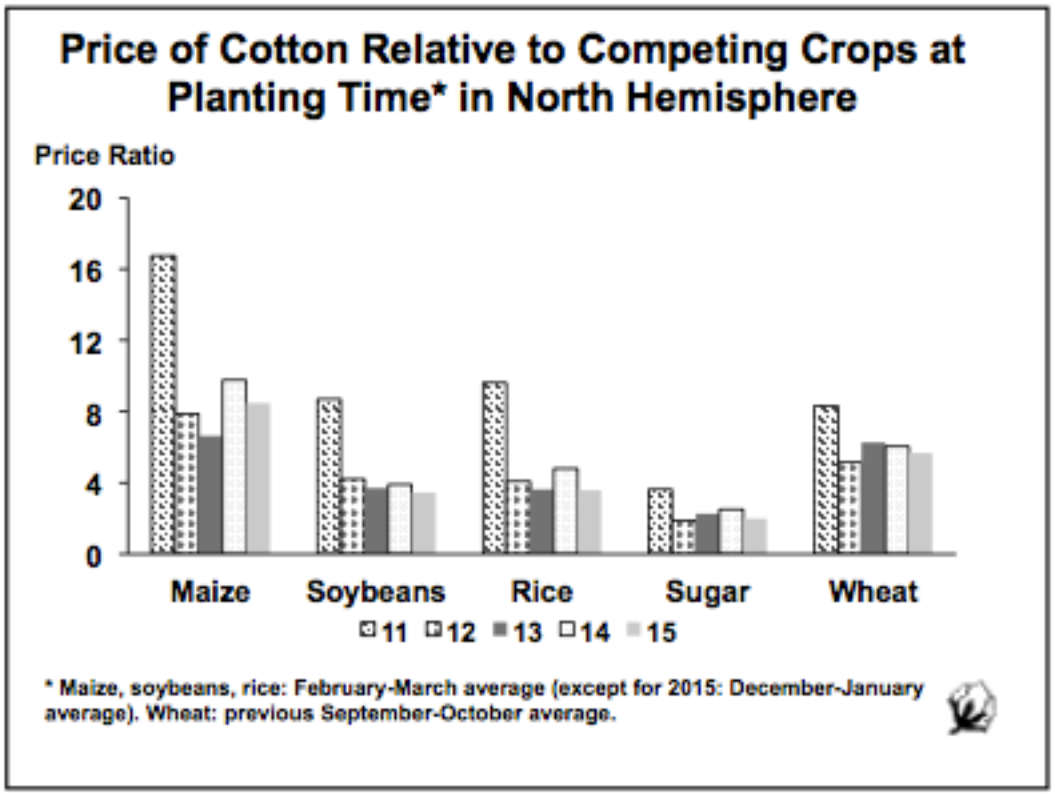

Figure 2.5: Price of Cotton Relative to Competing Crops at Planting Time* in North Hemisphere. Source: (Pandolph, 2015)

According to Huang high soybean values can fuel the expectations of a bigger acreage replacing some cotton acreage in key US planting districts (Huang, 2014). Figure 2.5 compares the price of cotton relative to competitive crop at the planting time in Northern hemisphere. If the price ratio of cotton to Soybean is four, it means that cotton is four times more expensive than cost of Soybean for that year.

Several segment producers such as ginners, warehouses, merchants, cottonseed handlers, cooperatives and manufacturers, have extended their support to cotton and hence it likely that this kind of unity and collaboration will enhance cotton cultivation over various other competing crops in US (Steadman, 2015).

2.3.5 Factors that Affect Cotton Prices

Price of cotton is very important to all stakeholders and the reason for this is that cotton is a multi-utility fiber as almost every part of cotton finds use in some way or other and is traded. There are two major factors that decide the prices of most commodities. First and the most important factor is the global demand and supply of the commodity. In addition to demand and supply, another major factor that largely affects cotton prices is government policy. Because the prices of cotton are governed by so many factors, predicting its future price has become very troublesome for the mill owners and the merchants. The factors that influence the prices of cotton is as follows (Marwaha, 2011):

1. Profits involved in other competitive fibers
2. World demand for consumer Textile
3. Discovery of new cotton market
4. Introduction of new and developed technology
5. Fluctuations in domestic cotton production
6. Price and other policies of government regarding cotton sector
7. Import/ Export scenario in the country
8. Fluctuations in currency value
9. China news related to Cotton

China has a major influence on the cotton price as it accounts for around 30% of global cotton fiber production. To some extent the fluctuations also depend on season of cotton which is as follows- India, Pakistan and US sowing commences from March, April and continues till May and harvesting is done in Nov./ Dec. whereas in China sowing is done in

Jan and harvesting from August to Sept (Marwaha, 2011). Figure 2.6 shows the seasonality index for Indian cotton. This index shows the trend of cotton prices because of seasonal changes where y-axis is the relative price of cotton and x-axis is months of the year. The month of April is assumed to have a cotton price of 100 units and other prices are relative to it as shown in figure 2.6.

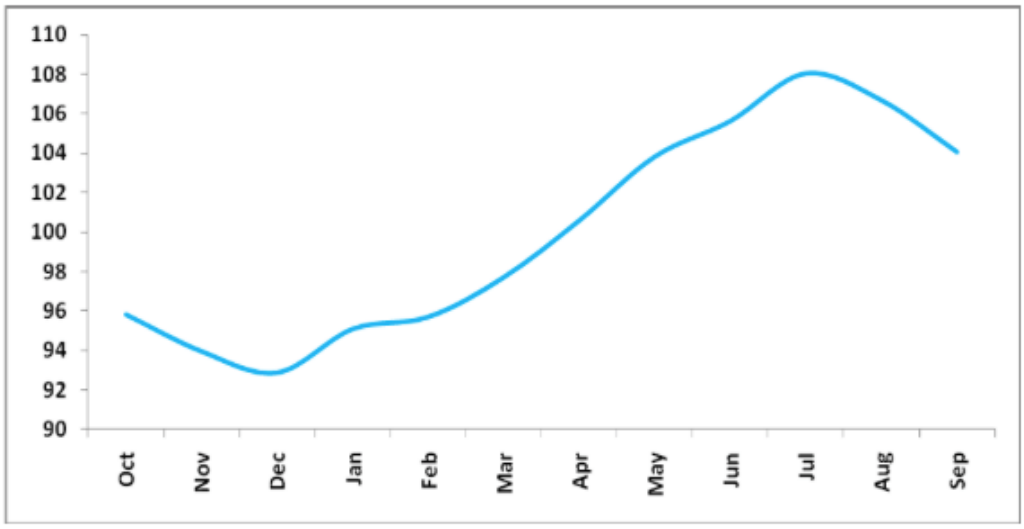

Figure 2.6: Seasonality Index for Indian Cotton. Source: (Marwaha, 2011)

2.3.6 Cotton Prices in Large Trading Countries

After climbing high in March 2011, international cotton prices fell sharply during rest of the calendar year. Gruere groups the cotton trading countries as small trading countries, medium-trading countries, large trading countries and countries with trade barriers and price control (Gruere, 2012)

Small cotton trading countries remain immune from immediate international price fluctuation of cotton. Even if they are insulated from sudden rise of fall in cotton prices, their internal prices often go parallel with international cotton prices. Over a given period of time,

exchange rate fluctuations can play important role in domestic price trends when variations in the A index are moderate. Medium cotton trading countries are in line with the A index. Coming to the large cotton trading countries like China, US and India, these nations do not necessarily reflect international prices trends as shown in figure 2.7 and figure 2.8. The government of these countries can insulate themselves from international influence by resorting to various measures and affect cotton prices in their domestic market. Such policies include import and export restrictions, domestic price support and system with fixed farmer prices. China and India are two big examples of such conditions (Gruere, 2012). The author also explains how did large cotton producing/ exporting countries react to the 2011 volatility.

When cotton prices had drastic fall from 2011 march to December, China still remained resistant to the fall in the prices of cotton and followed a different trend because of the government support price policy, the rebuilding of national reserve, as well as by import quotas and tariffs. The reported fall in the prices of cotton in China was just 39% as compared to 59% for Cotlook A index. The fall in prices in China was slowed by heavy government purchases of cotton for national reserve between Oct. 2011 and March 2012. The objective was to keep internal price above the support price says Gruere.

The US monthly farm price followed a very different trend as shown in figure 2.8 when compared to the sharp fall in the US cotton spot price like A index in 2011 and 2012. The reason for such a huge divergence in trend from international price trends is that US farmers tend to freeze in a sale price for a large part of cotton crop several months before the fiber becomes physically available. This strategy bore fruits when in 2011/12 the cotton prices were higher at beginning of the season than in the middle. In addition, export demand was

strong during the season as said by Gruere.

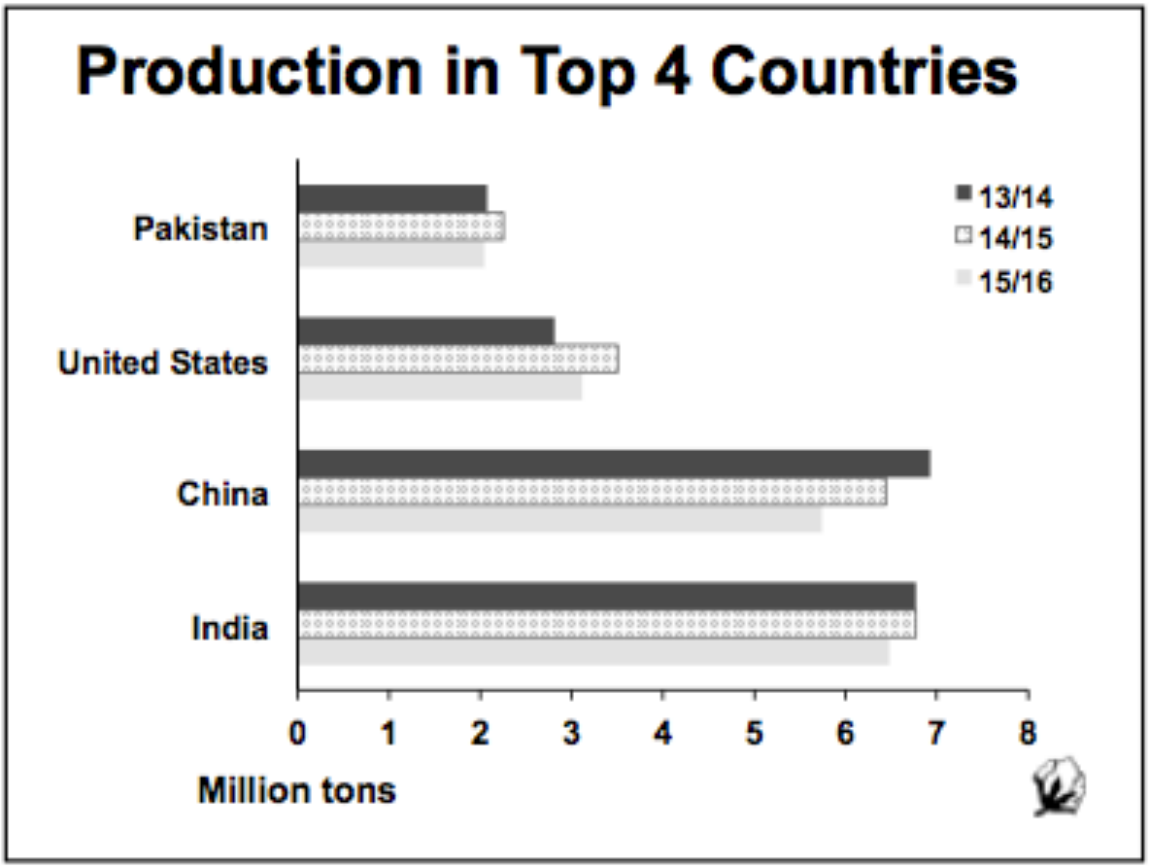

Figure 2.7: Production in Top 4 Countries. Source: (Pandolph, 2015)

The total drop of cotton prices in India was around 40%, which is also less than the decrease in Cotlook A index over the same period. The ban on exports announced on March 5, 2012 triggered a sharp but short-lived fall in cotton prices in India. Prices rebounded after ban was partially reversed on March 12 and maintained itself a little above A index (Gruere, 2102).

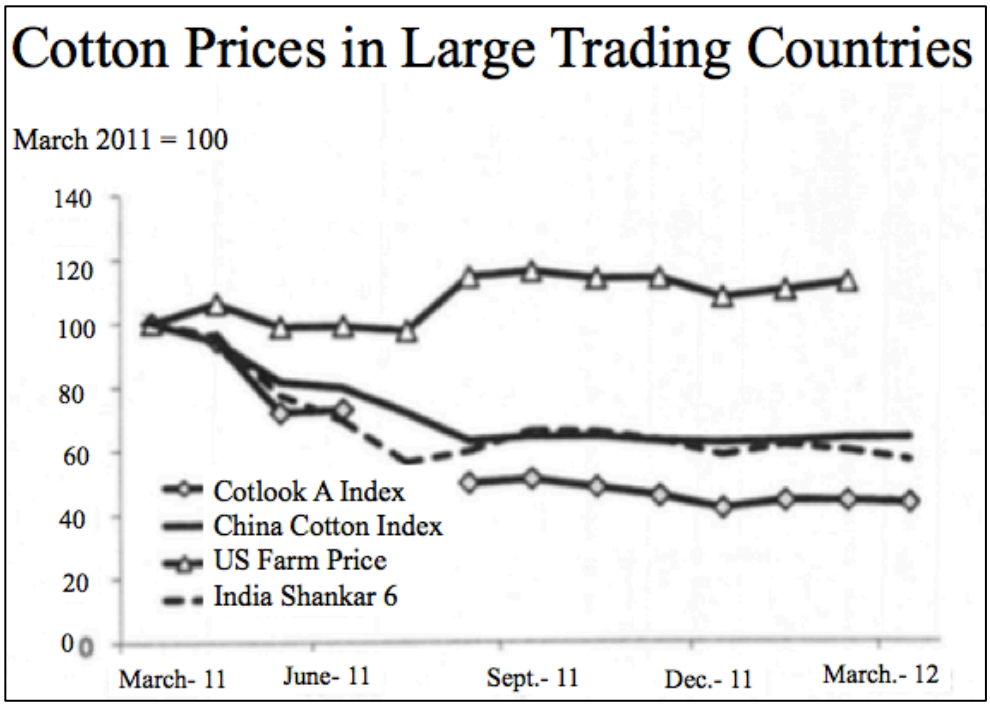

Figure 2.8: Cotton Prices in Large Trading Countries. Source: (Gruere, 2012)

2.4 The US Textile and Apparel Industry

2.4.1 Overview

China took over the Textile and Apparel industry in the later part of the twentieth century taking it away from the United States of America. Textile and Apparel industries almost vanished from the US and the industry experienced a $ 90 Billion decline between 1998 and 2012 and more than a million jobs were lost. One of the reasons behind this drastic fall in employment was clearly the involvement of China, which took away the domestic as well as International market of United States. The decline in demand for home textiles, which includes products like carpets/ rugs and other house furnishing products added to this loss and the reason of falling demand of home textiles was the falling housing and construction market in that phase (Copper, 2013). “The big weaving industries involved in producing

home textiles could no longer compete with the imports, mainly from Asia, and U.S. mills closed in the early 2000s, one after another," is as cited by Troy in his article. After home textile market reduced, even the apparel market went partially or completely to Asia because China joined the WTO and the multi-fiber agreement collapsed (Troy, 2013).

Although there was a storm which took away most of the market to China and other parts of world there is still a more than $ 70 billion economy for domestic US Textile and Apparel market which is also expected to grow for a number of different reasons that is explored in this paper (Copper, 2013).

Generation of employment in Asian countries was very important especially in highly populated countries like China and India and nothing could be better than the development of Textile and Apparel industries. In addition to employment generation, there were no restrictions on social costs like on noise, water, air etc. that were present in US. These countries were also successful enough to maintain skilled labor required for production. The biggest reason behind the growth of Chinese economy between 1980 and 2010 was availability of low cost and plentiful labor in addition to big investments in technology (Copper, 2013).

Thus, the markets shifted to China in the later part of the 20th century and China maintained its ability to produce low cost textile products over the past two decades. This resulted into a decline in the US Textile and Apparel manufacturing. US firms were in search of other businesses and they started concentrating on services more than they did on products. Over this period of time, US almost completely got dependent on China for its products and the Copper believes that the only way that US economy can come back on track

is by not being dependent on China for its products any more. Thus, US should concentrate on more internal production and it is only possible if it buys less from China and produces for itself. The Government policies can also be a major driving factor in accomplishing this comeback of internal production for US (Copper, 2014).

2.4.2 Advantages of Producing in US

Energy in US is cheaper than that in other manufacturing countries of the world. Energy in US is abundant and inexpensive. The production of shale gas in US makes them even more competitive. The energy benefit has made US so competitive today that it is capable to compete even with China. Wilson says "As recently in 2005, the price of natural gas in US was almost 3 times higher than in Europe. Today, natural gas in Europe is twice the price in US" (Wilson, 2013). Figure 2.9 compares the operating profits forecasted up to 2019. It is interesting to note that the operating profits in Textiles (mill and mill products) have gone up after 2011. Profits in apparel remain constant from few years.

Copper has cited that the major reason of manufacturing shifting back to US is going to be competitive edge in energy, transportation and reduced manufacturing cost due to better technology and productivity. When all the cost factors like energy, transportation, labor, land, machinery, productivity etc. are considered, the US States like North Carolina, South Carolina, Alabama, Tennessee and other southern states prove to be less expensive producing sites for certain products especially in spinning and weaving compared to other parts of the industrialized world.

Robert Reichard gives reasons why is it advantageous to manufacture in US. He points that labor costs in other parts of the world have gone up. In addition to that increasing

US research, innovation and diversity, improved delivery time, superior quality because of latest technology, an energy cost advantage, strong capital spending capacity, rising productivity, the made in US factor, rising exports, government's favorable policies, solid profits as other major benefits for production in United States (Reichard, 2014).

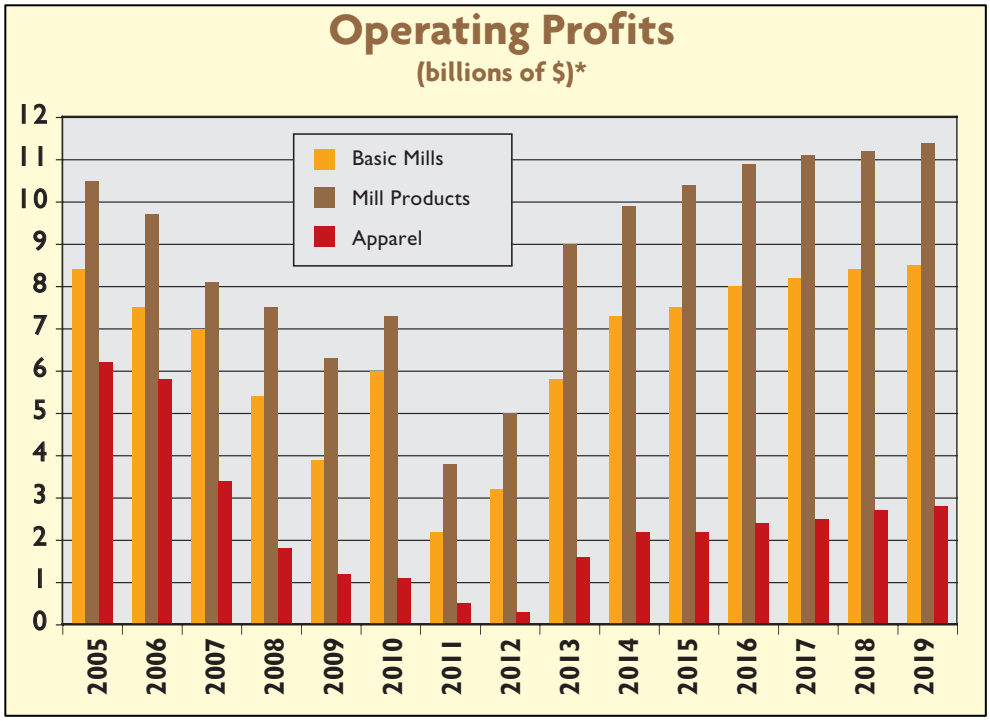

Figure 2.9: Textile and Apparel Operating Profits in United States. Source: (Reichard, 2015)

The increasing purchasing power of consumers in China and India will increase the demand and market of textiles in their own countries. The growing middle classes will also urge a need of increasing the social security. This might result into stricter standards in Environment pollution. The increase in domestic demand and change of government standards related to environment pollution might be some reasons of the shift of Textile manufacturing back to US.

Sperling forecasts that, existing market forces like rising wages, transportation costs, land prices, and strengthening Chinese currency might relocate the textile industries back to US (Sperling, 2012).

2.4.3 Labor Cost, Employment and Automations in the Textile Industry

Since the textile industry was labor intensive, the availability of low cost labor and often raw material cost was the most important driving factor for inexpensive production of textile products. Automation had not completely taken over. The US Textile and Apparel manufacturing drastically dropped because of availability of inexpensive labor in Asian countries. There was still some 25% textile manufacturing left but automation in the textile industry reduced the need of more workers and resulted in further unemployment in this field. Figure 2.10 shows the employment drop in Textile and Apparel industry from 1990 to 2014. More than 200,000 textile-manufacturing jobs were lost to automation in the last decade (Curtis, 2013). Copper says that because of this rate of development and innovation in automation in developed countries, there will be a need to re-think on employment options (Copper, 2014). Textile was once one of the most labor-intensive industries employing more than 1.3 million people in 1948. In particular southern part of United States used to be dominated by textile jobs in particular. The facts and figures about the past of North Carolina are astonishing. In 1940, 40% of the states manufacturing jobs were only in the field of Textile and Apparel. About 650 textile plants were shut down in the early twenty first century and thousands of jobs were lost (Curtis, 2013).

There has been a lot of automation and the labor requirement is itself falling in Textile manufacturing. Automations in autoleveling, automatic doffing transports systems,

automatic cleaning and automatic data collection in spinning industries have led to reduced labor requirements. The rotor and vortex/ jet spinning with winding also use automatic piecing, which drastically reduces the need of labor (Oxenham, 2015).

As in figure 2.10, there was a fall in employment from 1990 to 2010. Some of this drop in employment might also be because of automation in the textile industry, which must have reduced the need of labor. But, it should be interesting to note that there is no fall in employment after 2010.

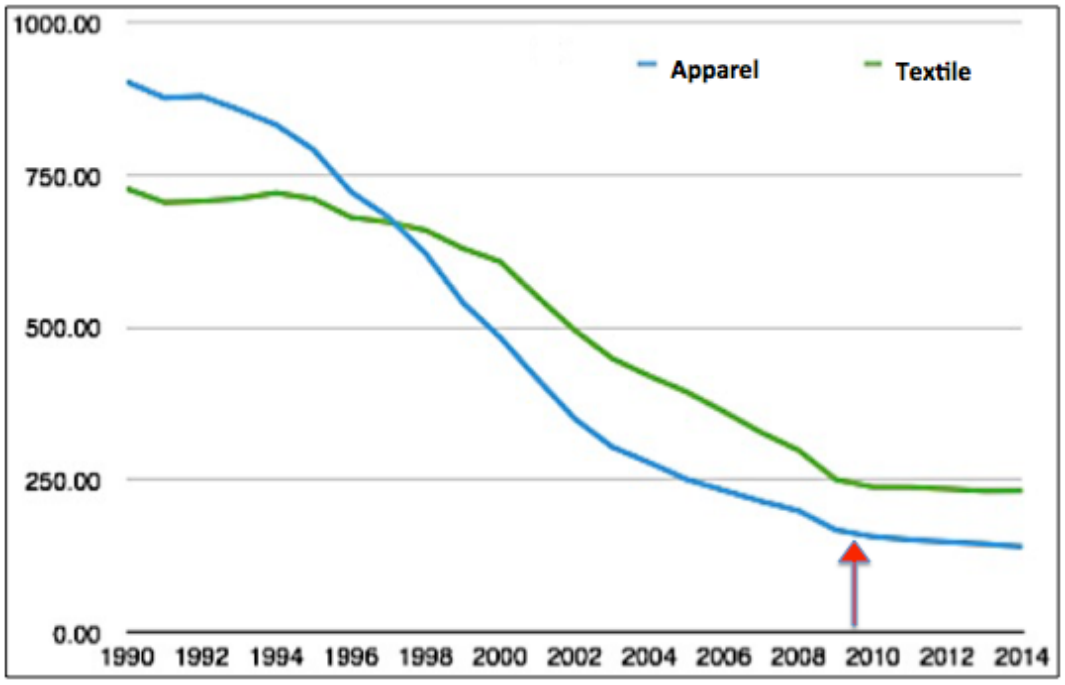

Figure 2.10: Employment in Textile and Apparel Industries (thousands) from 1990 to 2014. Source: (Burris, 2015)

As mentioned previously, one major reason behind the shift in manufacturing from US to China was availability of plentiful and low cost labor in China. This is the reason why China dominated Global Textile and Apparel production from more than twelve years. But, a

recent report in the New York Times says the Chinese workers were paid $3/day few years ago, which has now become almost $ 12/day. As now, automation has reduced the need of many workers and the labor costs in China have also gone up as shown in figure 2.11, this is a good time to consider the US manufacturing once again. But, as most of the textiles industries either closed or shifted from US more than two decades ago, there is a dearth of skilled workers now. This means factories are now struggling to attract the skilled labor and one big hurdle is training them (Curtis, 2013). According to Wilson, other developing countries like India and Indonesia will take over the textile manufacturing before US (Wilson, 2013). Capacity of India and other developing nations might not be able to accommodate the production volume of China if at all manufacturing industries plan to shift to other countries. So it is expected that some of it might come back to US.

Thus, rising wages in China coupled with higher transportation costs and tariffs for China forced the companies to consider American manufacturing sites. Mercer also reports that in 2012 among the left over textile jobs in the states, one third of it were concentrated in and around North Carolina and Georgia. Now, because of the advancement in technology, the textile industries are no longer as dusty and noisy like they used to be in the past and there is a big opportunity for it to return back to US. In fact, there are many new investments in the past five years in Textile manufacturing in US. The new technology is highly automated and requires lesser number of workers. But they are needed to be more educated and are paid higher than the base level workers. The advent of nonwovens has given rise to so many new markets for textile fibers. In the last decade, North Carolina has gained 1945 jobs and $ 719 million investment in nonwoven factories, which clearly indicates a comeback

of textiles in the form of nonwovens in North Carolina. Many have always preferred American made goods to Chinese made. Last year Wall-Mart planned to buy $50 billion of American made products among towels and washcloths (Mercer, 2014).

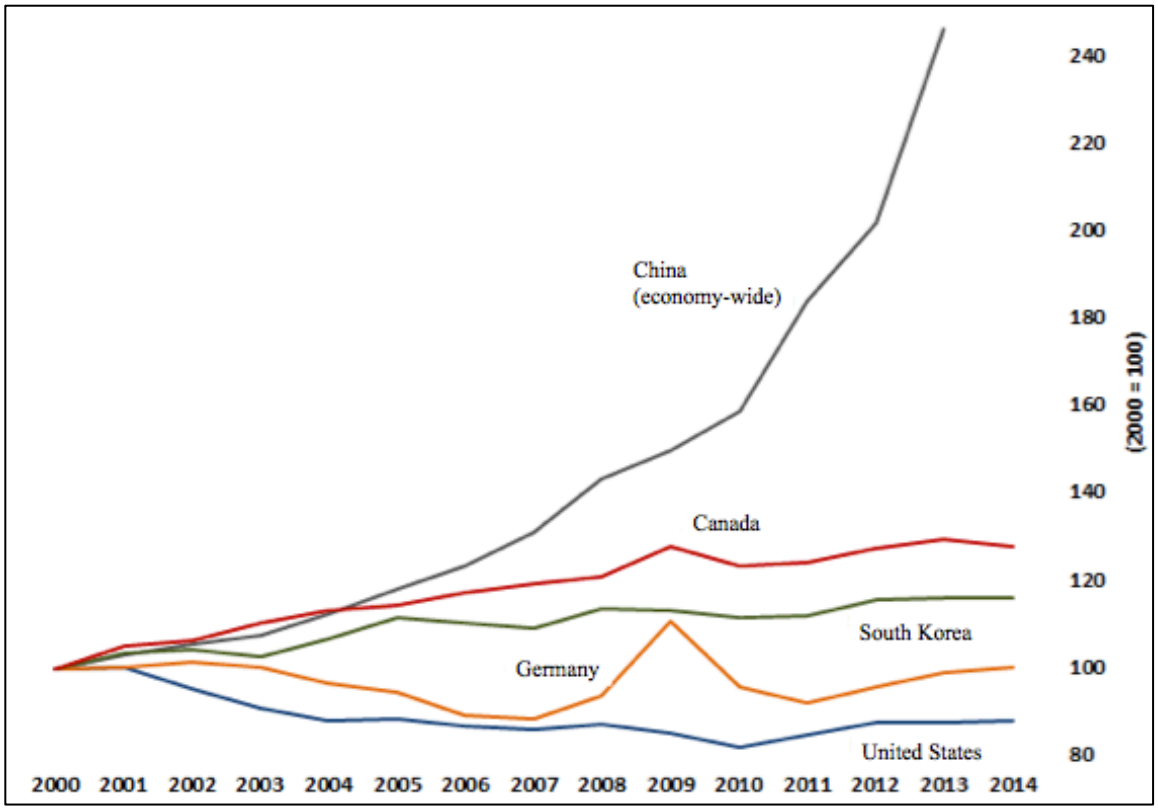

Figure 2.11: Indexed Unit Labor Costs in the Manufacturing Sector of Selected Countries, 2000-2014.
Source: Economics and Statistics Administration analysis of data from Bureau of Labor Statistics, International Labor Comparisons program and National Bureau of Statistics of China (Downloaded from internet: http://acetool.commerce.gov/labor-costs)

2.4.4 Apparel Production

As home textile require more energy and technology and not as much of labor, they have good scope of returning to US. But when it comes to Apparel production, it is still

labor-intensive and utilizes inexpensive labor. That is why nations like Bangladesh, Vietnam, and India etc. are enjoying garmenting units today and might do for a long time. The only way apparel production might return to US is by automation in this sector or by making it more technology intensive.

But, even if these kinds of labor intensive industries return back to US, it wont be for the purpose of generating employment but because of US's competitive edge in transportation, lead times, technology, quality and customer services. Even today only 12% of US private sector workforce is involved in manufacturing (Cooper, 2013). But, California is one big hub of Apparel manufacturing in the US and it is predicted that Los Angeles alone has almost 45,000 workers involved in Apparel production with a standard pay scale of around $ 10/hour. This pay is expected to increase to almost $ 15/hour in the next six to seven years and this will be a big challenge to the apparel industry in California and other parts of US. This might advance research in automating apparel production and reducing manpower required. Because of advancement in spinning industry so many labors are not required that has resulted in an increase in labor productivity. This resulted in many foreign investments in the spinning industries in US (Boreman, 2015).

2.4.5 Raw Material

Raw material accounts for almost 60 to 70 % of total sales in any textile firm. Thus, the volatility in cotton prices around the world might have had major effects in manufacturing shifts (Reichard, 2012). From figure 2.12, around 52% of total cost of ring yarn is raw material cost and that for rotor yarn is almost 72%. Also, labor cost for rotor yarn

manufacturing is comparatively lower than ring yarn because of more automation and lesser number of pre spinning processes (Oxenham, 2015).

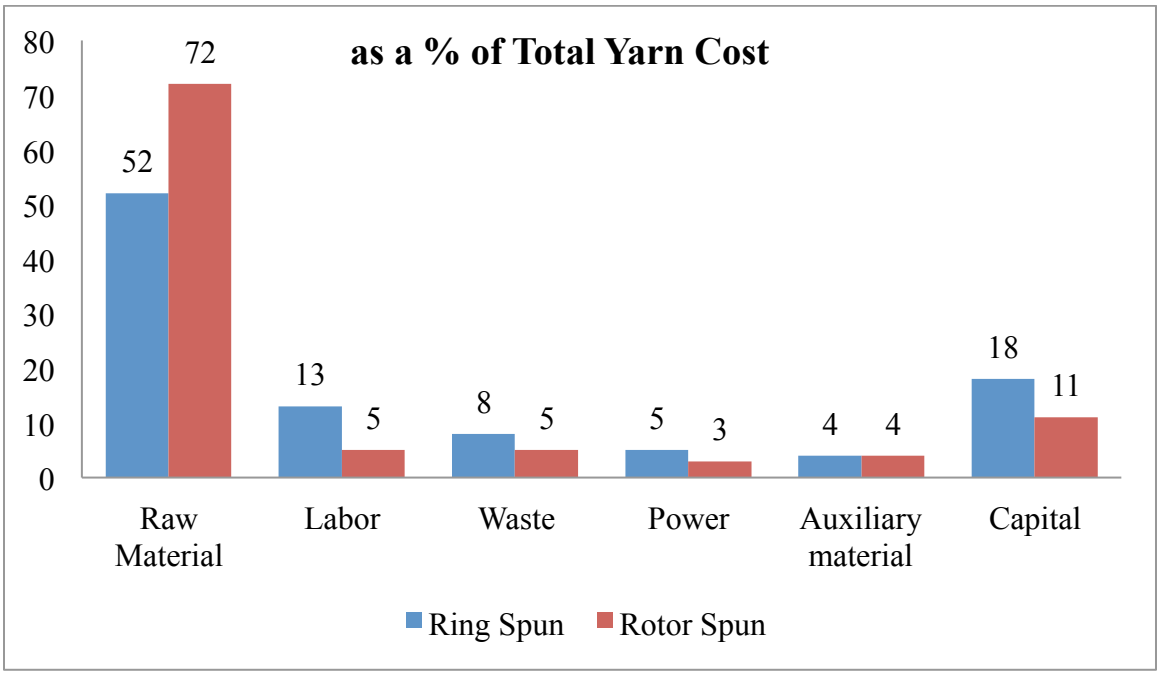

Figure 2.12: Component Cost of Ring Spun and Rotor Spun Yarn Source: (Oxenham, 2015)

2.4.6 Challenges for US Textile Industry

There are many investments from all over the world in the United States. But for this comeback to be on a large scale, US will have to go through a few challenges. One big challenge will be the large vertically integrated mills in Asia that produce home textiles. When it comes to Apparel, fashion matters a lot thus lead times matter a lot. But when it comes to home textiles, lead-time and speed is not as critical to these industries. The vertically integrated mills in Asia already producing home textiles on large scale will retain their advantage of an affordable and skilled labor force that is already available. The

availability of low cost and skilled labor is very difficult to find in the United States. Troy supports this and states, “One major challenge to US is unavailability of skilled labor”. This is probably the biggest reason that in the past five years, although many small investments in textile industries of US has taken place, there has not been a very large-scale shift yet. But Troy believes, as time passes, the know-how will develop among workers and there will be large-scale investments and a complete come back of the textile industry in US (Troy, 2013). Figure 2.13 shows how the number of textile and apparel industries has reduced over time but is constant after 2010.

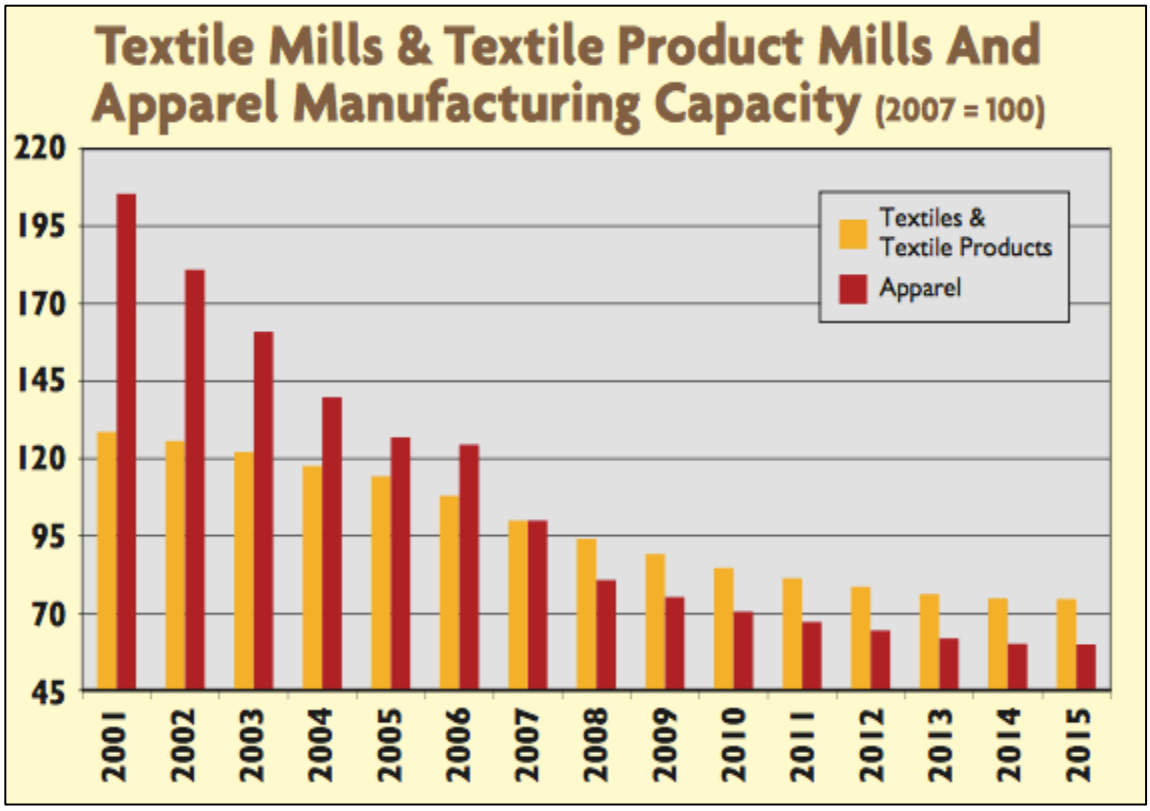

Figure 2.13: Textile and Apparel Manufacturing Capacity. Source: (Reichard, 2015)

2.4.7 Government Policy that Affect US Textile Production

In an article on Challenges and opportunities that the US textile industry will face in the coming year, NCTO (National Council of Textile Organizations) Chairman Jeff Price had something very interesting to say (Price, 2015). He discusses the importance of the Transpacific Partnership, which is a free trade agreement (FTA). TPP, according to him, has been one of the biggest challenges for the domestic textile industry development in US especially after including Vietnam in the agreement, which is also insisting on few special incentives to it. TPP includes Australia, Brunei, Chile, Canada, Japan, Mexico, Malaysia, Peru, New Zealand, Singapore, Vietnam and most importantly the US. It should be interesting to note that these countries do not include largest textile countries like India, China, Pakistan, Bangladesh, and Indonesia etc. Still, the TPP agreed countries contribute to almost 40% of the US international trade.

The reason why TPP was introduced was to enhance US domestic market because of the following as in Price's article.

1. Yarn-forward rule-of-origin: The yarn forward rule of origin for most apparel in the TPP plan was mandatory for all the nations signing FTAs since NAFTA (Fee, 2015).
2. Reasonable duty phase outs for particular textile and apparel items
3. Strong customs enforcement provisions

The TPP rule requires a TPP signed nation to use a TPP member nation produced yarn in the end product in order to qualify for duty free access. The US advisors and industry executives came up with this rule because of believe that in the absence of this yarn forward

rule, China would take over the US market completely. China is not a part of the TPP and this rule restricts Chinese yarn to be used by many TPP nations. Presently the export from US for textile is high because of the yarn forward rule, which is something extremely important to the US domestic textile industries (Phillips, 2015). TPP did give a boost to the American farmers, which is an access to export directly in the Japanese markets. But, at the same time, US manufacturers were facing a lot of competition from Vietnamese apparels, which were imported in the US (Fee, 2015).

One more challenge for US textile industry is the TTIP, which stands for Transatlantic Trade and Investment Partnership, another FTA between U.S. and the European Union. Europe is insisting on a complicated double transformation rule that requests to cut the yarn and fabric manufacturers out of US industry so that they can manufacturer entirely themselves. They also attempt to access U.S. military contracts (Price, 2015).

A lot about the future of textiles in US clearly depends on the kind of policies the Government comes up with. Vietnam is the second largest manufacturer of apparel products after China and is very much interested in joining TPP particularly because of textiles in the country. Vietnam is insisting on the yarn forward rule to be waived off for them. If the Government allows doing so, the U.S. markets might again get flooded with duty free Chinese products and this will be the biggest challenge in domestic market development (Phillips, 2015).

The NAFTA and CAFTA-DR free trade agreements had created good platforms for US domestic textile industries to compete in the world market. In Philip's article, one of the spinners says "we are pleased with the stability of our operating schedules and with volumes

of business opportunities that are presented to us. Compared to volatility of the past, this is pretty good time to us". In 1992, President George W. Bush signed NAFTA, which included United States, Canada and Mexico. The CAFTA-DR which stands for Central American Free Trade – A Dominican Republic and the CBI that stands for Caribbean Basin Initiative also provide incentives to FTA countries to export to US duty free only if the end product is made of textile yarn or fabric in countries that have signed CAFTA-DR or CBI. This encouraged many manufacturers in Mexico and Canada to use yarn produced in United States, which opened lots of opportunities for the US Spinners (Platzer, 2014). More than 2/3 of the textiles produced in the US is exported to western hemisphere nations that are members of either NAFTA, CAFTA-DR or CBI (Lu, 2015). The export products from the US included specialty and industrial fabrics, spun yarn, threads, felts and nonwovens etc., which account for nearly 50% of the total Textile and Apparel export to the markets of Caribbean countries and NAFTA countries (Lu, 2014).

Korea didn't have its name in the TPP or other FTAs. After waiting for years, the US congress officially passed the US Korea free trade agreement (KORUS) in 2011. This agreement was so widely recognized that it was considered one of the most important FTAs signed. The Textile and Apparel sector has been one important component of KORUS (Lu and Dickerson, 2015). The US Columbia trade promotion agreement (CTPA) was signed slightly after KORUS in the MAY of 2012. This promoted bilateral trade between US and Columbia.

Apart from these FTAs, which involve trade between nations, a law, which forces the domestic consumers to buy domestic made goods, can be a great market generation strategy.

The US senator Sherrod Brown proposed legislation, which would require federal agencies to procure Textile and Apparel products that are entirely made in the US. The exiting law only required the federal agencies to buy the products that are at least 51% American made but this is likely to now change to 100% (Anonymous, 2014).

U.S. textile industry supplies more than 8000 products to the U.S. military because of the Berry amendment. This agreement requires producing the products, going to US military, entirely in the U.S. itself right from fiber to finishing stage. This has resulted in a big market for US textile manufacturers and a defense agency is an important customer segment for them. (Price, 2015).

2.4.8 Return of Textile Industries

The textile industry generated a $54 Billion in shipments in 2012 and employed about 223000 people. Textile companies from all over the world, which includes Brazil, Canada, China, Dubai, Great Britain, India, Israel, Japan, Korea, Mexico, Switzerland, as well as in the US, have pledged to open or extend their textile manufacturing in southern states of US like Georgia, North Carolina, South Carolina, Tennessee and Virginia. The kind of manufacturing industries coming back are mostly yarn, thread, fabrics for apparel, furnishing, home products and technical textiles. Apparels are not in the list yet.

“Textile manufacturing – yarn, fabric, woven and nonwovens is still here and growing” said A. Blandon Godfrey, past dean of College of Textiles at NC State University. Dr. Godfrey also added that we are selling cotton yarn at rates lower than the Chinese as was reported in Mercer’s article (Mercer, 2014).

Price notes that textile and apparel exports in 2014 increased by 45% if compared with 2009. Price states "US textile industry exported to 199 countries, with 25 countries buying $100 million or more a year and the total textile and apparel exports were a record $24.4 billion in 2014" (Price, 2015). Reichard points that over the past few years, the amount of textile imports has remained almost same, which suggests that US companies are no longer losing market to Asia any more and the lower threshold limit has now come (Reichard, 2012). Figure 2.14 and figure 2.15 show the Textile and Apparel import and export for US. The exports are rising and the imports do not seem to have the same rate of increment like they used to have in the past.

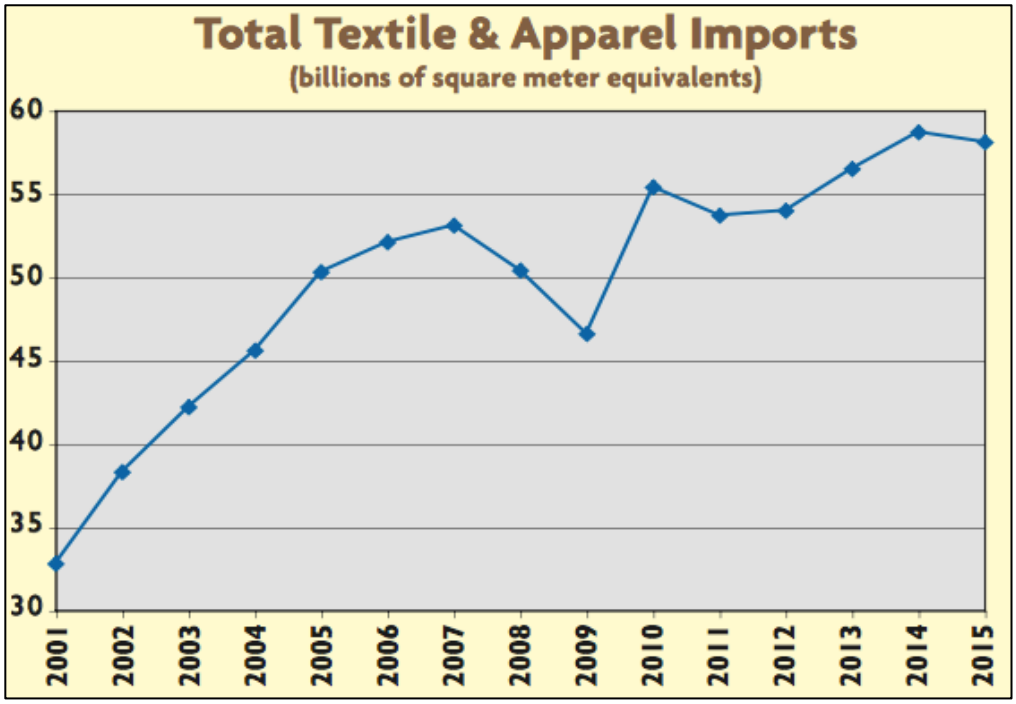

Figure 2.14: Total Textile and Apparel Imports. Source: (Reichard, 2015)

Figure 2.15: Total Textile and Apparel Exports. Source: (Reichard, 2014)

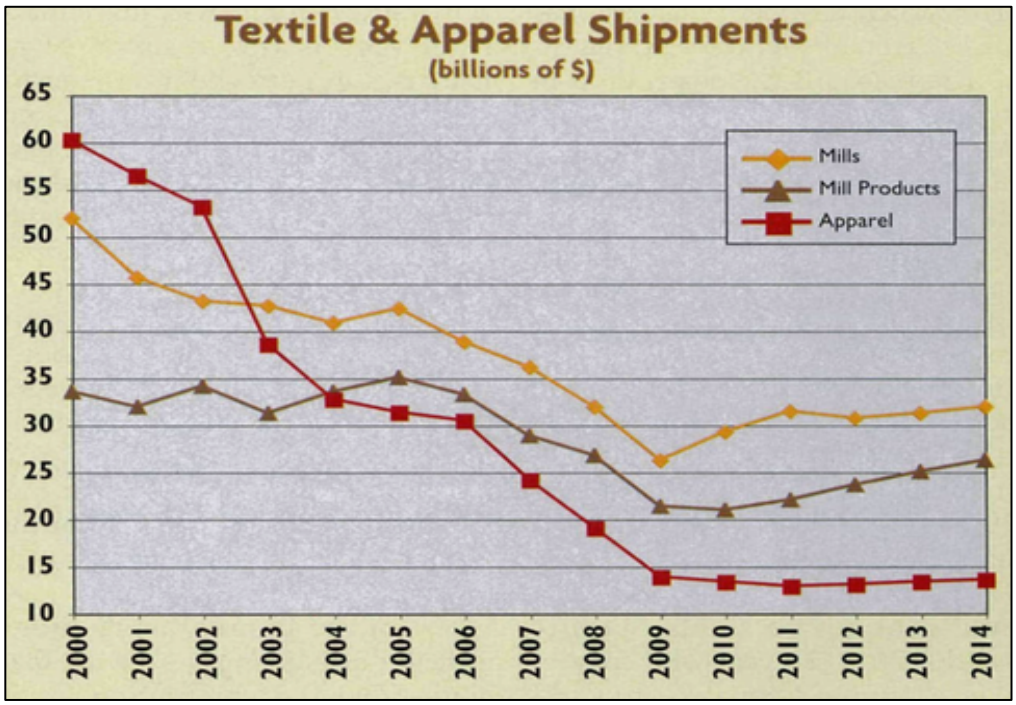

Figure 2.16: Textile and Apparel Shipments. Source: (Reichard, 2014)

Rodrigules and Taylor say that investments in the domestic textile market of US should be a good investment (Rodrigues, 2012). China will concentrate on services in education, health care and social security for years to come. Though China has enjoyed the production of textile and apparel of the world in the past two decades, they have done this at the cost of so much pollution and depletion of its natural country resources. So a priority will be given by Chinese government to improve social life style of its people. Taylor also says, Chinese exports will tend to decrease and imports might increase because the value of Chinese currency is going up against the value of US$ (Taylor, 2012). Figure 2.17 indicates the Chinese share of Imports to US, which has leveled off after 2010.

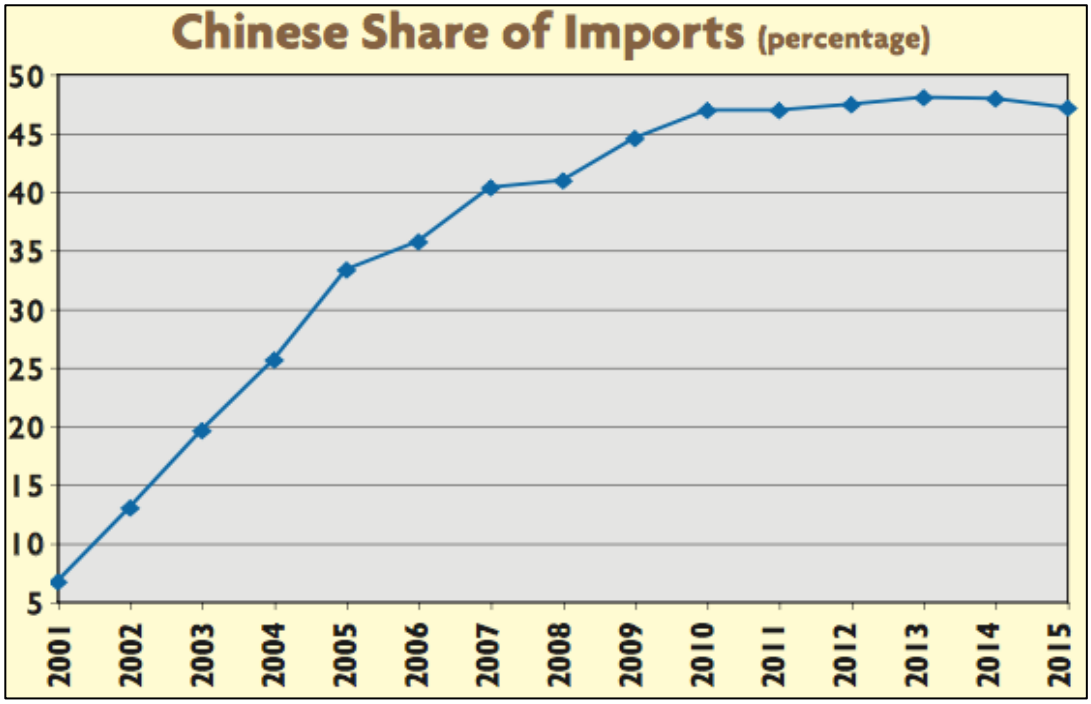

Figure 2.17: Chinese share of Imports to US. Source: (DOC, TW estimates, cited by Reichard, 2015)

2.5 Investments in Textile Industries in the Past Few Years

There have been many investments in the textile industry of US in the past few years. Mehta mentions that according to NCTO, 65 textile industry projects worth more than US$ 1.39 billion are being set up, including 32 projects worth US $ 999 million in the states of Georgia and North Carolina. He also says that countries like Brazil, Canada, China, the UAE, the UK, India, Israel, Japan, South Korea, Mexico and Switzerland already have plans to build or expand existing textile factories in the US states of Georgia, Louisiana, North Carolina, South Carolina, Tennessee and Virginia. US yarn is one of the lowest cost yarns in the western hemisphere industries and because of benefits like increase in wages in China, improved lead times on producing in US and low energy costs have given a great boost to spinning industry (Mehta, 2015).

In October of 2012, Shrivallabh Pittie Group, a leading textile manufacturer in India, chose Georgia as the site of company's first US-based manufacturing facility, a $70 million cotton yarn plant in Screven County that will hire 250 people. Some textile firms from North Carolina have plans to expand their exiting plants and even open some new ones, which will create 993 jobs in addition to an expected investment of $381 million (Mehta, 2015).

In a Textile World's special issue of 2014, the list of companies that have recently invested in the US textile and apparel industry is given. It is divided in five segments viz. fiber sector, yarn sector, nonwoven, composites and technical fabrics.

2.5.1 Fiber Sector

In fiber sector, there have been investments in filament based fiber products, bi-component fiber technology, specialty man-made fiber manufacturing, recycled polyester staple fiber products, polyester and nylon-based products, cellulosic pulp fibers etc.

The companies involved in big investments and creation of many jobs in US are Universal Fibers Inc., Fiber Innovation Technology Inc. (FIT), Universal Fiber Systems (UFS), Premiere Fibers Inc., Palmetto Synthetics LLC, JN Fibers Inc., Sun Fibers LLC, Unifi Inc., American Drawtech, Sappi Ltd., DAK Americas, Pharr Yarns LLC, PolyTech Fibers LLC etc.

2.5.2 Yarn sector

Many Yarn spinning plants are being set up and it has been confirmed that US has the ability to produce one of the lowest cost yarns in the world. The spinning plants that are coming up in US are the ones that make carded/combed yarn from premium cotton as well as from PC blend. These yarns particularly go in knitted and woven apparel. There is some investment in yarns used in specialty denims and in open end spinning mills too. Most of these companies export a lot of their yarn to other countries.

The companies, which recently invested in spinning plants or have plans to do so, are Gildan Activewear Inc., Swift Spinning Inc., Parkdale Mills Inc., Gulf Coast Spinning Co. LLC (GCS), Zagis USA LLC, Keer Group, Keer America Corp and Shri Vallabh Pittie Group, Parkdale America LLC etc.

2.5.3 Nonwovens

Nonwoven has a huge market in US. A lot of it goes to filtration, building and construction, agriculture, healthcare, technical fabrics, Geosynthetics, hygiene products, medical and other industrial markets. The medical textile segment has the highest growth but the disposable market is expected to remain in domination. Nonwoven producer Polymer Group Inc. (PGI) acquired Fiberweb Plc. Fitesa Simpsonville Inc, Hollingsworth and Vise Co. (HandV), Custom Nonwovens Inc., Korea Synthetic Fiber, Owens Corning, Spuntech Industries Inc., Jacob Holm Industries (America) Inc., Freudenberg Nonwovens, AstenJohnson, Eagle Nonwovens Inc. are some nonwoven industries which are planning an expansion in the United States.

2.5.4 Composites

Toray Industries Inc., which is a leading Tokyo based company, plans to acquire Zoltek Companies Inc. Chomarat North America Group, Advanced Composite Materials LLC (ACM), and Materials Sciences Corp. (MSC) have plans of expansion in US.

2.5.5 Technical Fabrics

There is a lot of weaving coming back but most of it is manufacturing of technical fabrics. Products include automotive textiles, military textiles, fabrics to hospitals and commercial markets, industrial fabrics, fabrics used for aircraft evacuation slides and life rafts etc.

List of companies that have either already invested or have plans to invest in fabric manufacturing in US are Highland Industries Inc., Takata Corp, Martex Fiber Southern Corp,

Bollag International, JBM Fibers Inc., Louis Hornick and Co. Inc., Monterey Mills, Gleniot Fabrics (TT) Corp. Inc., Auburn Manufacturing Inc. (AMI), Trelleborg Coated Systems, Trelleborg AB, Trelleborg Coated Systems US Inc., American Textile Co. (ATC), CT Nassau, Keystone Weaving, Culp Inc, Brawer Bros Inc., Warp Technologies Inc., Cone Denim LLC, Westex by Milliken, Valdese Weavers, United Furniture Industries NC LLC etc. (Reports from Textile World, 2014/ 2015).

Chapter 3 – Methodology

3.1 Purpose of Research

This research focuses on the analysis of the production costs incurred in textile industries in various countries over the past decade. Analysis of the integral and comprehensive data would give a practical interpretation of the direction and magnitude of changes in the worldwide textile and apparel production. This will be used to determine the short-term and long-term opportunities available to the US textile manufacturing industry. Special emphasis is also being given on effect of cotton price volatility on shift in production.

3.2 Research Objective

The "US textile manufacturing industry" is too broad a term for the execution of an effective research design. To remain focused on opportunities for US textile industry while still exploring multiple sectors of US textile industry, these research objectives dealt selectively with spinning, knitting, and weaving around the world.

The research objectives are:

1. Create a single data base which should include textile manufacturing costs in various countries, change in the prices of raw material over the years and new investments on textile machinery in the US in recent years.
2. Determine opportunities for cost-competitiveness for US spinners, weavers, and knitters giving special consideration to the volatility in the raw-material cost by analyzing and interpreting the collected data.
3. Determination of the opportunities and challenges for US spinners, weavers, knitters and use this to predict the future of textile manufacturing.

The basic research objective was to determine the opportunities for US spinners, weavers, and knitters based on cost-competitiveness. This objective was to gather the manufacturing costs of spinning, weaving and knitting in various countries around the world. Data from various surveys conducted by the International Textile Manufacturers Federation (ITMF) was explored and their claims were confirmed from various industry sources. Data from Textile World's Yarn market section was also collected. ITMF was the best available source for cost comparison of various countries because it is updated every two years and since this has been published for over two decades it lends itself to an analysis of historical trends. The TW's Yarn market was the most accurate data for fiber and yarn cost comparison because it is updated on bi-monthly basis. Prices are known by making calls to respective textile industries giving most accurate data.

3.3 International Production and Total Cost Comparison

Among the surveys available by ITMF, International Production Cost Comparison and International total cost comparison was considered. The production cost had the conversion cost which included the cost of power, labor, waste, Aux. Material, Interest and depreciation. The total cost also had the raw material cost included, which has the biggest driving capacity as of today. The ITMF's international Production Cost and Total cost comparison reports available to this study were for the years 1991, 1995, 1997, 1999, 2001, 2003, 2006, 2008, 2010, 2012, and 2014. Data from all these reports were combined into a single database. After combining all the data, a trend was clearly visible and the most recent reports were used to explore the opportunity available to the US textile industries because of cost-competitiveness.

Because of its association with most machine manufacturers, ITMF's data is based on conducting numerous cost calculations. Individual companies consultants and textile trade associations supply cost factors for the participating countries. They are carefully reviewed by the four machinery manufacturers cooperating in the study, with a view to arriving at representative average factors for the country concerned.

3.4 International Textile Machinery Shipment Statistics Report

Another ITMF survey available for this study was International Textile Machinery Shipment Statistics report. Again, all the reports from 1990 to 2014 were combined to form one single database and then analyzed on the trends of textile machinery shipments. From this it was possible to track changes in machinery shipments to different countries. It helped determine the volume of textile industries coming in US in the recent years and supported the research objective.

3.5 Textile World's Yarn Market

Yet another survey from "Textile world, yarn market" was collected and a database was created which had the raw material fiber prices and its fluctuations over the years updated until 2015 (Textile World, Yarn Market). It was a part of the research to determine the effect of fiber price volatility on cost-competitiveness to US spinners, weavers and knitters. They collect data on bi-monthly terms by actually making a call to the textile industries in the country.

Chapter 4- Results Pertaining to Spinning

4.1 Cost Trends in Ring Yarn Manufacturing

The total cost of manufacturing yarn including the cost of raw material for different countries is compared. Figures 4.1, 4.3 and 4.5 show the total cost to manufacture a yarn, which includes the addition of all the cost components like labor, power, auxiliary material, capital, waste and most importantly the raw material. The cost is compared for the years 2003, 2006, 2008, 2010, 2012 and 2014 utilizing data that was collected from ITMF's International Production Cost Comparison. Total cost in USD/kg for US is shown in bold red in order to give clear identification against other countries.

It is interesting to analyze the breakdown of total cost to its various components since this enables the identification of the key factors for the lower manufacturing costs in the US. Figures 4.2, 4.4 and 4.6 show the cost components for the year 2014. An additional benefit of such an analysis is that it highlights areas where there may be potential improvements, so that the total cost may be possibly further reduced, thus ensuring that the US can maintain its long term competitiveness.

From figure 4.1, it can be concluded that the manufacturing cost of Italy is the highest. After 2008, manufacturing cost of China has also increased a lot and is now much higher than other countries. India has been one of the most inexpensive ring yarn manufacturers for a long time but recently, in 2014, it is found that the total cost for manufacturing yarn in India is 3.519 $/kg as compared to US manufacturing of 3.509 $/kg. Thus, for Ring Yarn manufacturing, US is currently the most inexpensive country.

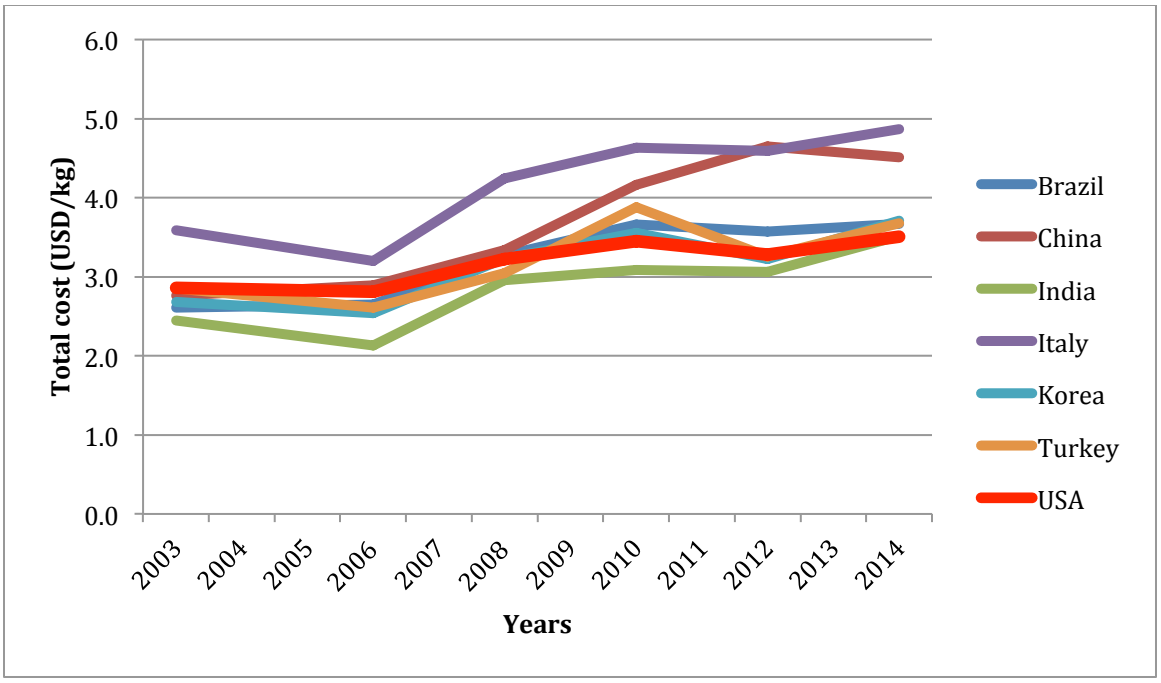

Figure 4.1: Country Ring Spinning Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

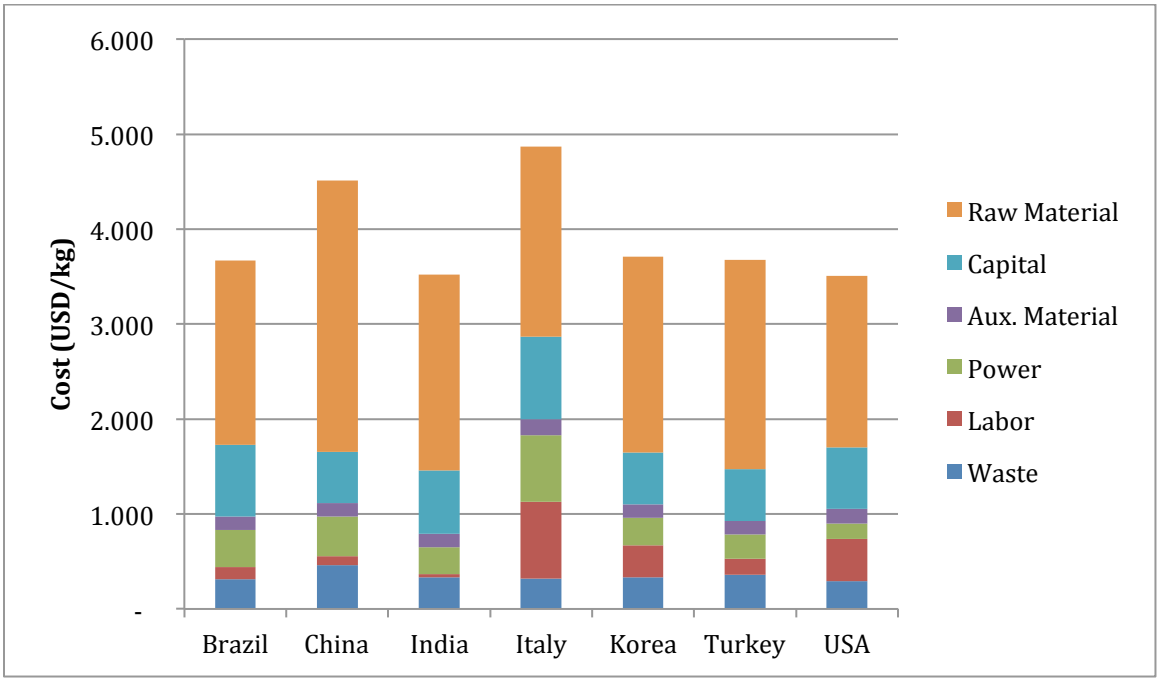

Figure 4.2: Cost Components of Ring Spinning for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

Figure 4.2 shows that cost of raw material plays a significant role in making US manufacturing highly cost competitive, as raw material is available at low cost in the US compared to other countries. US also has one of the most inexpensive and plentiful power provisions. The power cost in US is only 0.16 $/kg of yarn produced as compared to that in India which is 0.289 $/kg and that in China which has gone to as high as 0.418 $/kg. It is interesting to note that while Italy's raw material cost are "reasonable" this country has the highest costs for Labor, Energy and Capital, which results in it having the highest manufacturing costs among the countries surveyed.

4.2 Cost Trends in Rotor Yarn Manufacturing

It is interesting to note that when it comes to Rotor Yarn manufacturing, China has become the most expensive country to manufacture yarn using this technology followed by Italy, Turkey, Korea, India, Brazil with the least expensive being US as shown in figure 4.3 and figure 4.4. The total cost to manufacture a rotor yarn in US in 2014 was 2.393 $/kg where as other countries have their manufacturing costs close to or greater than 2.6 $/kg.

From a comparison of figures 4.1 and 4.3 it is possible to analyze why the US is a much better performer when it comes to Rotor yarn as compared to Ring yarn. In open-end spinning, there are a lower number of processing steps and the proportionate cost of raw material in total cost is comparatively higher than Ring yarn. While ring yarn has 50-60% raw material cost, rotor yarn has more than 70% of its total cost in raw material. Thus, the cost of raw material will matter very much in rotor yarn manufacturing. As raw material in US is comparatively available at lower cost, US has successfully become the most inexpensive country to manufacture rotor yarns.

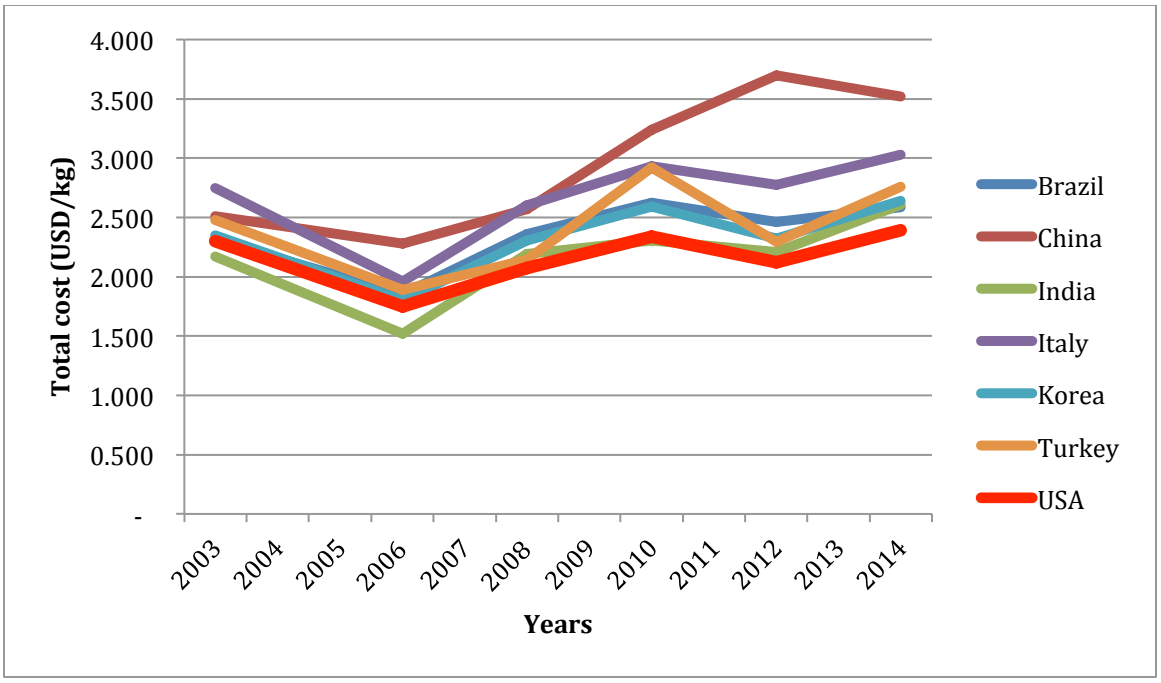

Figure 4.3: Country Rotor Spinning Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

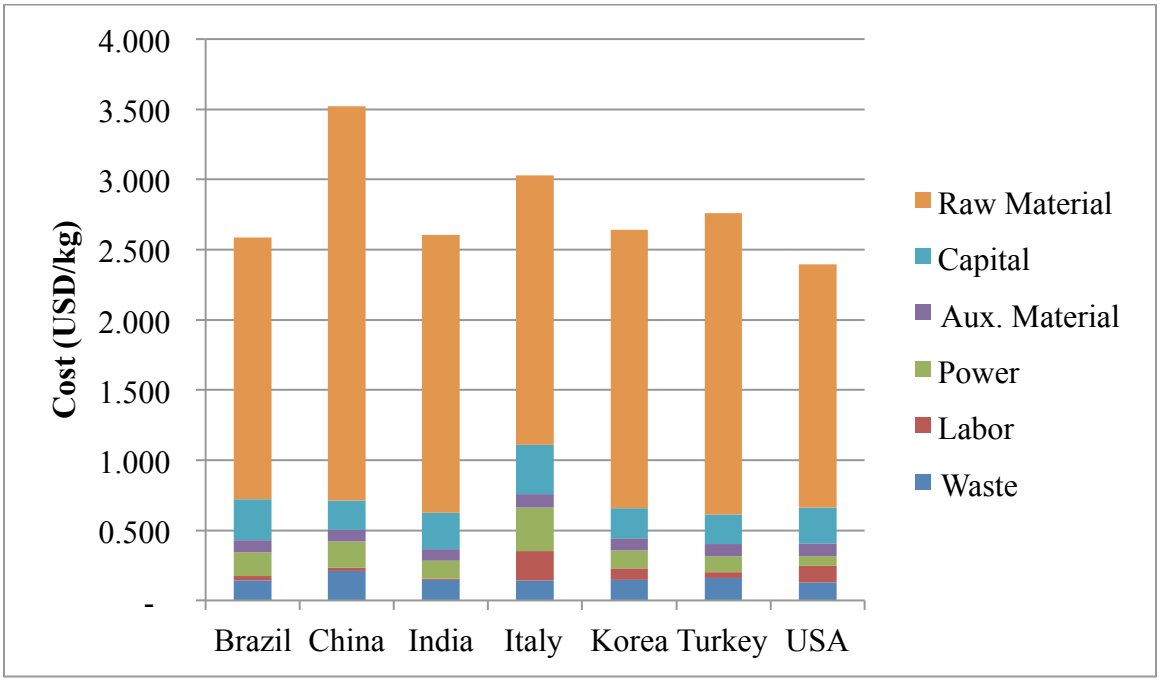

Figure 4.4: Cost Components of Rotor Spinning for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

4.3 Cost Trends in Textured Yarn Manufacturing

US is the country to manufacture one of the most inexpensive ring yarn and rotor yarns in the world. When it comes to textured yarn like polyester, nylon, polypropylene etc. a different trend is noticed when compared to staple yarn manufacturing. The total cost to manufacture a textured yarn is the highest in Italy followed by US. India and China are the countries, which are still the low cost producers of this yarn.

It is clear that Italy is the most expensive country to manufacture any kind of yarn because of its high labor cost. US proved to be the most inexpensive ring yarn and rotor yarn manufacturer but it might not be a good idea to manufacture textured yarn in US because of its exceptionally high raw material costs as shown in figure 4.5 and 4.6. The cost of Polyester in US for the year of 2014 was $2.1/kg, which was higher than its cost in other countries. Cost of this fiber in China was $1.72/kg and India was $1.7/kg. Further details on cost of polyester as a raw material can be obtained from figure 5.4.

4.4 Spinning Capacity and Shipments in US

2010 was an important year that bought changes in the cost of manufacturing in US, and it started to become very profitable to spin ring yarn and rotor yarn in the US. As a result, spinning machinery shipments started to increase after 2010.

Figure 4.7 shows the trend of spinning capacity and spinning shipment in the US for short and long staple ring spinning machines. Investments in new spinning machinery began to drastically decline after the year 2000 and it became almost zero for almost a decade. But, after the year 2010, there was an improvement in shipment statistics and new investments in short staple spinning are still coming up.

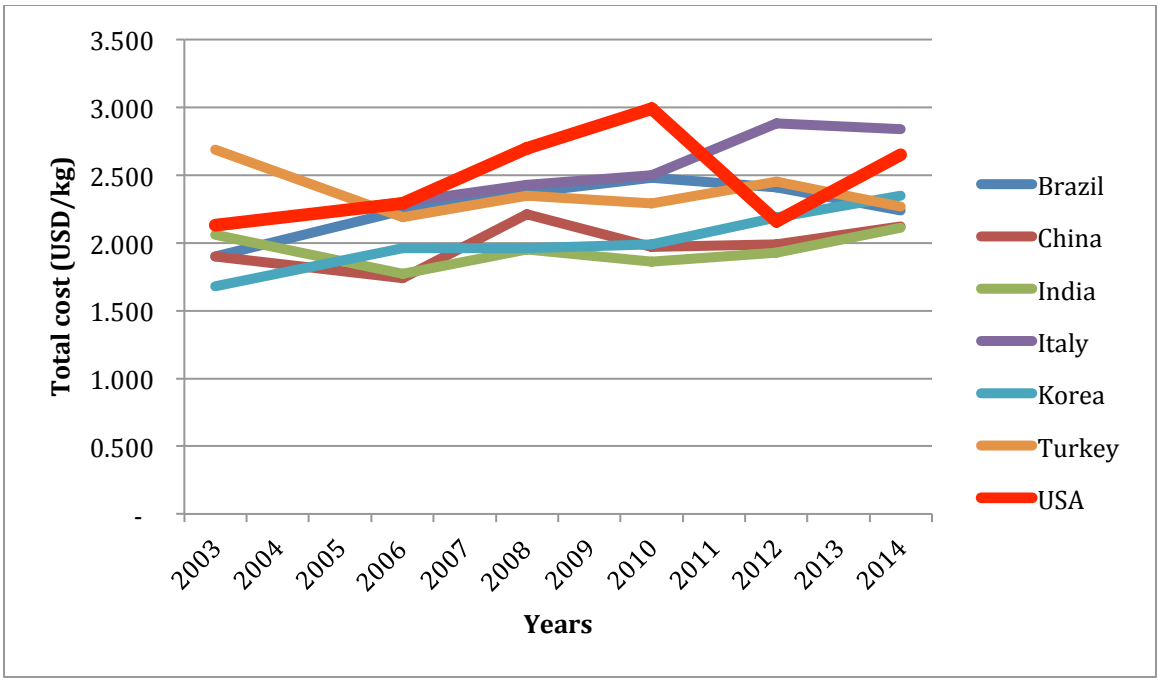

Figure 4.5: Country Textured Yarn Spinning Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

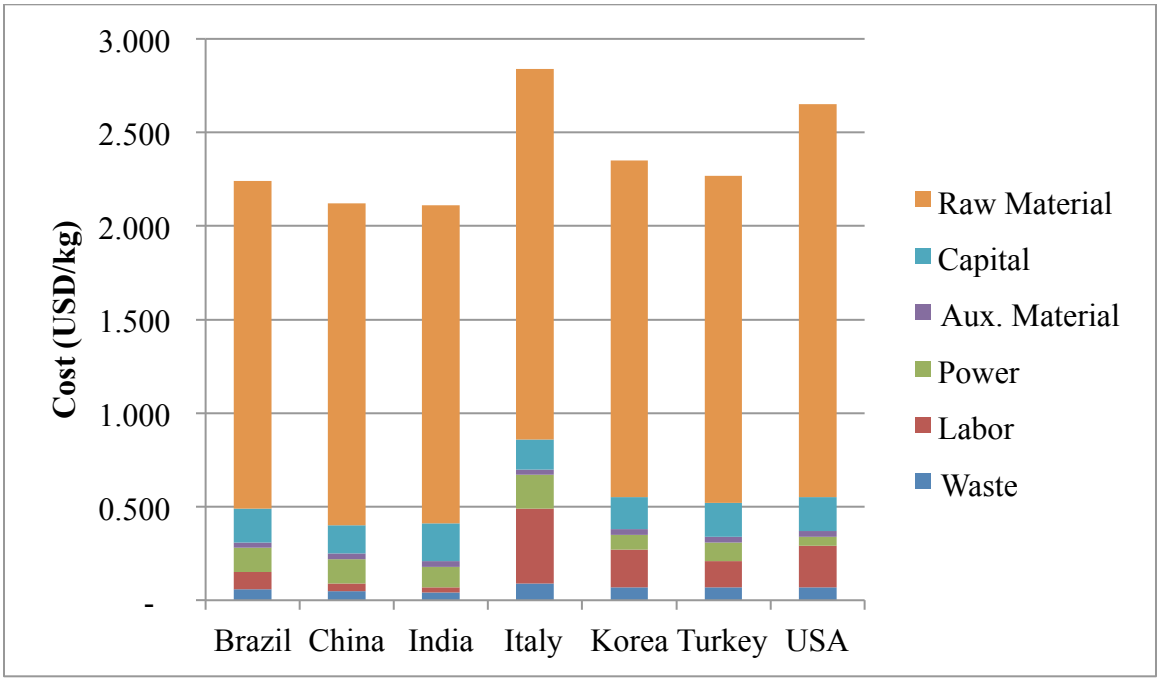

Figure 4.6: Cost Components of Textured Yarn Spinning for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

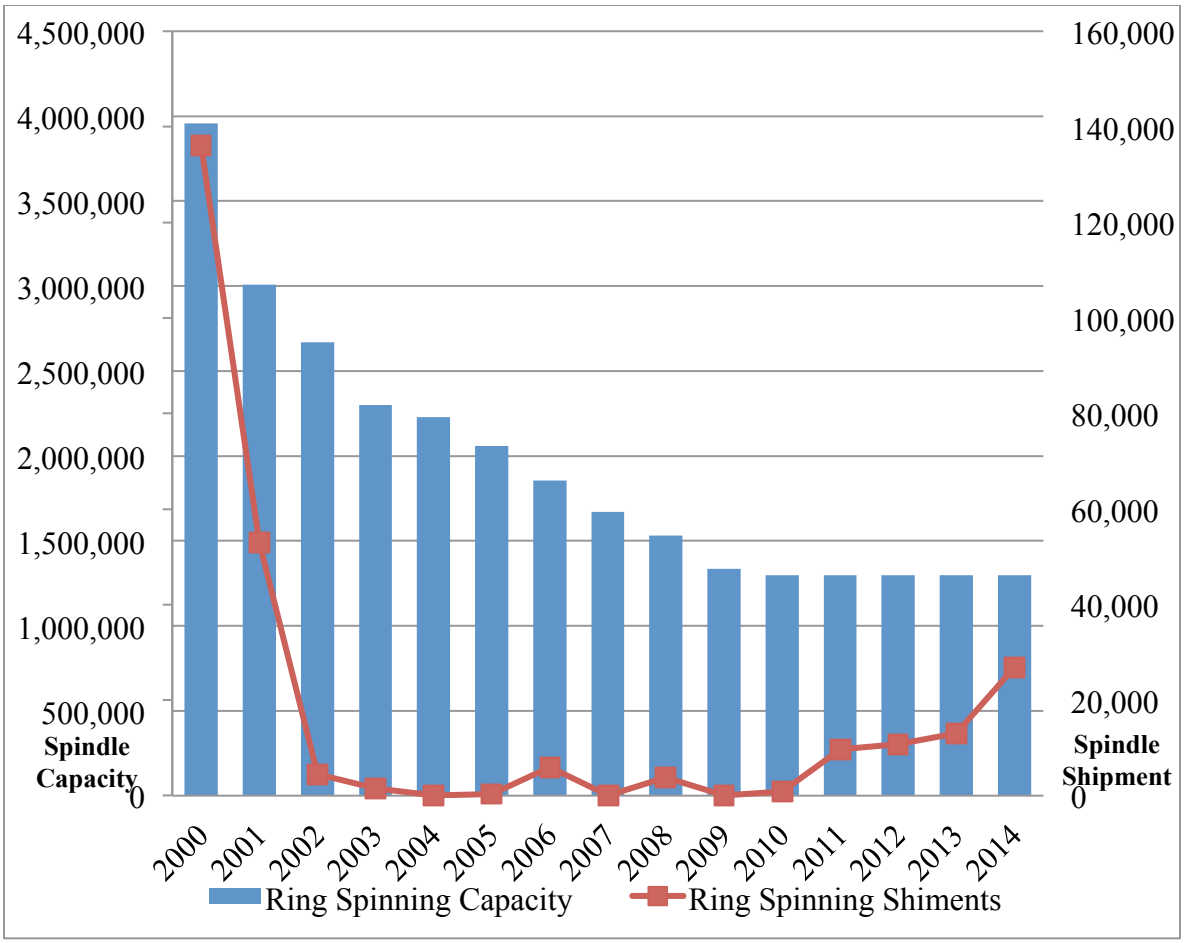

Figure 4.7: US Ring Spinning Capacity and Shipment by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

The number of newly installed ring spinning machines was almost zero from 2002 to 2010 but for the last few years there has been thousands of spindles installed and this figure is rising every year. This clearly indicates that the investors around the world have realized the benefit of manufacturing in US and new investments in ring yarn production has increased over these years. A similar trend was also shown for rotor spinning machines. The investment in rotor spinning is more than that in ring spinning. In 2014, 26,832 ring spinning spindles and 60,323 rotor spinning spindles were shipped in US which indicates that higher investment is taking place in rotor spinning machines.

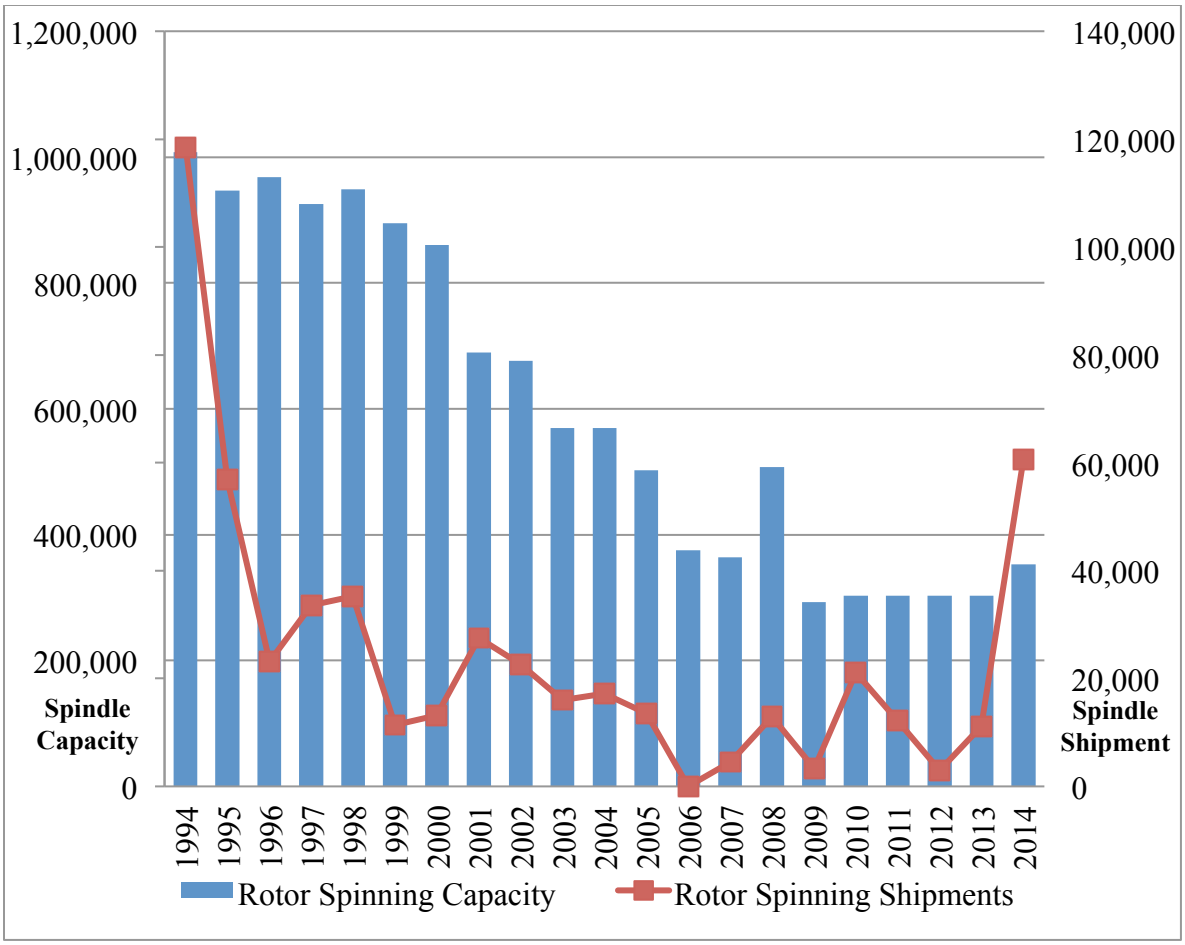

Figure 4.8: US Rotor Spinning Capacity and Shipment by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

Chapter 5- Raw Material Costs in Yarn Manufacturing

5.1 Cost of Cotton Fiber and Yarn in US

Raw material cost is a very big factor in driving textile manufacturing back in to US. It should be interesting to see figures 5.1, 5.2, 5.3 5.4 and 5.5 that show the historical trends in fiber and yarn prices. The data for figure 5.1, 5.3 and 5.5 was collected from yarn market section of Textile World. Figure 5.1 compares the spot prices of cotton in US with the US cotton yarn rates.

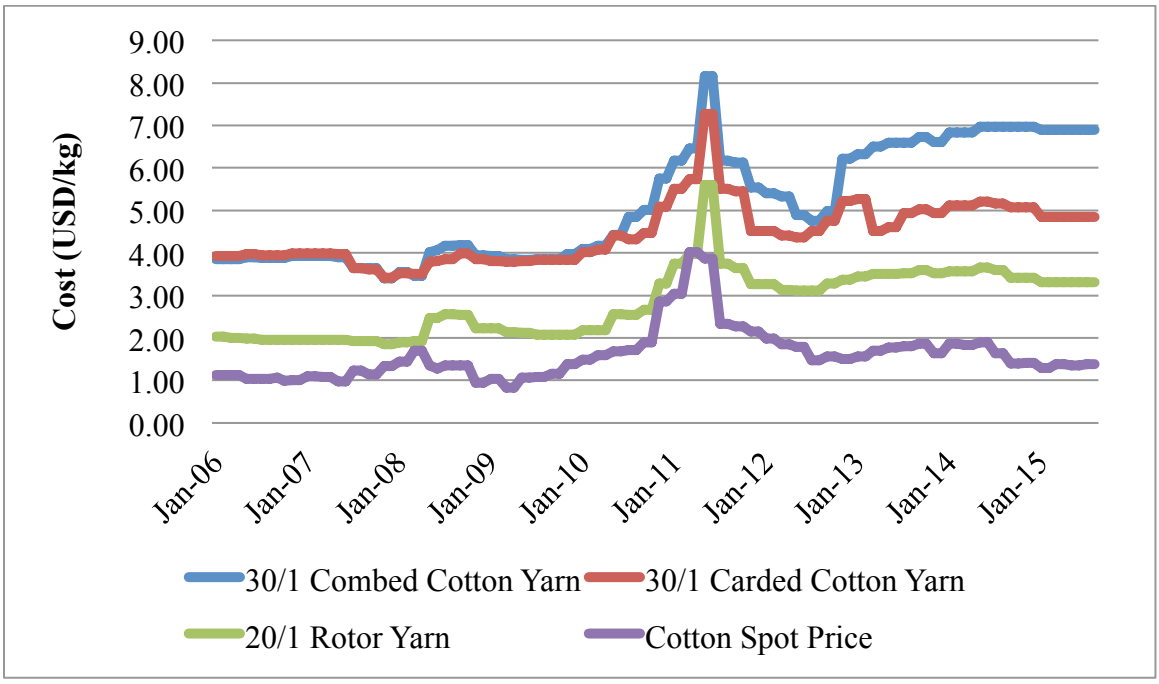

Figure 5.1: Cotton Yarn and Fiber Prices by Year. Source: Created by author. Data from Textile World, Yarn Market (2006-2015)

It is clear from figure 5.1 that the trend in prices of cotton yarn and cotton fiber has a similarity. In 2011, the fiber rates went at its all time high of $4/kg. This was followed by

yarn rates too. Cotton fiber and yarn price have very strong correlation with each other and the price of cotton yarn is dependent on the price of cotton fiber.

Figure 5.1 also indicates that the prices of carded cotton and combed cotton were not very different from each other, until the cotton prices peaked in 2011. After that, the combed cotton yarn rate rose over carded yarn rates and maintained its place at a higher price, consistently. This might be because many yarn spinners shifted to carded yarn manufacturing from combed yarn after the increase in prices of raw material. This reduced the supply of combed yarn and its prices went up.

5.2 Country Cost of Cotton to Produce Ring Yarn

It is advantageous to manufacture ring yarn in US mainly because of its low raw material costs. Figure 5.2 compares the cost of cotton from 1990 to 2015 for different countries. The cost of cotton from various countries was collected from ITMF's International Production Cost Comparison for a quality that nearest matches to 1-1/8" of cotton fiber. For example, Shankar-6 was selected from India.

The cost of raw material for US in 1990s was not as inexpensive as it is now when compared to other countries. US didn't have the advantage of comparatively lower cost of cotton in those times. High costs of raw material coupled with heavy labor costs killed spinning industries in the US. But, over the past decade, the cost of raw material in US has been very inexpensive. After 2010, a significant difference in raw material rates can be seen from the US, compared to other countries as in figure 5.2.

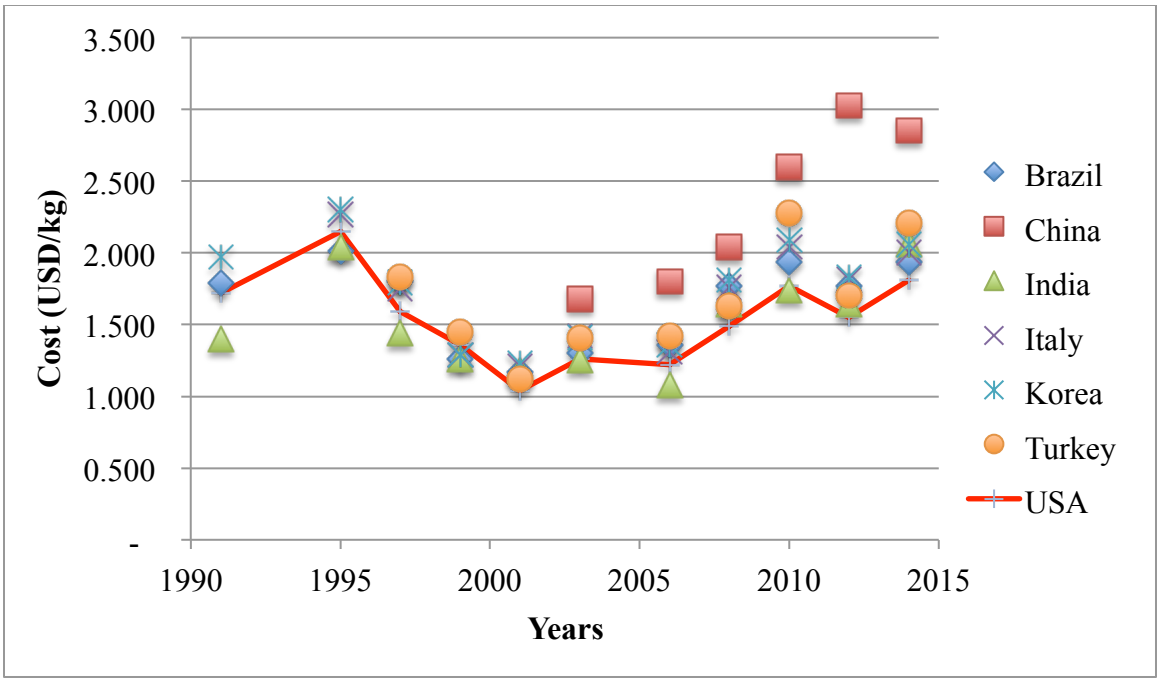

Figure 5.2: Country Cotton Fiber Cost by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (1991-2015)

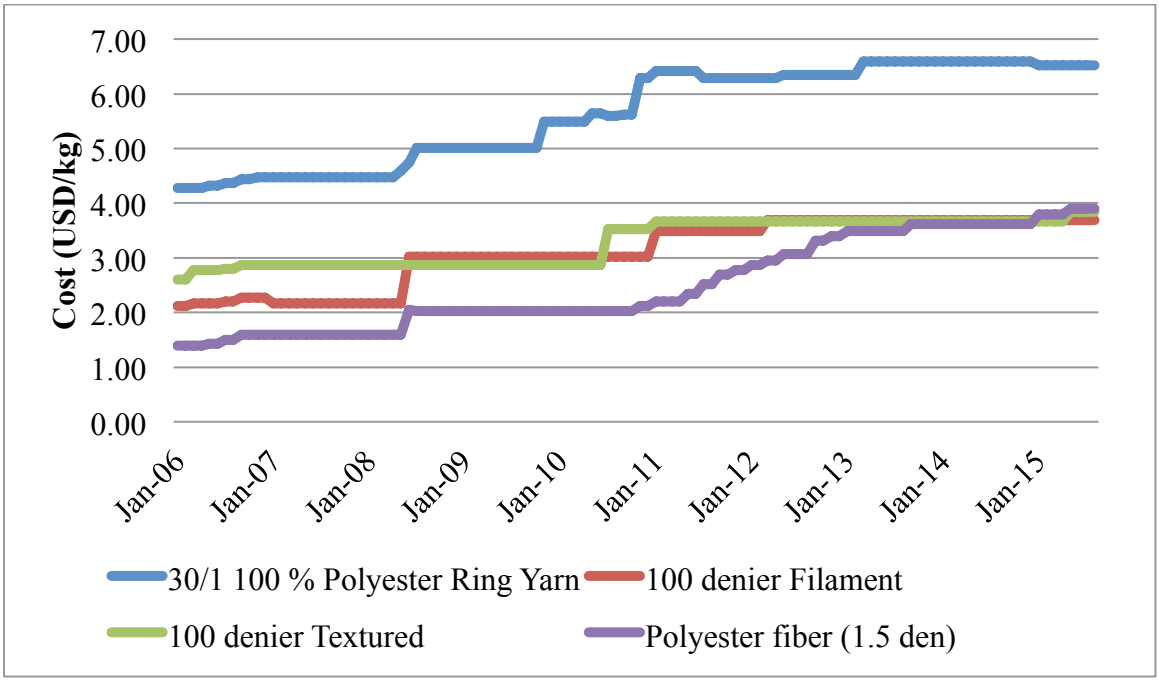

Figure 5.3: Polyester Yarn and Fiber Prices by Year. Source: Created by author. Data from Textile World, Yarn Market (2006-2015)

5.3 Cost of Polyester Fiber and Yarn in US

The prices of polyester fiber went up after January of 2011. One reason behind it could be rise cotton prices, which forced many manufacturers to substitute cotton with polyester to some extent. This increased the demand of polyester fiber. In the past few years, the fiber and yarn rates have remained consistent.

5.4 Country Cost of Raw Material to Produce Polyester Yarn

Manufacturing of Polyester yarn or any textured yarn is expensive in US because of its high raw material costs. Figure 5.4 compares the cost of raw material to produce 100% textured polyester yarn of 75 denier and 72 filaments (75d72f textured Polyester yarn). The cost of synthetic fibers and chips in US is more than other countries. Almost 80% of the manufacturing cost is the raw material cost in spinning polyester. The raw material to manufacture synthetic yarn is itself so expensive that it makes it difficult for synthetic yarn manufacturing industries to produce synthetic yarn at competitive rates.

5.4 Cost Comparison of Cotton with Man-made Fibers

The scenario changed after 2011 as shown in figure 5.5. The difference in the cost of cotton in comparison to man-made fibers considerably increased after 2011 when prices of cotton had gone extremely up. Demand for cotton decreased and that for these man made fibers (specially polyester) increased over the past four years. This was because many manufacturers might have started using Polyester or viscose rayon instead of cotton. With the advent in various nonwoven markets for polyester and polypropylene, the demand for these fibers is increasing.

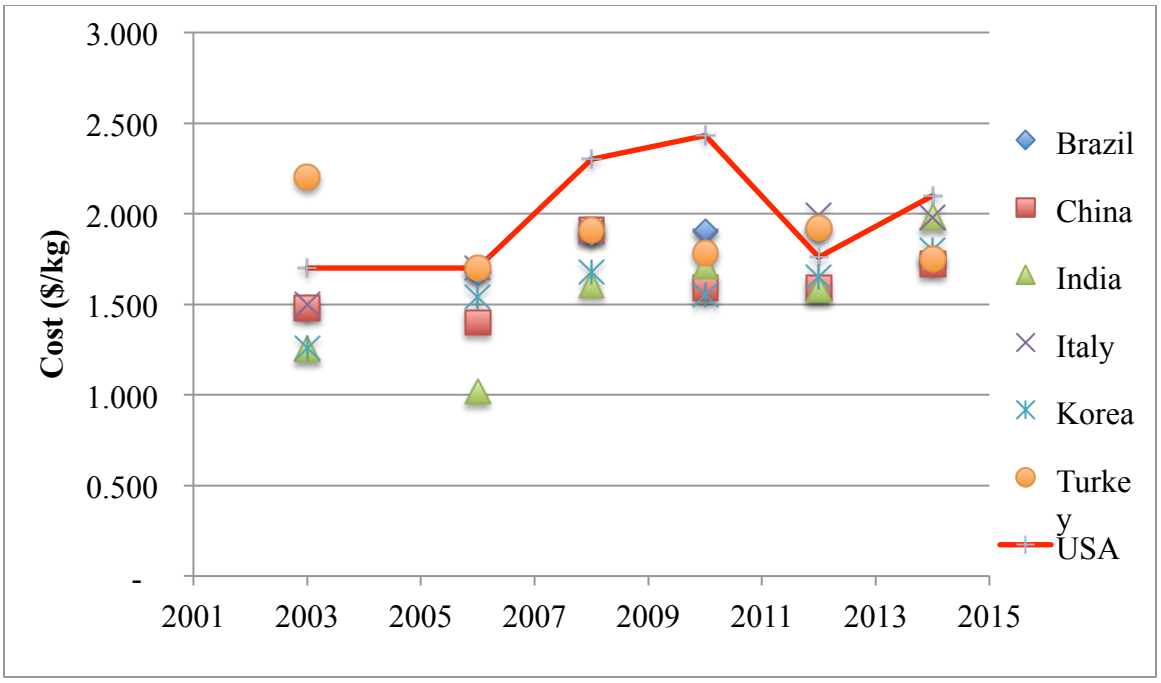

Figure 5.4: Country Polyester Fiber Cost by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

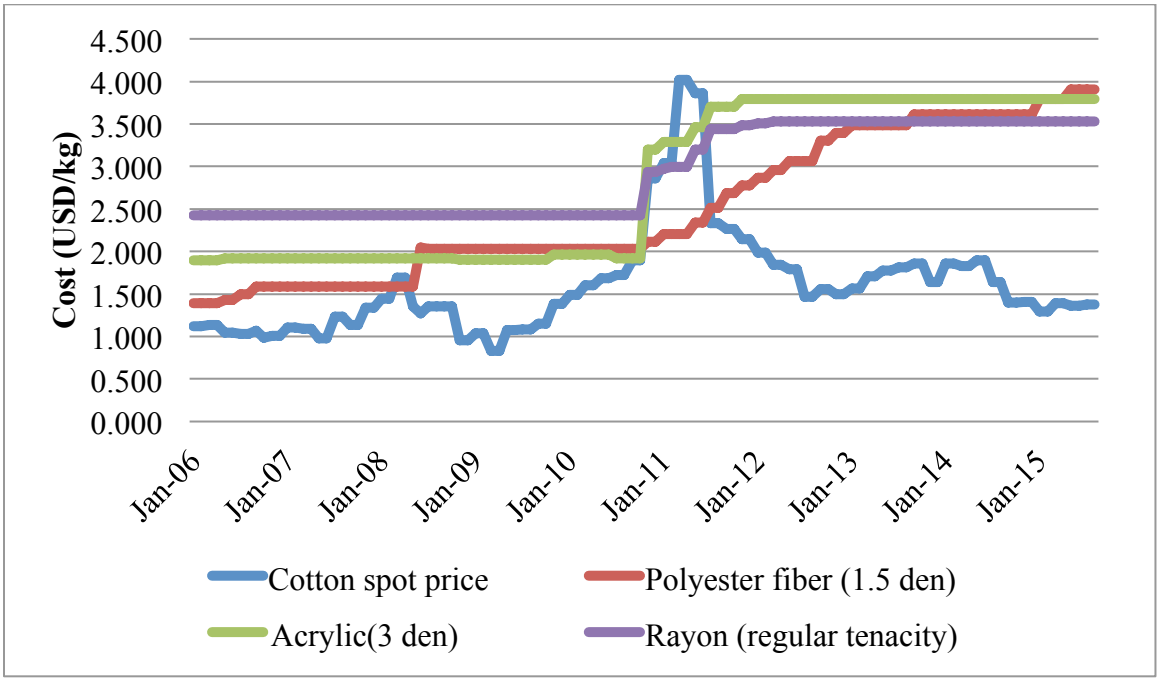

Figure 5.5: Cost of Cotton Vs. Cost of Man-made Fibers by Year. Source: Created by author. Data from Textile World, Yarn Market (2006-2015)

Chapter 6- Results Pertaining to Weaving

6.1 Cost Trends in Manufacturing Woven Fabric from Ring Yarn and Rotor Yarn

This chapter deals with the cost of manufacturing of woven fabrics from ring yarn, rotor yarn and textured yarn. Figure 6.1, 6.3 and 6.5 deals with the total cost of manufacturing woven fabric for the years 2003, 2006, 2008, 2010, 2012 and 2014 and data was collected from ITMF's International Production Cost Comparison. Figure 6.2, 6.4 and 6.6 has the cost components for manufacturing woven fabric in different countries for the year 2014. The prices are for printed cloths made from 100% cotton yarn of 30s Ne warp and weft with grey width 168 cm and GSM 190 gram/meter. The thread density of fabric is 27.6 threads/cm in both warp and weft and rate of output is considered to be between 18-22 meter/machine hours for air-jet weaving machines for fabrics manufactured using ring or rotor yarn.In 2003, it was expensive to manufacture fabric in US. Many weaving companies shifted from US to Asian countries. But, in 2014, US was the second most inexpensive country for woven fabric manufacturing from rotor yarn after India and third most inexpensive country for woven fabrics form ring yarn after India and Turkey. The cost per meter for this construction of fabric in US was almost $1/meter, which is approximately 10 cents higher than that in India for each meter but lower than most other countries. US do have an advantage because of availability of ring and rotor yarn at a lower price but other components also play a significant role in making US extremely cost competitive. Around 20 % of total cost of manufacturing woven fabric goes in labor, which is high in US and extremely low in India making India around 10-cents/ meter cheaper for the fabric construction and conditions under comparison.

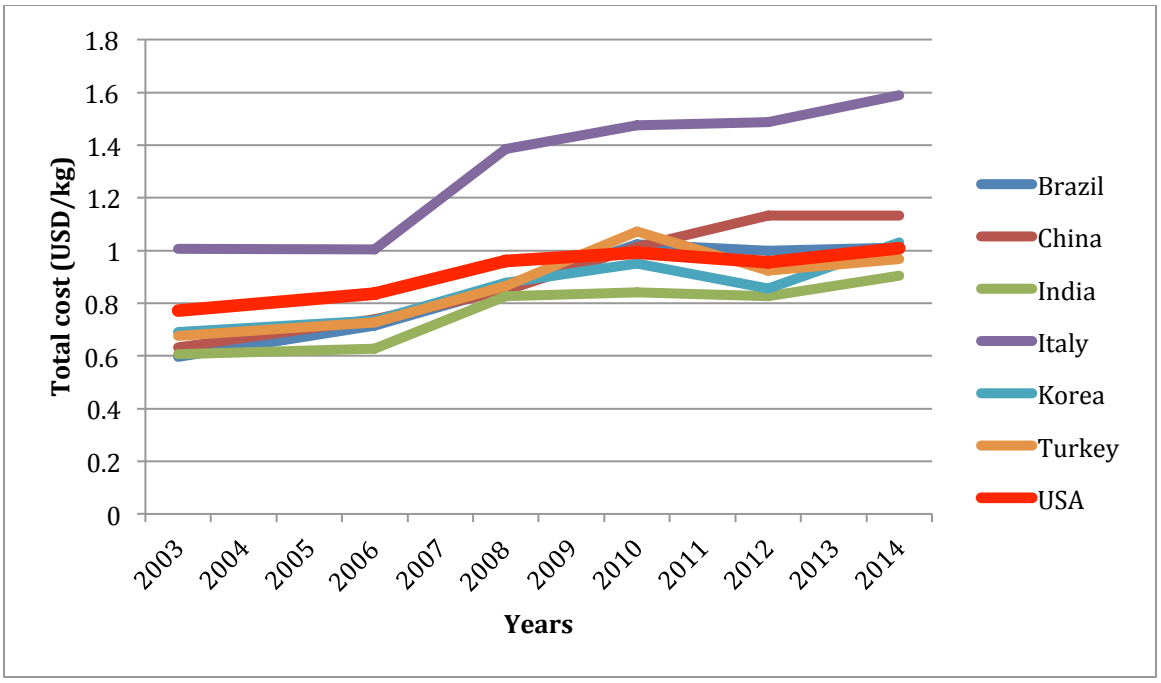

Figure 6.1: Weaving with Ring Yarn Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

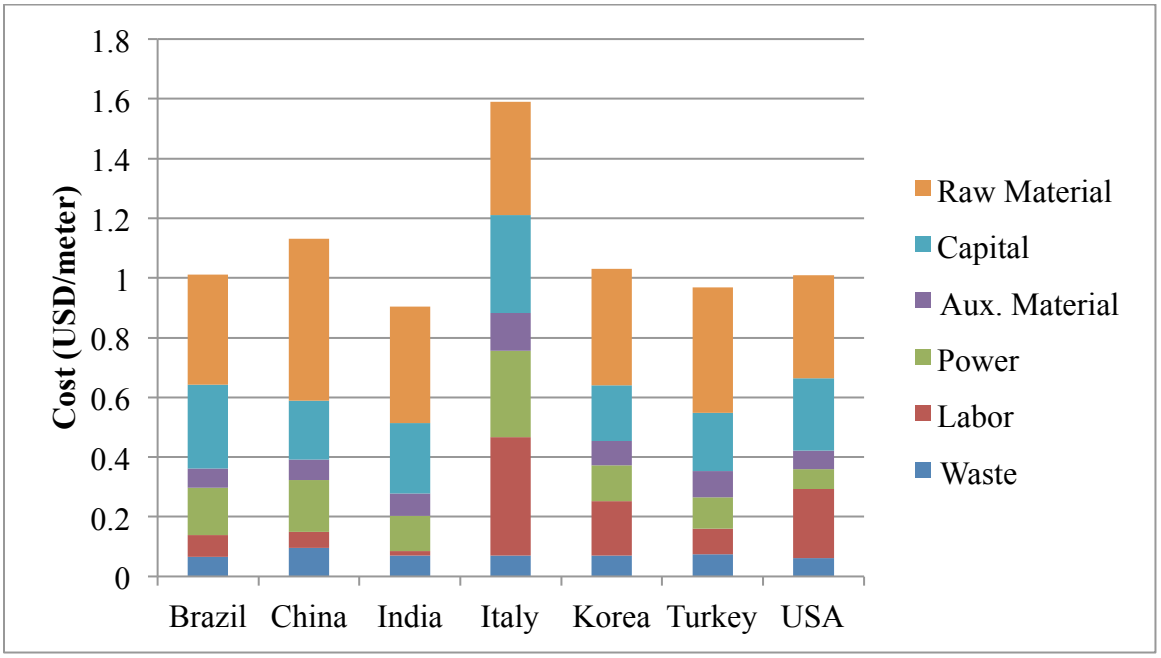

Figure 6.2: Cost Components for Weaving with Ring Yarn for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

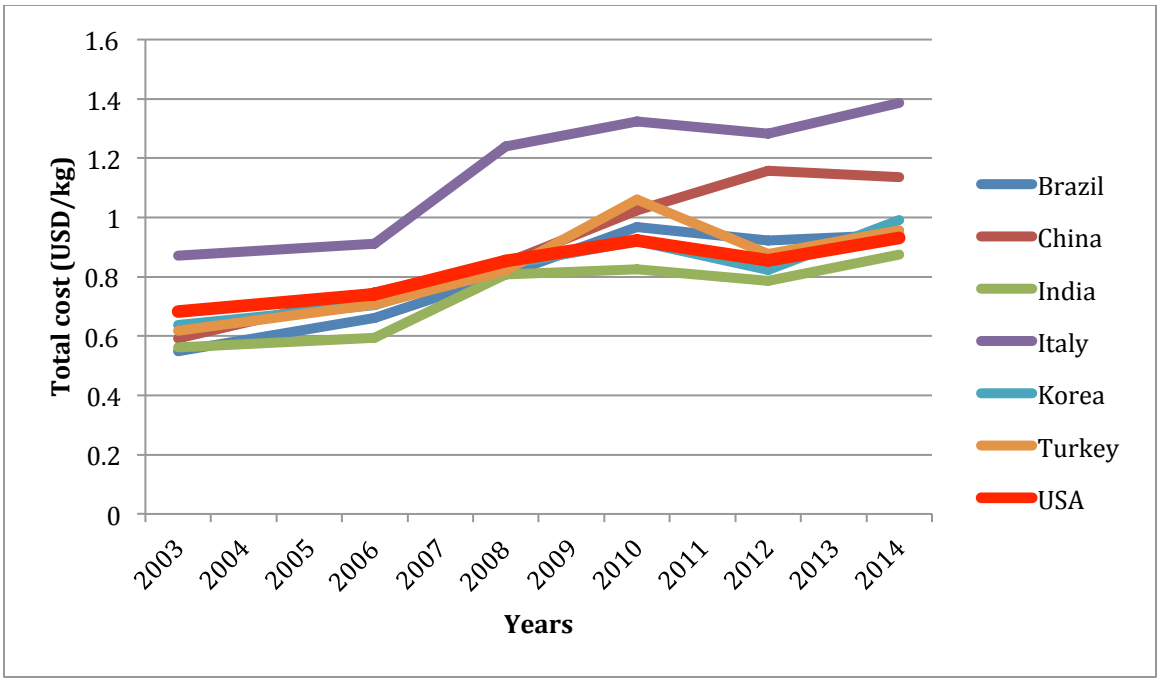

Figure 6.3: Weaving with Rotor Yarn Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

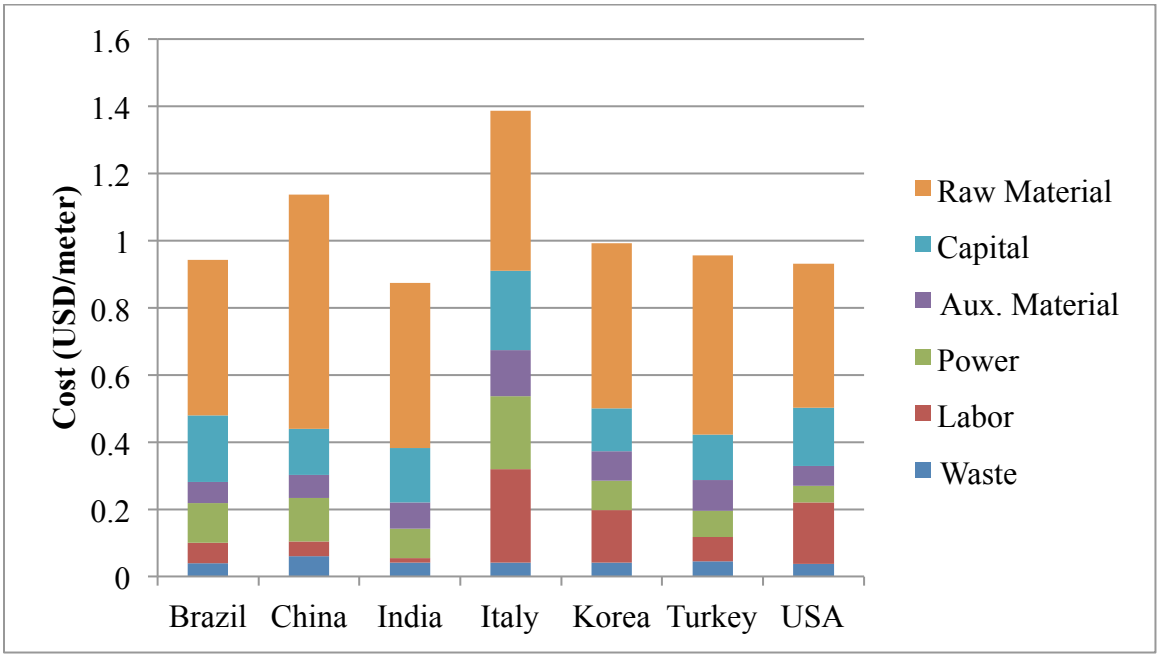

Figure 6.4: Cost Components for Weaving with Rotor Yarn for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

6.2 Cost Trends in Manufacturing Woven Fabric from Textured Yarn

The cost of weaving 100% polyester textured yarn into fabrics of 106 grams/meter on a rapier loom is considered. The raw material and spinning of textured yarn in US is expensive at present and so is the cost of manufacturing woven fabric.

Interestingly, it is not the raw material, which is making a big difference in cost of manufacturing, when it comes to weaving from textured yarn in US as shown in figures 6.5 and 6.6. The labor cost is making the biggest difference. The rate of output of woven fabric from textured yarn is considered to be only 12-meter/machine hour that resulted in the labor cost to go high because labor productivity went down. The rate of out put for woven fabric from ring yarn and rotor yarn was around 20-meter/machine hour and labor productivity was better. The reason for different production rates is because ring yarn and rotor yarn was considered to be woven on air jet weaving machines which are highly efficient with high production rates. Since textured yarn cannot be woven on air-jet looms, it was considered that they were woven on rapier machines that have lower production rates. If the same analysis would be done considering that textured yarn was woven on water jet machines and not rapier machines, the scenario might be different.

One interesting things to note is that China is another country after India to successfully manufacture low cost woven fabrics from textured yarn unlike for fabrics from ring yarn and rotor yarn.

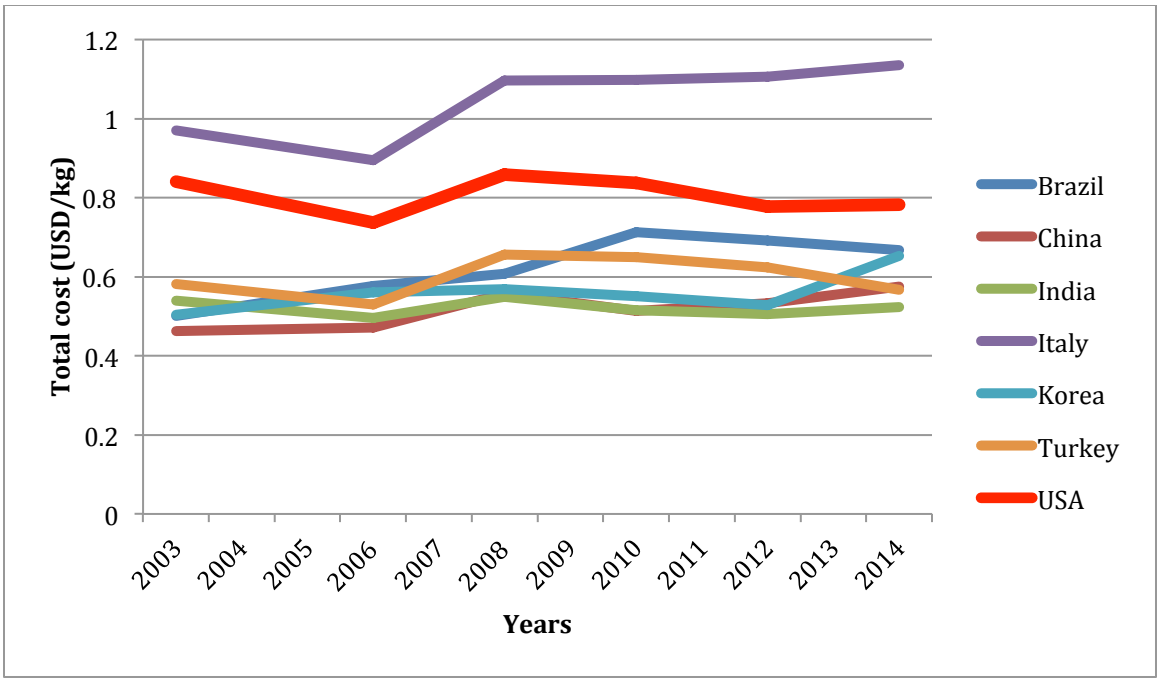

Figure 6.5: Weaving with Textured Yarn Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

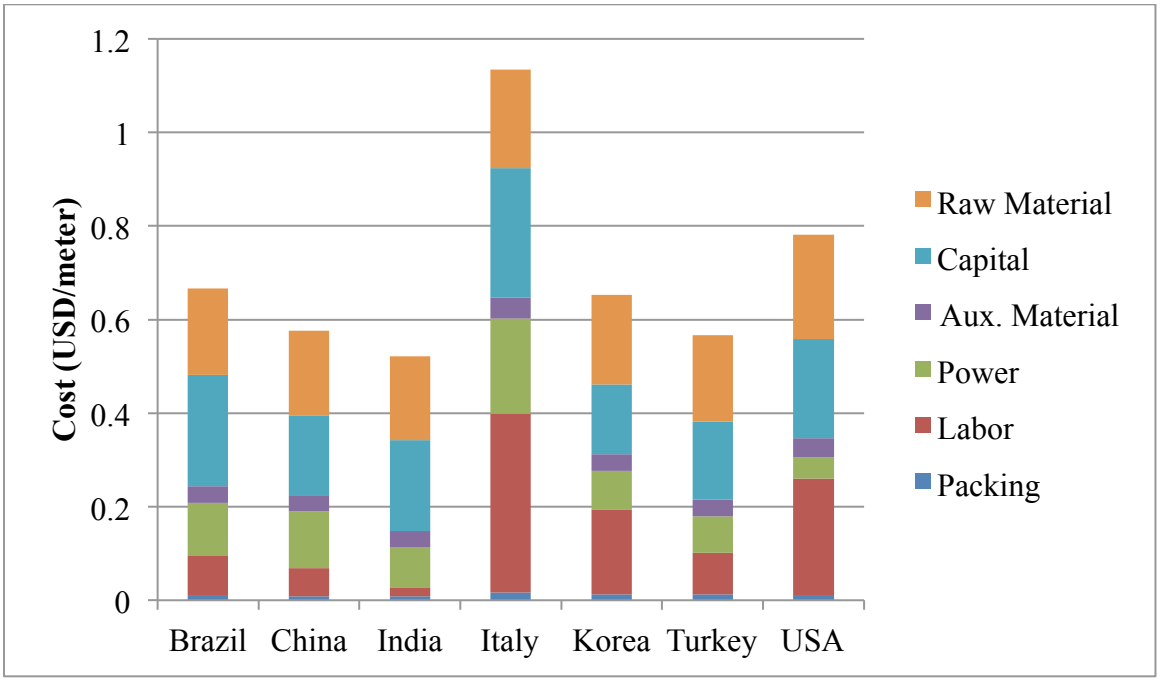

Figure 6.6: Cost Components for Weaving with Textured Yarn for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

Chapter 7- Results Pertaining to Knitting

7.1 Cost Trends in Manufacturing Knitted Fabric from Ring Yarn and Rotor Yarn

Figures 7.1, 7.3 and 7.6 show the total cost per meter of knitted fabric from ring yarn, rotor yarn and textured yarn respectively. Circular weft knitting machines with 30-inch diameter, 24 gauge and 96 feeders were considered. For ring yarn Single Jersey, for rotor yarn Lapique. Knitted fabric with ring yarn has an unfinished weight of 230 grams/meter and that for rotor yarn fabric is 359 grams/meter.

As shown in figure 7.1, the cost of manufacturing a knitted fabric from Ring yarn in 2014 for US was 0.86 $/meter which is only 2 cents/meter higher than the cost of manufacturing it in India. Cost of manufacturing for US, India, Brazil, Korea and Turkey are very close to each other and competition is very high.

For knitted fabric manufactured from rotor yarn, manufacturing in the US becomes the most inexpensive option as it cost only 0.92 $/meter for a 359 grams/meter quality in 2014. It was followed by India with the cost of 0.96 $/meter for same fabric construction. China is presently the most expensive country to manufacture knitted fabric from rotor yarn even surpassing the cost of knitted fabric manufacturing in Italy.

Figures 7.2 and 7.4 show the cost components for knitting ring and rotor yarn for the year 2014. Again, low cost availability of yarn played role towards successful low cost manufacturing of knitted fabric from cotton yarn for US. Cost of manufacturing in China is very high because of expensive cotton yarn in China.

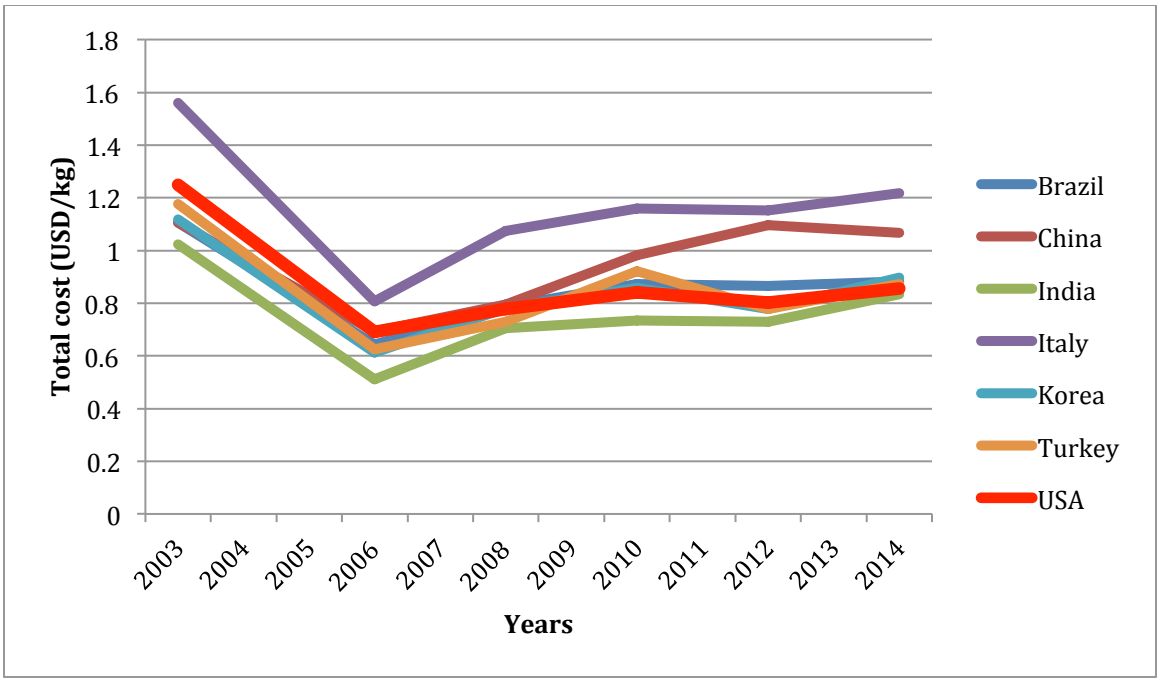

Figure 7.1: Knitting with Ring Yarn Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

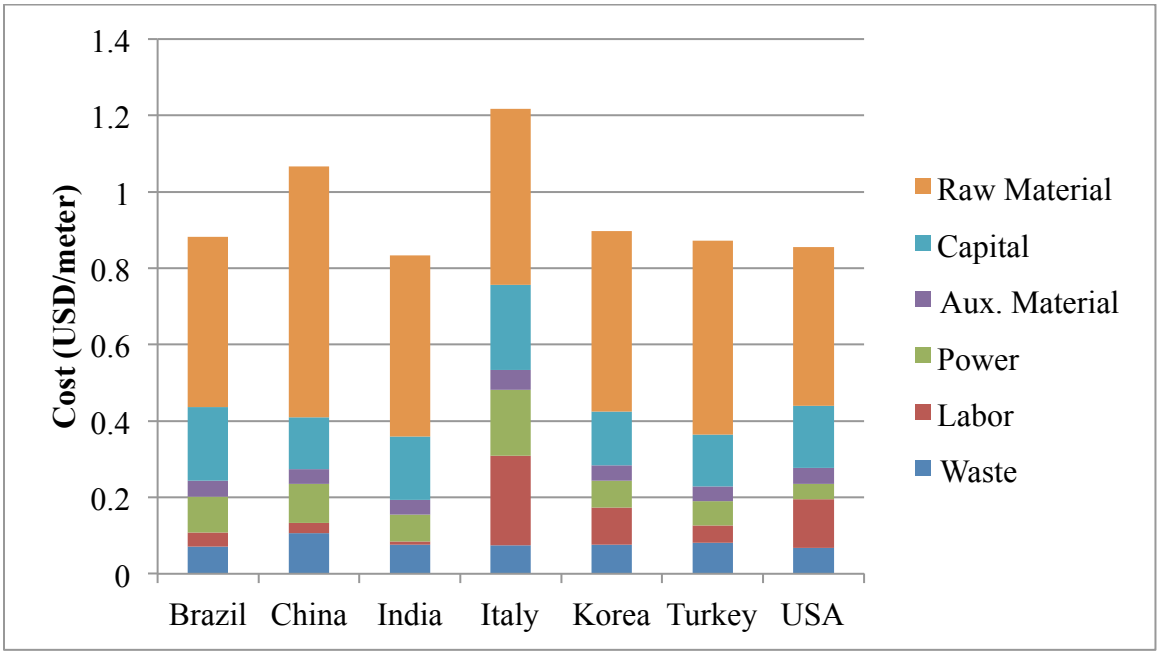

Figure 7.2: Cost Components for Knitting with Ring Yarn for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

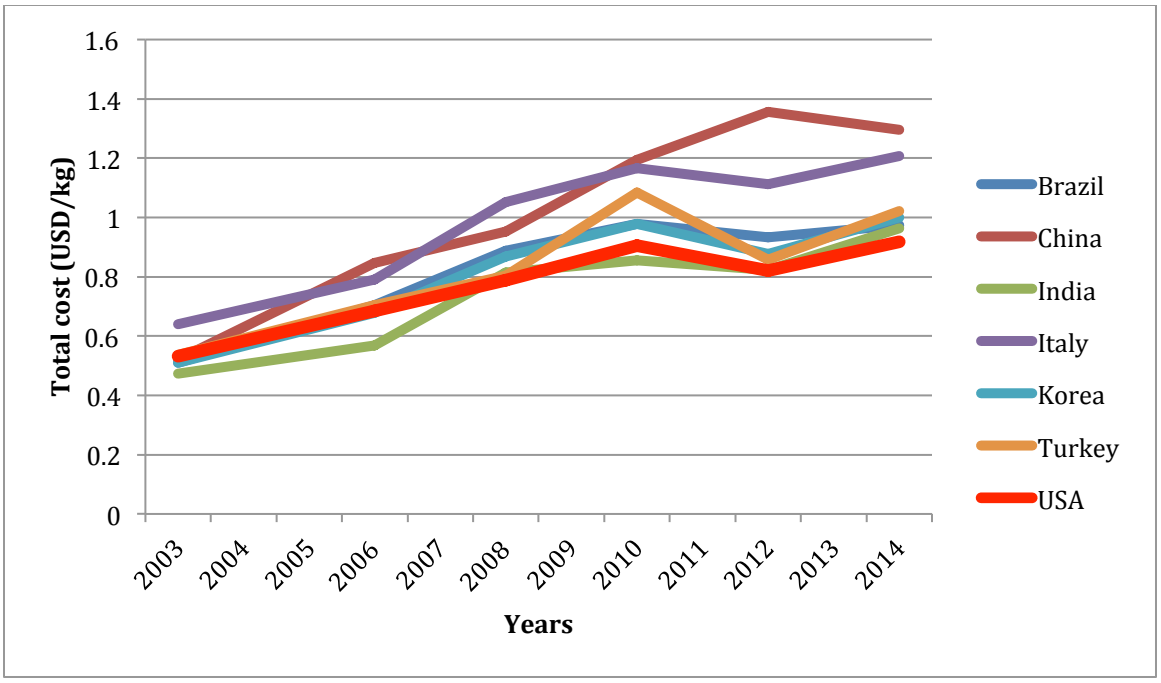

Figure 7.3: Knitting with Rotor Yarn Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

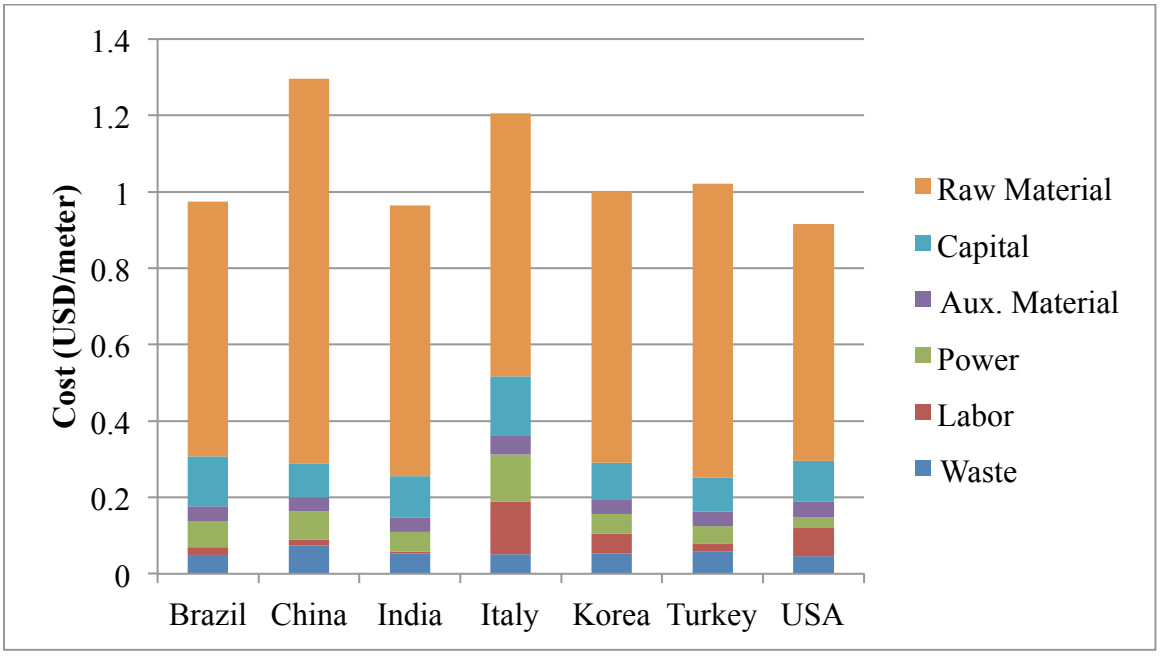

Figure 7.4: Cost Components for Knitting with Rotor Yarn for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

7.2 Cost Trends in Manufacturing Knitted Fabric from Textured Yarn

For a knitted fabric manufactured from textured yarn, 100% textured polyester yarn with interlock construction was considered to produce a fabric of 209 grams/meter on weft knitting machine. As shown in figure 7.5, the cost of producing knitted fabric from textured yarn in the US is very high. China, which was one of the most expensive destinations for knitted fabric manufacturing of cotton yarn, became one of the most inexpensive destinations to make knitted fabric from textured yarn. Figure 7.6 makes it clear that raw material is the biggest driver and the availability of low cost synthetic raw material makes China highly cost competitive.

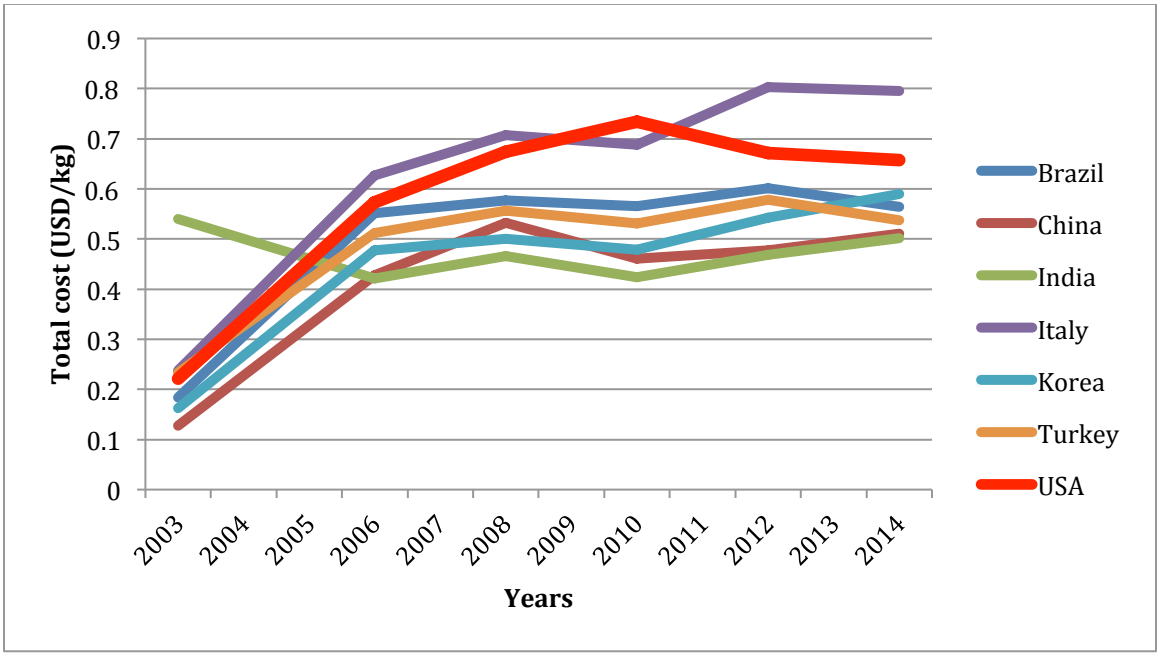

Figure 7.5: Knitting with Textured Yarn Costs by Year. Source: Created by author. Data from ITMF International Production Cost Comparison (2003-2015)

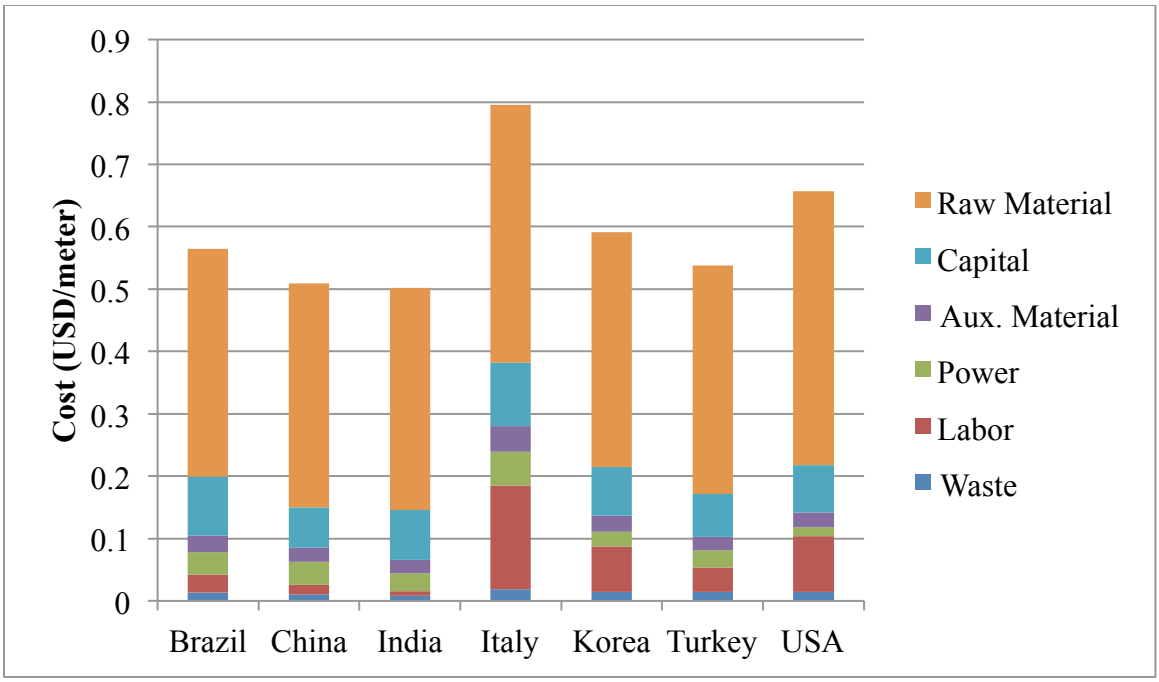

Figure 7.6: Cost Components for Knitting with Textured Yarn for 2014. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

It is clear from the figures that knitting with cotton yarn, ring or rotor, in the US is quiet possible at competitive rates. Knitting with textured yarn should be challenging because of expensive raw material costs.

Chapter 8- Conclusions & Recommendations

The US was one of the biggest textile manufacturing countries in the past. In late 1990s, textile manufacturing shifted to other countries, specifically Asian countries. Since then, the US textile industry has faced the greatest challenge because of global competition. Competitive advantage in cost of production mainly because of labor cost allowed a few Asian countries to take a big market share in textile products.

The biggest share in cost components of total production cost in textiles is the raw material. The significant of labor cost reduced over time because of automation. Another major component, that plays a significant role, is the cost of power. The cost of cotton in the United States is lower than its cost in other countries mainly because of the farm bill and government support. Additionally, US textile industries also enjoy inexpensive power costs further reducing the cost of production. These factors have allowed US short staple spinning, weaving and knitting industries to be able to manufacture yarn and fabric at competitive rates.

It is interesting to note that foreign companies are investing in US textile industries to manufacture in US which enables them to brand products as "Made in America" in addition to reduced lead times and latest trends. All these benefits come with an advantage of low cost of manufacturing for cotton textile yarns.

8.1 Summary of Results by Research Objective

- Create a single data base which should include textile manufacturing costs in various countries, change in the prices of raw material over the years and new investments on textile machinery in US in recent years.

This research objective was fulfilled by collecting data from ITMF's International production cost comparison, ITMF's International machinery shipment statistics and Textile World's Yarn market.

- Determine opportunities for cost-competitiveness for US spinners, weavers, and knitters giving special consideration to the volatility in the raw-material cost by analyzing and interpreting the collected data.

Clearly, the biggest opportunity and cost-competitiveness for US spinners lies in its strength of having inexpensive cotton available within the country. US has an advantage over China and other countries because the prices of cotton in the country is the most inexpensive. Because of this cost advantage, US has the capability to produce the one of the most inexpensive Rotor yarns in the world and second most inexpensive Ring yarn after India. Besides the benefit of low cost raw material, US has a favor in power costs, which is inexpensive and plentiful in the US. The cost of labor in India and China is still very inexpensive when compared to US labor costs but since there has been a lot of automation in textile industries, the need of labor has reduced drastically benefiting US textile manufacturing.

Even weaving and knitting with ring and rotor yarn has become very inexpensive in US because of the lower cost of cotton yarn and benefits in cheaper power costs. In addition to all these advantages, it gives US weavers and knitters reduced lead times to keep up with the changing trends in the fashion industry.

The cost of cotton has undergone a lot of fluctuation in the year of 2011 and a many investments have taken place in the textile industries of United States by foreign industries

since 2010-11. As the cotton fiber prices changed, the yarn prices changed accordingly which proved how an important role raw material plays in determining yarn rates.

Unlike cotton, the cost of polyester raw material is expensive in the US. Texturizing and weaving/ knitting from textured yarn in US is very expensive because of high rates of raw material.

- Determination of the challenges for US spinners, weavers, and knitters and prediction of the future of textile manufacturing.

For textile process the requires high amount of manual labor, like cutting and sewing or garmenting in general, it is difficult to overcome the cost advantage that other countries with low cost labor have at present. US is the biggest exporter of Cotton and can potentially be a big manufacturer of Cotton yarn and fabric too. But, cutting and sewing the fabric to make an end product out of it will be very expensive because of lack of automation in the garmenting industry. Although there is a lot of new investments taking place in US textile industries, the apparel production stays with countries like Bangladesh, Vietnam and India to name a few. Even the manufacturing cost of US yarn and fabric is almost equal to the manufacturing cost of India. Thus, the biggest challenge for US spinners, weavers and knitters is the developing countries. With increasing labor costs and raw material costs in China, the textile production, which was almost entirely taking place in China, is shifting to other countries. Obviously, the small developing countries would not be able to take up the whole of the shift and a lot of it is coming back to US because of other benefits associated with making in US.

The future of textile manufacturing lies in short staple yarn manufacturing and weaving and knitting from this yarn. Big investments in these industries have just started and it has a long way to go. With so much of research and developments taking place, any automation in garmenting will result in cutting and sewing to come back to US making composite mills possible. With cotton yarn and fabric manufacturing taking its pace in US, there might be investments in making synthetic raw material available at inexpensive rates, which will be a comeback for the complete textile industry as a whole.

8.2 Recommendations

The industry members should actively continue to look for opportunities to be cost-competitive. The rising costs in China, brand benefits of "made in USA" products, power cost in US are to name a few benefits in addition to the biggest advantage in raw material costs. New investing industries will have to undergo with a few challenges of setting up a complete new industry in US and training the workers because textile manufacturing had vanished a decade ago and some of the know-how is almost lost by now. Few industries have already taken the initiative and it won't take time for the know-how to spread, as generation of employment is very important in US.

For researchers, this study has exposed a number of areas where additional studies can be done. This study didn't take into account the import and export benefits from country to country. Synthetic raw material is expensive in US but what if it is imported from other countries and texturizing, weaving and knitting is done in the US itself. Will US be cost competitive in such a situation?

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Appendices

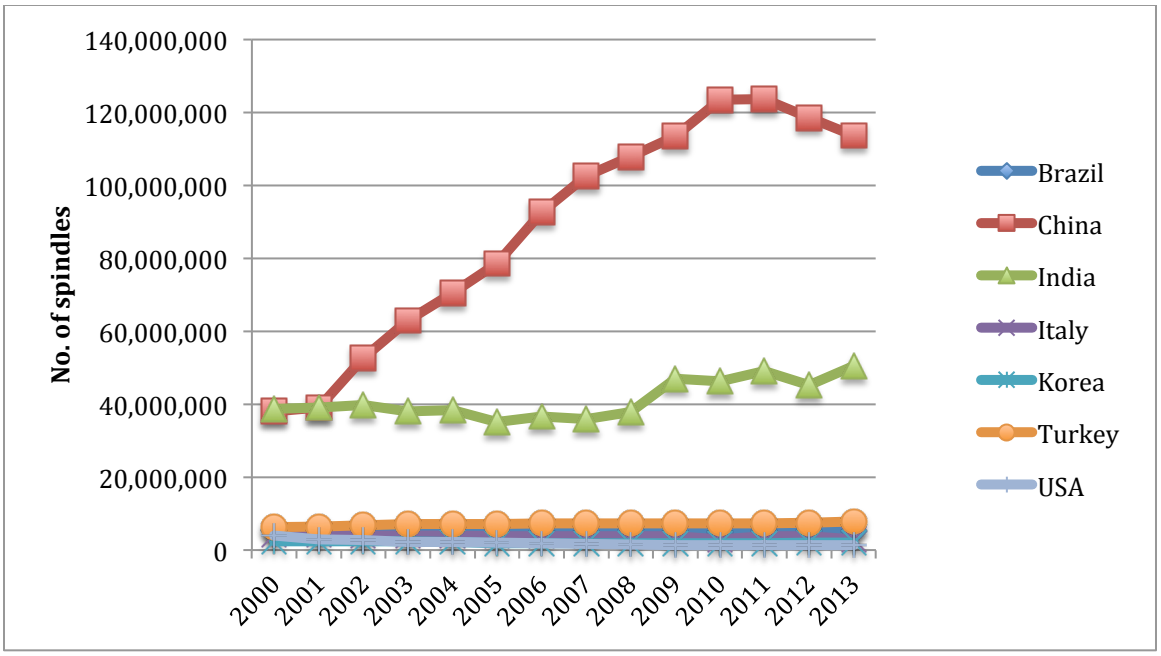

Figure 9.1: Country Ring spinning capacity by year. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

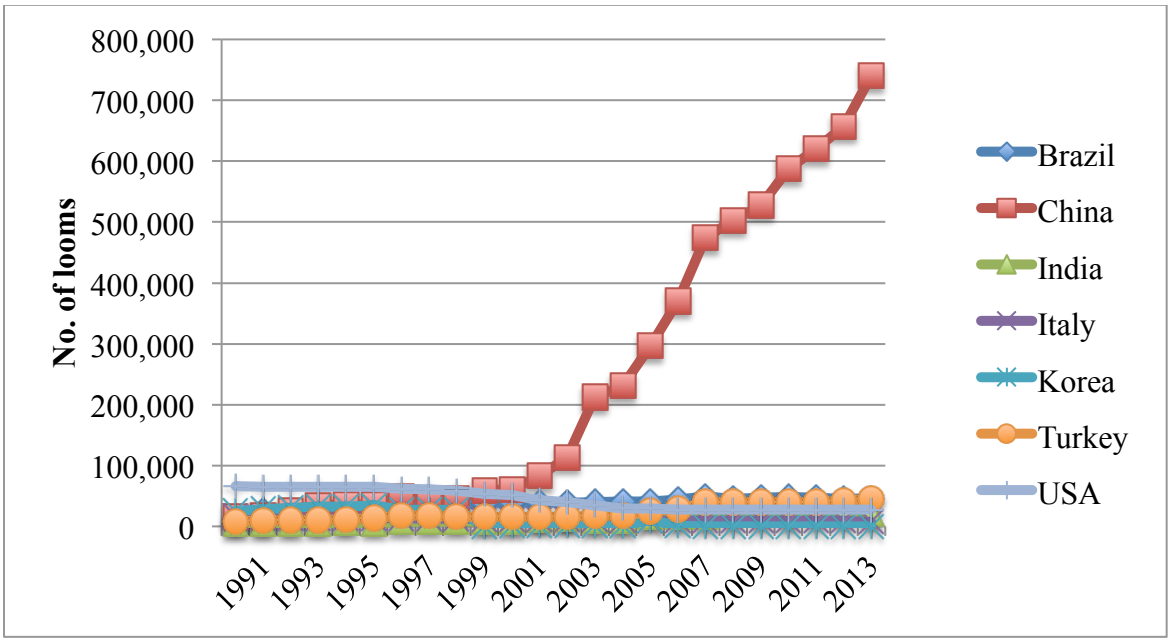

Figure 9.2: Country weaving capacity by year. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)

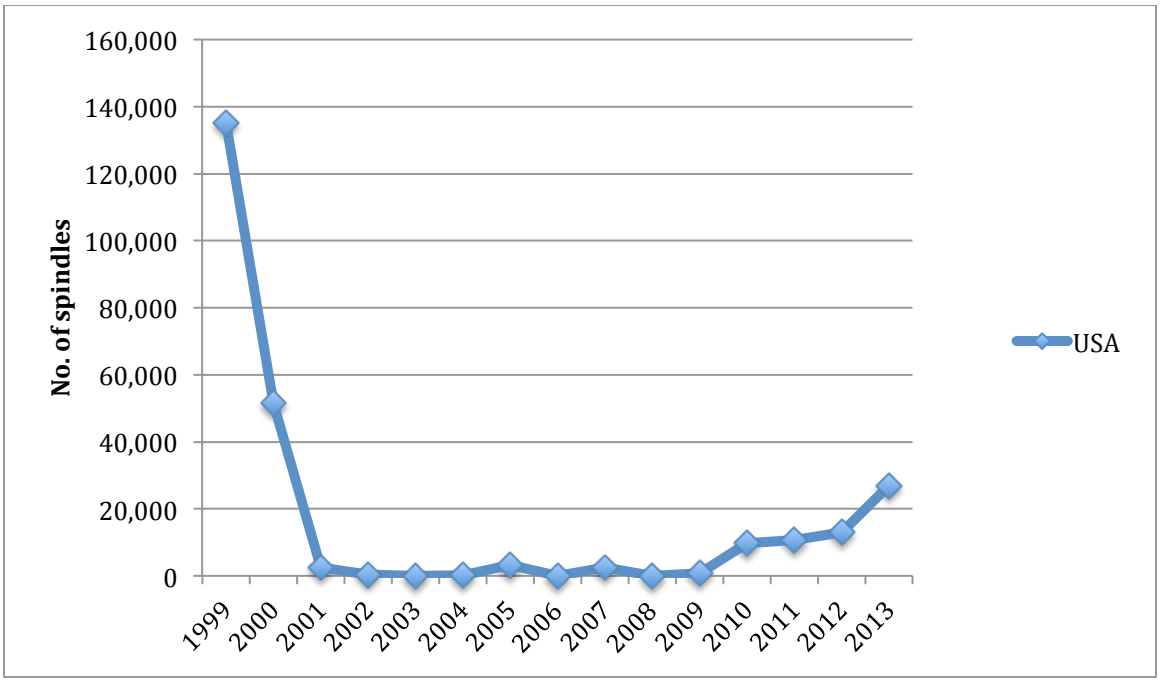

Figure 9.3: US weaving shipment by year. Source: Created by author. Data from ITMF International Production Cost Comparison (2014)