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Economics Group

Special Commentary

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Is U.S. Manufacturing in Decline?

The manufacturing sector has played an important role in the evolution of the U.S. economy ever since the industrial revolution. In recent times the nation has observed a wave of outsourcing and news stories of factory closures with jobs disappearing from local communities. Some have suggested that these trends are indicative of a domestic manufacturing sector that is in decline. In this report we break down the evidence and explore the history of the U.S. manufacturing sector and contemporary trends to determine if manufacturing is, in fact, in decline.

We find that previous measures of the health of the U.S. manufacturing sector such as employment do not accurately capture the new face of U.S. manufacturing that is now more capital intensive in the form of technology. This adoption of technology requires fewer, more highly skilled and productive workers than in the past. We use this structural change in the industry as a framework for analyzing the manufacturing sectors of emerging market economies. We also explore the future of U.S. manufacturing in light of increasing demand for U.S. factory technology among emerging market economies. We find that on an output basis, the manufacturing sector of the economy remains stronger and more productive than at any other point in the past. Furthermore, the future of the U.S. manufacturing sector will likely depend more than ever on exporting our accumulated manufacturing knowledge and technologies to assist emerging market economies increase their capital intensity, productivity, and improve their manufacturing processes. We expect that this trend will help support further growth in U.S. exports, which in turn will provide support to U.S. economic growth.

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Measuring U.S. Manufacturing Growth

One of the key metrics that many point to as evidence of a decline in manufacturing is the fact that the industrial sector of the economy now employs far fewer workers than in the past. As can be seen in Figure 1 below, employment in the manufacturing sector has been more or less declining since 1980, with the declines accelerating sharply after 2000. For several decades prior to 1980 the robustness of the manufacturing sector could be accurately measured by job growth in the industry. But, the positive correlation between manufacturing output and industry job growth begins to break down in the 1980s. In fact, the correlation from 1947 to 1980 is 0.86, while from 1980 to 2010 the correlation reversed itself to -0.80, implying that as manufacturing output increased, employment decreased. Thus, the divergence between manufacturing employment and output suggests that the best measure to gauge the impact of manufacturing's contribution to the economy is to use output, and not employment, of the industry.

Total manufacturing output since 1960 can also be seen in Figure 1. It is clear that the trend in total output has continued to rise even though employment has declined. The reason for the separation can be directly related to the structural shift that occurred in the industry brought about by the adoption of new technology into the manufacturing process. The adoption of technology increases the productivity of labor which in turn allows output to grow without

increasing the labor needed for production.[1] With the advances in technology over the past thirty years, the increased investment in technology has made manufacturing more productive, allowing the U.S. to remain globally competitive.[2] The strong growth in labor productivity since the 1980s has also helped boost corporate profit growth over the same time period (Figure 2).

Figure 1

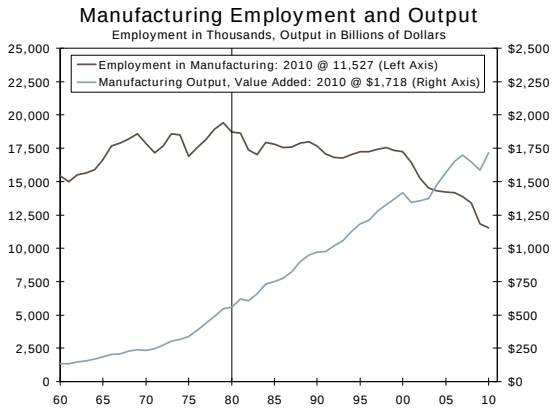
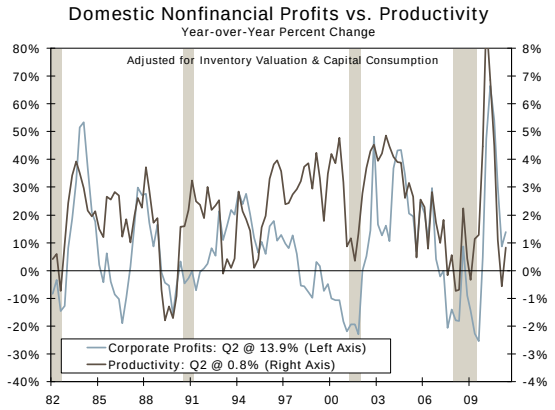


Figure 2



Source: U.S. Department of Commerce, U.S. Department of Labor and Wells Fargo Securities, LLC

The Home-Grown Technological Revolution

The 1980s were ripe with new technologies and techniques for managing the production process. During this time, new technologies such as computer numerically controlled (CNC) machines and other computer technologies were being developed and manufactured in the United States. These technologies helped boost domestic labor productivity. Also during this time period, new supply chain management techniques such as Just-in-Time inventory management and computerized supply chain management allowed firms to become more responsive to economic cycle changes.[3] The 1990s saw the advent of robotic technology in the manufacturing process. This technology removed the need for labor in repetitious tasks that could now be programmed. In today's manufacturing environment input costs are a constant concern, and the rise of global competition has forced domestic manufactures to minimize costs and increase productivity more than ever. Some firms have turned to outsourcing in order to remain globally competitive. However, as we argue in the next section, the long-run cost advantage of offshore manufacturing has begun to subside in light of rising labor and transportation costs.

The factory technology adoption within domestic manufacturing leads to another important revolution in the manufacturing sector, the need for fewer but more highly skilled workers.

Many of the technologies that are now used to streamline manufacturing processes have been developed and manufactured in the U.S. For example, the software that powers robotic manufacturing processes such as Computer Aided Design (CAD) was developed domestically. The by-product of these advances in U.S. manufacturing techniques is a new industry that specializes in streamlining manufacturing processes. This industry includes factory equipment manufacturers, supply chain consultants, and plant design and engineering firms. This industry has continued to flourish since the increased demand for automation in the 1980s.

The factory technology adoption within domestic manufacturing leads to another important revolution in the manufacturing sector, the need for fewer but more highly skilled workers.[4] Our group has argued that one of the key reasons for the elevated unemployment rate in the U.S. is the ongoing structural unemployment problem throughout the country. As technology has crept into the production process, the more complex manufacturing equipment has increased the need for

[1] Bryson, J. and Quinlan, T. (2010). What Really Drives Growth in the Industrial Sector?
[2] Congressional Budget Office. (2004). What Accounts for the Decline in Manufacturing Employment? CBO Economic Budget Issue Brief.
[3] Anderson, S. and Brown, M.A. (2011). Deciphering Business Inventory Trends.
[4] Berman, Bound, and Griliches. (1993). Changes in the Demand for Skilled Labor Within U.S. Manufacturing Industries: Evidence from the Annual Survey of Manufacturing. National Bureau of Economic Research. Working Paper No. 4255.

factory technicians, electrical and computer engineers, and programmers. These professionals are more highly skilled than traditional assembly-line factory workers (for further evidence of the increasing educational requirement of modern factory workers see Berndt et al. 1992).[5] In many cases, these individuals have advanced degrees in engineering and computer science. The shift in demand for these new workers has left many lower-skilled factory workers without a job.

The manufacturing industry continues to evolve into a production model that requires far fewer, but more highly skilled workers. However, the long-term benefit of adopting the technology will help to ensure the competitiveness, and therefore preservation, of the U.S. manufacturing industry. There may in fact be in-sourcing of manufacturing activity and new manufacturing jobs as labor costs, supply chain uncertainty, and transportation costs continue to rise abroad. The new technologically advanced domestic production facilities will be in the best position to produce goods at globally competitive prices. We explore the case of the rise in production costs in developing countries in the next section and outline why, in our view, the long-term competitive nature of any country's manufacturing base is highly dependent on the level of technology used in the production process. We find that domestic producers of manufacturing technology and domestic consulting firms are able to "export" our knowledge and capital to developing nations in order to fill a key need of spreading manufacturing technologies and techniques that have been perfected in the U.S. to these nations that are now also facing higher labor and production costs of their own.

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A Global Perspective: Rising Labor Costs in BRIC Countries

U.S. manufacturers and those of other developed nations have been actively engaging in outsourcing activities as an effective means of cost reduction. Countries that can provide cheap and abundant labor are targeted as locations for production facilities. Specifically, the BRIC countries (Brazil, Russia, India and China) have dominated the interests of foreign investors. Manufacturers in developed nations have been attracted to the BRICs for their abundance of labor, lower labor costs, and efficient transportation infrastructure.

In addition, trade liberalization and open capital markets have allowed for increased foreign direct investment (FDI). The inflow of FDI and the further development of infrastructure has fostered the growth of a middle class in these nations. Evidence suggests that increasing FDI has a tendency to drive up real wages in the manufacturing sector.[6] As the middle class expands and wealth continues to rise, these economies become more influenced by increased demand for locally manufactured goods. It is for this reason that many U.S. manufacturers are opening operations within these countries, to take advantage of the growth of the middle class and to be closer to their consumers.

Furthermore, the rapid middle-class expansion provides an incentive to manufacturers with existing operations within these countries to remain within these nations, as opposed to relocating operations to other nations where labor costs are not rising as rapidly. In particular, the advantage to U.S. manufacturers of maintaining operations within these BRIC countries is that they are able to generate revenue from a globally diverse consumer base. Especially today, when demand from developed economies has been slow to rebound, U.S. manufacturers' sales have been boosted by the strong demand from emerging economies. Therefore, while lower labor costs and developed infrastructure enticed foreign producers to invest in the BRICs, the growing domestic demand within these nations motivates manufacturers to maintain, and in some cases expand, operations within the BRIC nations.[7]

Today, the BRIC countries are recognized as having a competitive advantage, specifically as it pertains to labor costs in the production process, both over the developed nations as well as other

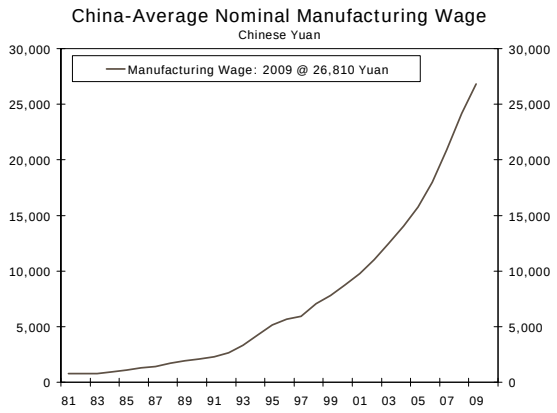
[5] Berndt, E. et al. (1992). High-Tech Capital Formation and Labor Composition in U.S. Manufacturing Industries: An Exploratory Analysis. National Bureau of Economic Research. Working Paper No. 4010.
[6] Henry, P.B., Sasson, D. (2008). Capital Account Liberalization, Real Wages, and Productivity. National Bureau of Economic Research. Working Paper No. 13880.
[7] "Tomorrow's Markets" (2008). UK Trade and Investment in co-operation with the Economist Intelligence Unit.

emerging market economies. However, rising labor costs in the BRIC nations, coupled with continued upward pressure on transportation and commodity costs, will likely detract from their cost advantage and force some producers to search for lower cost alternatives. A recent report published by the Boston Consulting Group suggests that within the next five years, the total cost of production for many products will only be 10 to 15 percent less in Chinese coastal cities than in the U.S. cities where production facilities are most likely to be located.[8] When combined with rising transportation costs and the strengthening Chinese labor organizations that are gaining success in demanding higher wages and benefits for factory employees, the labor-cost advantage in China is rapidly eroding.

When producers face rising costs of the inputs to production they look for ways to lower the costs of those inputs. However, not all of the factors of production's costs can be controlled. For example, when the prices of commodities increase a producer cannot avoid the increasing costs without altering the use of that commodity altogether and ultimately changing the product. Labor costs, on the other hand, are relatively easier to manage. If upward pressure of wages and salaries pushes labor costs beyond the desired threshold of the producers, they can search for cheaper labor. Therefore, as BRIC nations lose their labor-cost advantage through upward pressure on wages, producers will again move their manufacturing operations to yet untapped markets. Specifically, the BRICs are feeling a growing pressure from some countries in Southeast Asia and Africa, countries who are not yet as advanced and have an abundance of labor at a lower cost. Losing their cheap labor advantage is detrimental to continued growth in foreign investment and thus, in order to remain competitive, BRIC countries need to find a way to maintain and extend their lower production-cost advantage.

Figure 3

Figure 4



Source: IHS Global Insight, IPEAdata and Wells Fargo Securities, LLC

Because labor costs are rapidly rising factories must find a way to boost productivity in order to stay globally competitive.

When looking at the rapid growth in two of the four BRIC countries the dramatic increase in labor cost becomes evident (Figure 3 and 4). Nominal manufacturing wages in Sao Paulo, Brazil's largest and most populous city, have been steadily rising since the early 2000s. In July 2011 wages in manufacturing were 53 percent higher than they were just five years ago in 2006. Similarly, nominal manufacturing wages in China have increased more then 200 percent from 2000 to 2009. Furthermore, we have no reason to believe that the rising trend in wages and salaries in the BRICs will subside.

Because labor costs are rapidly rising, factories must find a way to boost productivity in order to stay globally competitive. Classical macroeconomic theory recognizes technological progress as a necessary component of productivity and production.[9] To increase productivity through

[8] Sirken, Harold L., et al. (2011). "Made in America, Again: Why Manufacturing Will Return to the U.S." The Boston Consulting Group.
[9] Solo, R. (1969). Capital and Labor Intensive Technology in Developing Countries. Journal of Economic Issues.

technology the BRICs can learn from the developments in U.S. manufacturing. As mentioned above, U.S. manufacturers have continually invested in capital technology and production techniques in order to remain a competitive force in manufacturing. By investing in production technologies manufacturers have been able to increase output while decreasing the amount of labor they employ.

Technology that allows increased output without increased amounts of labor is referred to as labor-augmenting technology. Labor-augmenting technology expands a nation's production capabilities by increasing the efficiency of labor, which in turn can lead to greater profits at lower production costs. Therefore, by adding technology into the production process the BRICs will be able to increase their productivity and ultimately help maintain their low-cost advantage. Further, technological innovation shifts the demand for workers away from unskilled workers and toward skilled workers. This rising demand for skilled workers will further develop the middle class in the BRICs, which is already a driving influence of foreign investment in these countries.

To increase productivity through technology the BRICs can learn from the developments in U.S. manufacturing.

Even in the face of rising labor costs, producers remain attracted to the BRICs due to the size of their markets. However, continued upward pressure on wages and rising transportation costs will increasingly force producers to shift production away from BRIC nations unless productivity can be boosted. In order to remain competitive, the adoption of new technology into the production process is needed. The U.S. will be able to capitalize on the increased demand for technology from these emerging market economies.

The Future of U.S. Manufacturing

As BRIC manufacturers find a growing need to implement technology into their production processes, U.S. manufacturers have an opportunity to support that demand. U.S. companies have already seen steady export growth in manufacturing technology and value-added goods and services. As evidenced by Figure 6, U.S. real exports of capital goods have continued to steadily increase since the early 1990s. The only disturbances to the trend were the steep drop-offs during the 2001 and 2009 recessions. In addition to the U.S.'s consistent upward trend in capital goods exports we also notice that U.S. exports are increasingly destined for BRIC countries. Comparing the share of total U.S. exports that go to the European Union (EU), Canada and the BRIC nations, Figure 7 highlights a slow drop-off in U.S. imports by the EU and Canada, while the share going to the BRIC nations has increased to 12 percent from about 4 percent over the past decade.

Figure 5

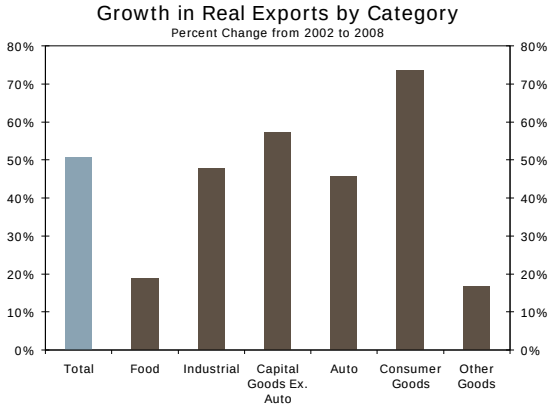
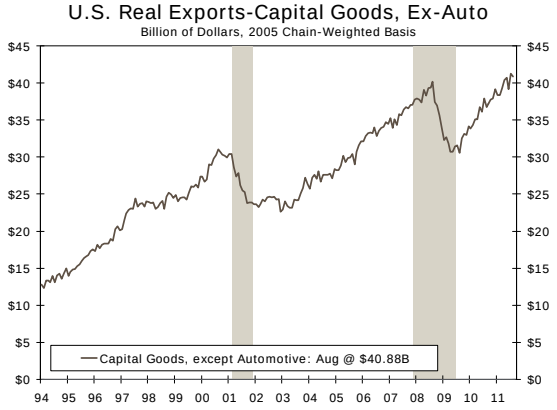


Figure 6



Source: IHS Global Insight, U.S. Department of Commerce and Wells Fargo Securities, LLC

The BRIC nations have become increasingly more significant as a trading partner, specifically as an importer of U.S. industrial and business machinery.

In general, there has been a shift toward greater exports to BRIC countries in recent years.[10] As can be seen from Figure 8, there has been a shift in the share of U.S. industrial and business machinery exports to the BRIC nations.[11] The percentage of U.S. exports of industrial and business machinery going to the BRICs has risen significantly since 2002. The share of exports going to either the BRIC countries or to all nations less the four BRICs has been indexed to the share they held in 2002. Thus, we can see that since 2002 the share of these exports that the BRIC nations held has never dipped below the 2002 levels. The evidence from figures 6, 7, and 8 demonstrates the fact that the BRIC nations have become increasingly more significant as a trading partner, specifically as an importer of U.S. industrial and business machinery. The proven demand for capital goods among BRIC countries should continue to support U.S. export growth in the future. This is good news for U.S. manufactures and exporters of production technology and consulting services.

Figure 7

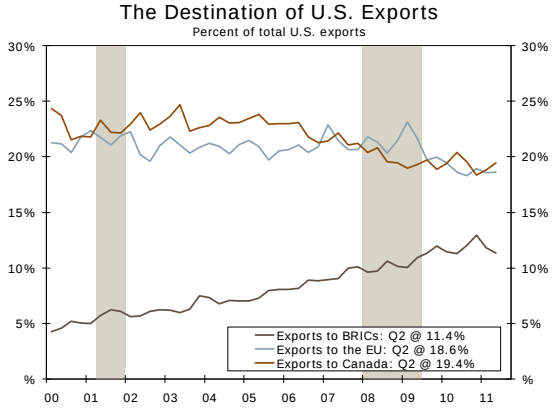
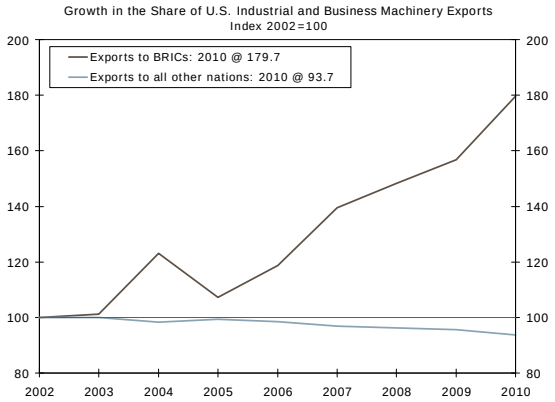


Figure 8



Source: U.S. Department of Commerce and Wells Fargo Securities, LLC

The types of goods that we produce and the way we produce these goods has fundamentally changed.

In looking at recent trends and the emerging demand for labor-augmenting technology in emerging market economies around the world, we believe that the future of U.S. manufacturing is bright. In addition to helping boost domestic manufacturing output, there will be several other positive benefits to exporting our knowledge of highly automated manufacturing techniques to other nations. This trend will help boost output among domestic equipment and software manufacturers in the U.S. along with the demand for operational management and supply chain consulting services. We will continue to see demand for labor-augmenting technology from emerging market economies, as they struggle to maintain their low-cost production advantage. It is this growing demand for capital goods that leads us to the conclusion that manufacturing in the U.S. is not in decline, but rather the types of goods that we produce and the way we produce these goods has fundamentally changed. A new wave of domestic manufacturing can be found in the need to help developing industrial nations create more efficient and productive manufacturing facilities through the use of technology and knowledge provided by the United States. This emerging industry should help support greater export growth and serve as a much needed engine for domestic economic growth.

[10] Bryson, J. and Kruse, T. (2011). Can America Double Its Exports in Five Years?
[11] Industrial and Business Machinery exports is defined as the summation of U.S. Census Bureau's 5-digit End-Use Code 21180 (Industrial machines, other) and 21500 (Business machines and equipment). The share of exports to the BRIC countries is the total of industrial and business machinery exports to Brazil, Russia, India and China aggregated as one level, which is then taken as a percentage of total U.S. industrial and business machinery exports. Exports to all other nations is calculated as total U.S. industrial and business machinery exports less the aggregated BRIC level, and then also taken as a percentage of U.S. total industrial and business machinery exports.

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