A homecoming for US manufacturing?

Why a resurgence in US manufacturing may be the next big bet

September 2012

At a glance

Certain conditions, including transportation and energy costs, favor re-shoring R&D and production to the United States—especially for the chemicals and metals sectors.

Localizing production can mitigate supply-chain disruptions—totalling $2.2 billion in financial impacts for United States industrial products companies in 2011.

A PwC analysis finds that manufacturing steel products in the United States instead of China can provide a net cost benefit of 2% of revenue.

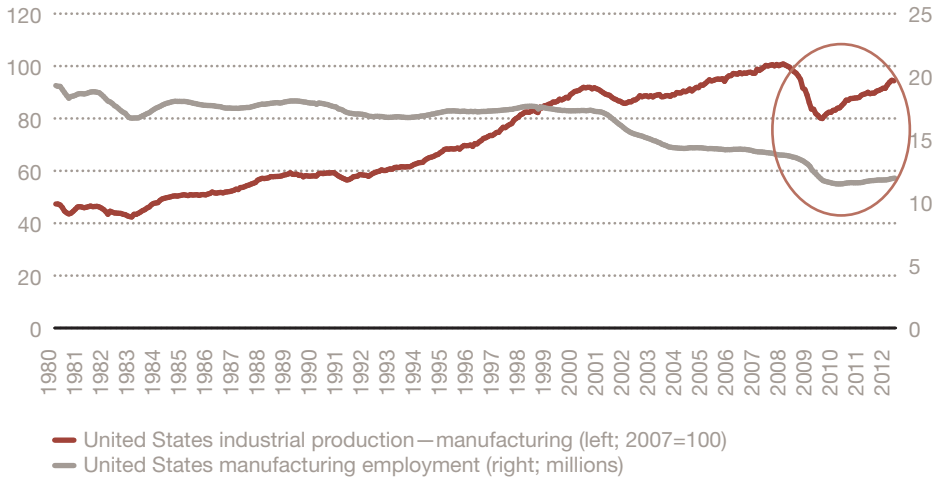
pwc

Reviving domestic manufacturing has been at the core of lifting the United States economy through—and in the wake of—the Great Recession. Indeed, industrial output has experienced a slow uphill march since 2009; however, it still hovers below pre-recession levels, while manufacturing employment has risen to a lesser extent (see Figure 1). Is this rebound simply a traditional cyclical recovery, or is the United States manufacturing sector poised to enter a second golden age? And, if so, what will drive such a renaissance?

Consensus views on such a resurgence have been, to a large degree, shaped by the thinking that rising labor costs in markets such as China are driving manufacturers back to the United States. Rising wages in emerging markets are certainly part of the story, but will likely play a less prominent role than other factors in manufacturers' decisions to re-shore or on-shore to the United States.

A cyclical rebound in the United States manufacturing sector is under way, but this one is buttressed by new—and potentially long-enduring—structural changes

Figure 1: United States industrial production and employment



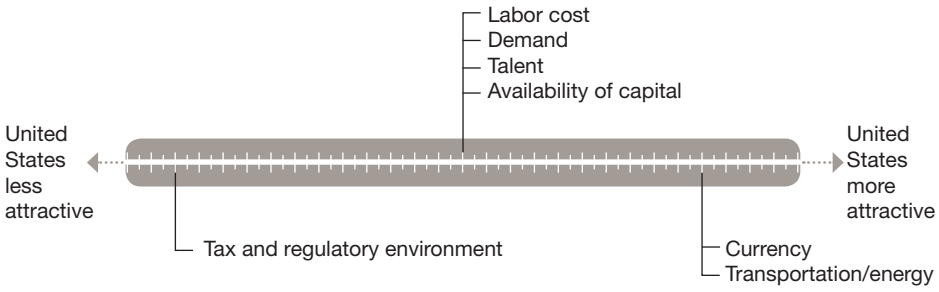
Source: *Federal Reserve, Bureau of Labor Statistics, PwC Analysis*

Back in the USA: the factors driving companies back home

PwC examined some of the key factors that could drive a manufacturing resurgence, including labor, transportation, energy, and materials costs, as well as demand, talent, availability of capital, taxes, and currency. The United States manufacturing sector is experiencing a cyclical recovery. However, structural—and likely sustained—changes in some of these areas could extend the recovery beyond what might be expected in a typical economic upturn. Even if an increase in the relative competitiveness of United States labor costs were to unfold, that seems unlikely to be sufficient to result, in itself, in a domestic manufacturing resurgence.

Instead, a host of other factors—particularly transportation and energy costs, and currency fluctuations—are more likely the most salient reason United States manufacturers will choose to produce closer to their major customer bases. And, for manufacturers with principal customer bases located in the United States, this means re-shoring production back to the United States market. The range of factors helping the United States become a more attractive—or unattractive—manufacturing location is summarized in Figure 2. This report explores these factors. Such a shift back to the United States. would likely lead to improved employment demand in the United States by manufacturers in both the production and R&D spheres.

Figure 2: Summary of manufacturing attractiveness trends



Source: Census Bureau, Bureau of Transportation Statistics, Bureau of Economic Analysis, PwC Analysis

Reuniting R&D and production in the United States

Indeed, there has historically been a strong link between manufacturing and domestic R&D investment, with 70% of all private funds spent on R&D in the United States coming from this sector.[1] It is noteworthy that companies that have moved production back to the United States—or are opening new production facilities there—have often cited R&D location as a factor. For example, Otis Elevator noted the importance of collocating manufacturing and knowledge workers when relocating a plant from Mexico to South Carolina.[2] One reason Chesapeake Bay Candle opened a facility near Maryland was to embed R&D into its factory for speedier response to new trends.[3]

Resurgence prospects: where it's hot, where it's not

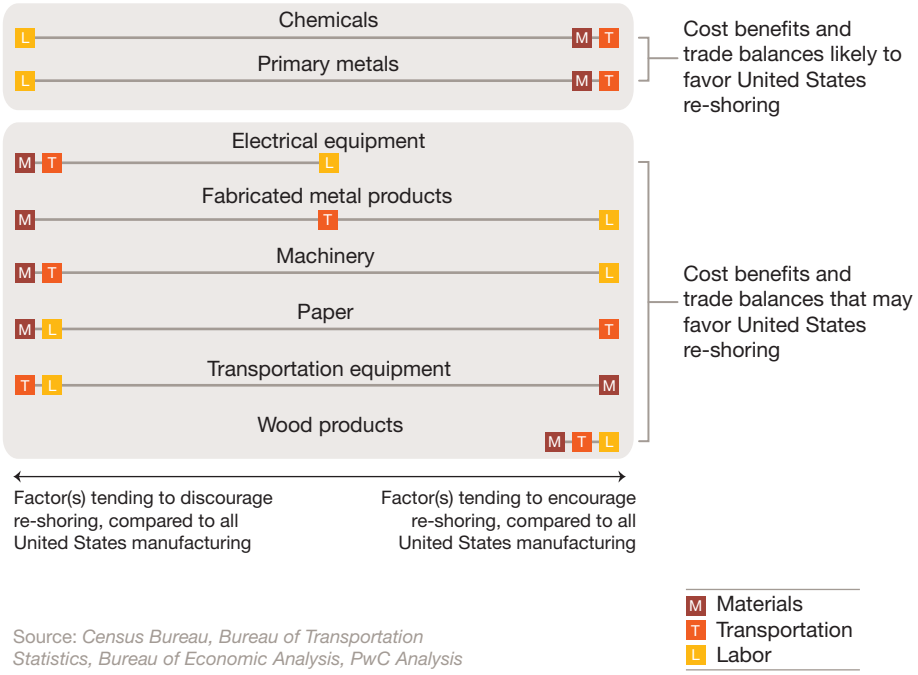
Clearly, ramping up or relocating manufacturing production and R&D in the United States generally holds greater advantages for some industries more than others. We considered to what extent major costs (i.e., labor, materials, transportation, and energy) make on-shoring or re-shoring to the United States an attractive scenario across a number of manufacturing subsectors. To build a "Re-shorability Heat Map," relative levels of labor and raw material intensity were estimated by using United States Census Bureau data on production wages and materials, parts, and packaging, respectively, as a percentage of value of product shipments. The relative ability of each industry to absorb transportation costs was estimated by value per ton data from the Bureau of Transportation Statistics Commodity Flow Survey. In addition, we considered the most recent annual trade balances by subsector (see Figure 3).

Chemicals*, metals: biggest United States on-shoring beneficiaries

While each subsector of the overall manufacturing sector may have certain industry groups that are more advantaged than others (e.g., agriculture and heavy machinery within the machinery subsector and auto within the transportation equipment subsectors), our analysis indicates that, on an overall basis, chemical and primary metal subsectors stand to benefit the most from changing cost dynamics in the United States and have large opportunities and cost incentives to re-shore, especially when considering annual net imports. Wood products should also benefit significantly from the changes in major costs; however, lower net imports may limit the benefits of on-shoring.

* Current investments focused on petrochemicals and other commodity chemicals. We anticipate the impact of this on further downstream value chains in the future (adhesives,plastics, specialties).

Figure 3: Prospects for selected subsectors



Source: *Census Bureau, Bureau of Transportation Statistics, Bureau of Economic Analysis, PwC Analysis*

1 http://www.nsf.gov/statistics/infbrief/nsf12309/
2 "Business and Civic Leaders Speak at the Insourcing American Jobs Forum at the White House," CQ Transcriptions, January 11, 2012.
3 "The boomerang effect," The Economist, April 21, 2012.

The anatomy of cost advantages through US re-shoring: the steel products sector

Note: The steel products manufacturing sector described in this analysis is NAICS 3312 and includes products produced from purchased steel, such as steel pipe and tubes.

Methodology

The PwC steel products cost model is an analysis of major inventory, transportation, and labor costs associated with manufacturing in China vs. the United States when the final goods are sold in the United States. The model starts with the Census Bureau Annual Survey of Manufacturers data for NAICS 3312: Steel Products Manufactured from Purchased Steel and applies a "what-if" scenario to compare major differences in these costs if the goods were manufactured in China instead of the United States and shipped to the United States for sale.

Inventory cost variables considered in this scenario analysis included: a) level of raw material and final goods inventory based upon estimates of time in transit and safety stock, and b) cost of financing these inventories. Transportation cost variables include ocean shipping costs associated with raw materials and final goods, while labor cost variables focused on manufacturing wages in the two countries.

The net difference in inventory, transportation, and labor costs between the China and US manufacturing scenarios was derived as:

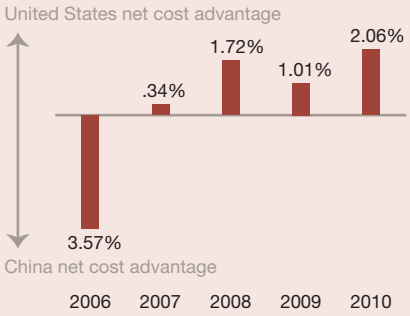
1) Net Inventory Financing Cost as % of Industry Revenue + Net Transportation Cost as % of Industry Revenue + Net Labor Cost as % of Industry Revenue, or

2) (Inventory financing cost (China)- Inventory financing cost (US))/ Industry Revenue + (Transportation cost (China)- Transportation cost (US))/Industry Revenue + (Labor cost (China)- Labor cost (US))/ Industry Revenue

A positive net percent cost indicates that the United States is more advantaged from a profitability perspective on the basis of these factors, while a negative net percent cost indicates that China is more advantaged.

Removing the China-United States supply chain link advantage

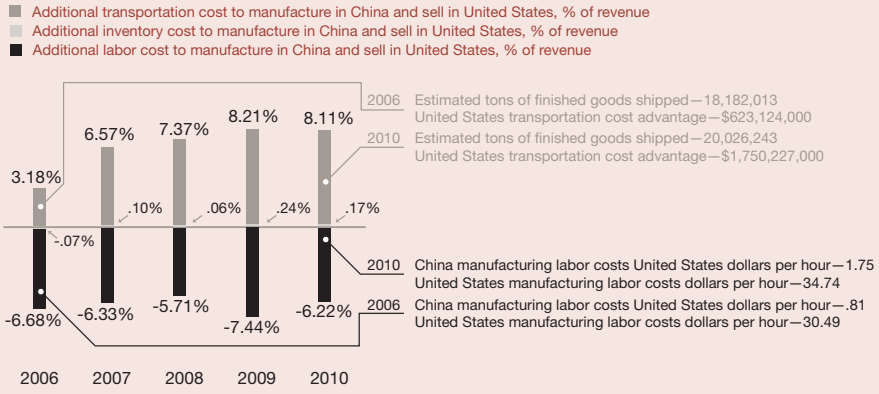
Advantage United States: Net difference in labor, transportation, and inventory cost for steel products manufactured in the United States vs. China (as a percentage of revenue)*



Source: *Census Bureau, EIU, PwC Analysis*

*Due to the time period examined in this model, this analysis does not include the more recent impact of less expensive energy on domestic production costs. This factor is expected to significantly improve United States cost competitiveness in the future.

Breakdown of the difference in labor, transportation, and inventory cost for steel products manufactured in United States vs. China



Source: *Census Bureau, EIU, PwC Analysis*

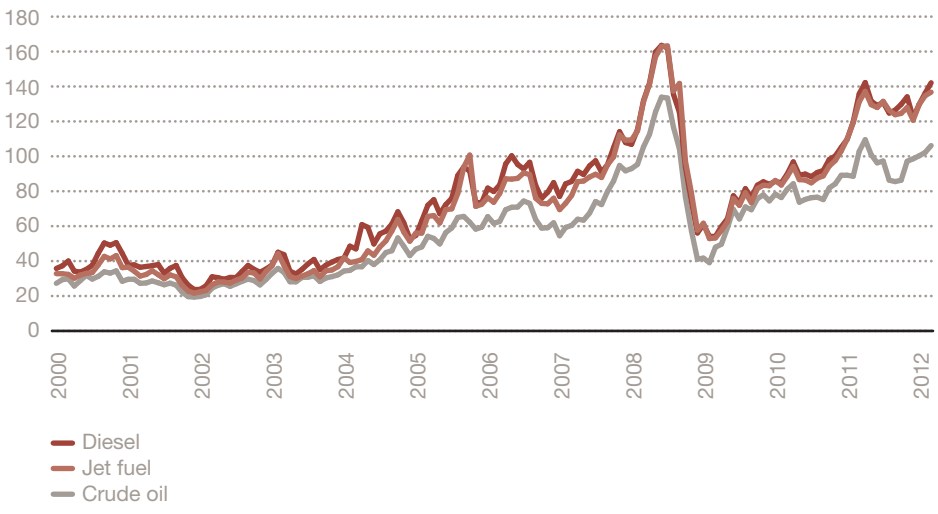
What makes the United States highly attractive

Factor 1: cutting transportation and energy costs, protecting the supply chain

Diversifying the supply chain can cut transport costs, avert logistics snares…

The bull market in energy commodities over the last decade has contributed to a major increase in transportation costs for manufacturers with global supply chains. This is reflected by the parabolic rise in crude oil spot prices as well as the prices for refined derivatives such as diesel (relevant to trucking/rail) and jet fuel (air) (see Figure 4). All else equal, manufactured goods with lower value-to-weight ratios are generally less able to absorb higher transportation costs related to manufacturing overseas and shipping to the United States. For example, some machinery companies, such as Caterpillar[4] and AGCO,[5] are producing more in the United States for sale to the North American market. It is not unreasonable, given expected growth in global demand for energy (especially in Asia and in India and China particularly), to assume that transportation costs remain at least elevated, which makes production closer to a customer base much more attractive. This can also cut down on lead times (e.g., design changes can be implemented more quickly), reduce required inventory levels, mitigate some currency risks, and give more control over intellectual property. Take AGCO, which is expanding a facility in Minnesota to meet local demand for tractors but has kept some production of tractors in France (which used to be sold in the United States) to meet demand outside North America. In some cases, manufacturers may choose to mitigate some IP-related risks in the forms of products, processes, or technological complexities through their selection of countries that are regarded as having relatively strong protections and enforcement in IP-related matters. These were among factors cited by companies in a recent MIT survey, which found that 14% of United States companies in the sample definitely planned to move some manufacturing back to this market.[6]

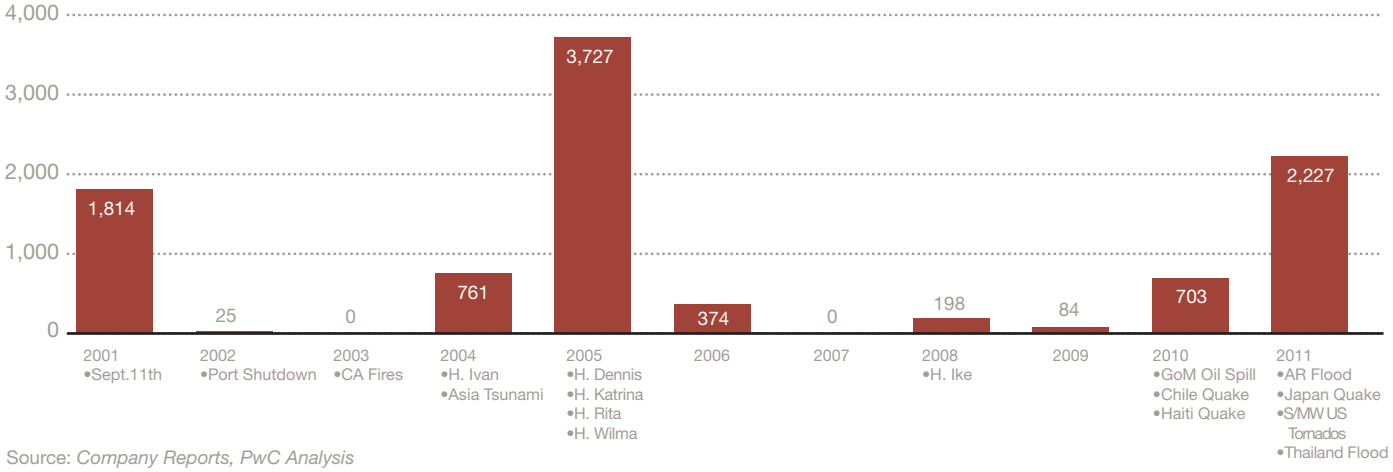
Figure 4: Transportation energy prices, United States dollars per barrel



Source: *United States Energy Information Administration, PwC Analysis*

4 "Caterpillar selects Athens, Georgia, for new plant," Reuters, February 17, 2012.
5 "Jackson's AGCO facility renovation is nearly complete," AgriNews, March 1, 2012.
6 "Some Firms Opt to Bring Manufacturing Back to United States," Wall Street Journal, July 18, 2012.

Figure 5: Financial impact of supply-chain events by United States F1000 manufacturers, $ millions



Source: *Company Reports, PwC Analysis*

…and, at the same time, reduce supply-chain disruption risks

Concerns over transportation costs that motivate companies to alter supply chains can also cause a commensurate reduction in supply-chain risk. A PwC study on resilience of United States manufacturers—based upon their disclosures of financial impacts from supply-chain disruptions over the last 10 years—finds these companies are experiencing more financial consequences due to recent natural disasters in Asia than in other parts of the world. While the United States has had its share of supply-chain events (e.g., multiple severe hurricanes in 2005), this finding strongly suggests the merits of geographically diversifying supply-chain risks and reinforcing the so-called "China plus 1" model, for example.

United States shale gas trend bodes well for manufacturing industry

Technical progress in extracting natural gas from shale has created new investment opportunities for manufacturers in the United States across several subsectors, particularly in chemicals and metals, due to more affordable energy and greater downstream demand from increased drilling. The news is replete with examples of companies spending more in the United States based upon this

trend. Examples include:

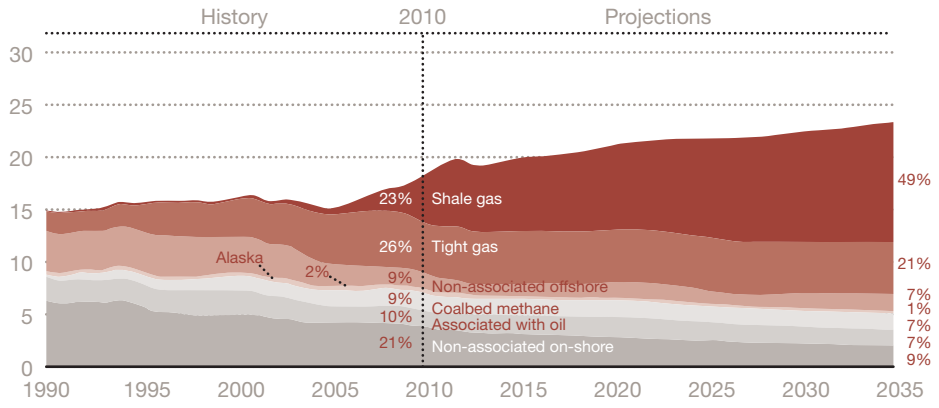
- Nucor is opening a new direct-reduced iron (DRI) plant in Louisiana because of lower costs of natural gas, which is used in the DRI process.[7]
- US Steel invested over $100 million in an Ohio plant to help meet demand from shale gas extraction activities.[8, 9]
- Dow Chemical is constructing an ethylene production plant in Texas to take advantage of more affordable feedstock.[10]

Shale gas development is a major factor that can drive further manufacturing investment in the United States. According to a recent PwC study, high shale gas recovery and low prices could impact United States manufacturing industries by adding one million workers, and reduce natural gas expenses by as much as $11.6 billion annually through 2025.[11] The EIA estimates shale gas will account for 49% of all natural gas production in 2035, up from 23% in 2010 (see Figure 6).

Factor 2: currency trends an X factor

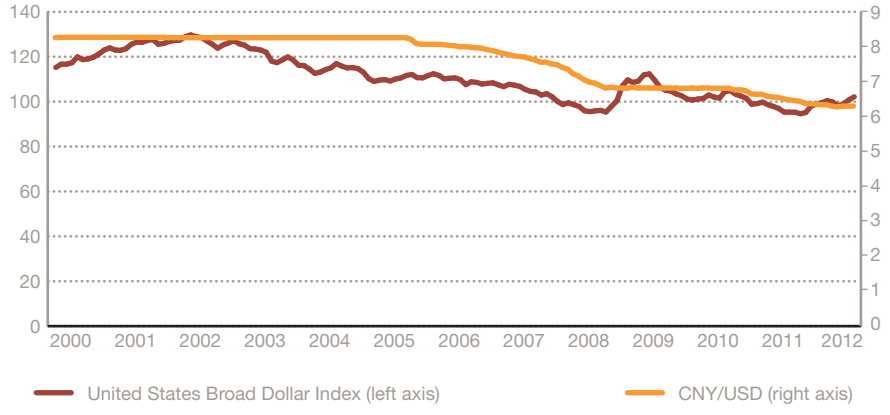
The United States dollar has generally depreciated over the last decade, and China's currency has risen moderately, which narrows the cost gap between producing in the United States and importing from China for domestic consumption. In addition, the secular decline in the United States dollar (down approximately 15% against a basket of major currencies since 2000) helps make the United States a potentially lower-cost location for exports to other countries. This is one factor contributing to strong growth in the export of goods since the end of the recession. An appreciation of the yuan relative to the United States dollar seems likely to continue longer term as China's economy grows, which should be favorable for United States manufacturers.

Figure 6: United States natural gas production, 1990–2035 (trillion cubic feet)



Source: *United States Energy Information Administration, AEO2012 Early Release Overview*

Figure 7: United States Broad Dollar Index and United States/China spot rates



Source: *Federal Reserve, PwC Analysis*

7 "Natural Gas Signals a 'Manufacturing Renaissance'," The New York Times, April 11, 2012.
8 "Valley can be heart of industries," Tribune Chronicle. June 17, 2011
9 " US Steel's December 31, 2011 10-K"
10 "Dow to Build New Ethylene Production Plant at Dow Texas Operations," Business Wire, April 19, 2012.
11 PwC, Shale Gas: A renaissance in United States manufacturing?, 2011.

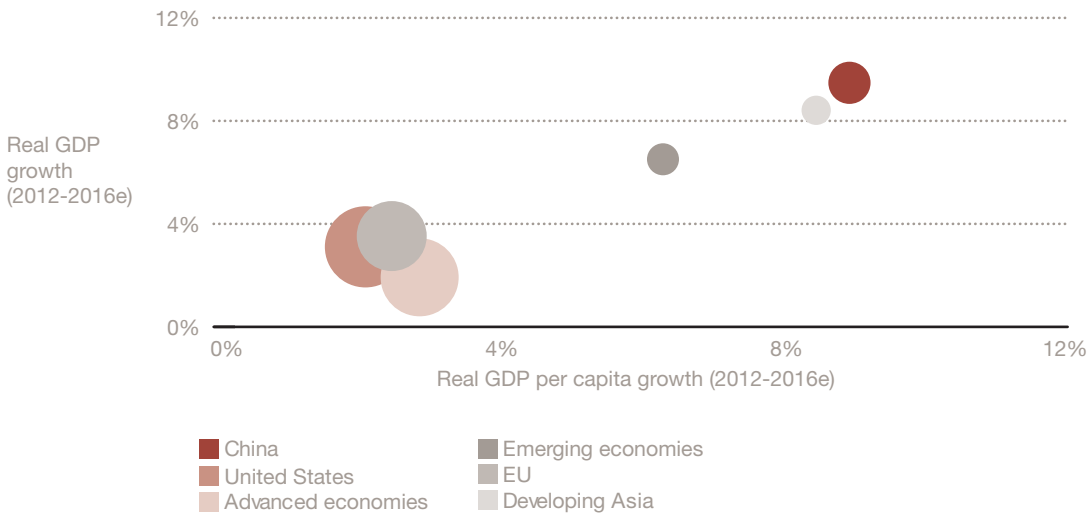
What makes the United States relatively attractive

Factor 3: United States market demand—it's still big

China, developing Asia, and other emerging markets are forecast to continue to grow real GDP and real GDP per capita, at a faster clip than the United States, the EU, and advanced markets (Figure 8). However, the disparity in wealth, as measured by real GDP per capita, is expected to persist, with the United States dwarfing China and other emerging markets. This difference in the relative standard of living, as well as the size of the United States market, supports decisions to invest in new domestic production of goods targeted for United States consumption. This rationale is indeed drawing in foreign manufacturers. Germany's ZF Group is constructing a new factory in Georgia to produce gear boxes for wind turbines, citing demand from the United States market as a reason. Yamaha Motor Corp is moving ATV production to an existing plant in the same state, off-shoring from Japan, because the majority of sales of these vehicles is in the United States[12] At the same time, global manufacturers with a multi-region strategy that source from Asia, for example, are likely to keep production in that region to serve those local growing markets—consistent with the trend toward regionalization of manufacturing for the largest global manufacturers.

12 "Made in America starts to ring true: Foreign, domestic companies ramping up. Weak dollar, fertile market bringing production jobs back to United States." The Atlanta Journal-Constitution, June 12, 2011.

Figure 8: Real GDP growth and real GDP per capita growth, bubble size = 2011 real GDP per capita



Source: *International Monetary Forum, PwC Analysis*

Factor 4: labor costs—United States premium rises slowly, steadily

Of late, manufacturing executives have noted that higher labor costs in emerging, fast-growing economies, especially China, are challenging profitability and thus weakening a once-strong advantage for off-shoring in the first place: labor arbitrage. This concern is unlikely to ease, as the Chinese government's policies and the rising cost of living in urban areas add to wage pressures. China's hourly manufacturing labor costs (including direct pay, bonuses, healthcare and other social benefits, labor-related taxes, and subsidies), forecast to trend upwards, supports this anecdotal evidence (see Figure 9). Over 2008-2012, these costs are expected to rise over 80%, and are also expected to make a similar jump over the next four years. This compares with an estimated increase of around 10% for the United States over the same time period.

However, examining China's precipitous growth in labor costs in isolation is a bit myopic. The cost premium—based upon the difference in absolute wages between the United States and China—has actually been expanding, and is forecast to continue to do so. Consider that in 2012, average United States manufacturing sector hourly wages are estimated to be $33.70 greater than those in China; by 2016, that premium is forecast to be $35.61 Also, when considering relative productivity levels as measured by the change in manufacturing unit labor costs (labor cost per unit of manufacturing output), labor cost inflation in China still does not appear the most significant driver of United States re-shoring from China for many manufacturing industries for the next several years. Rather, given the above, it seems likely that labor arbitrage involving China and other low-labor-cost emerging markets will persist for the foreseeable future for more labor-intensive manufacturing industries.

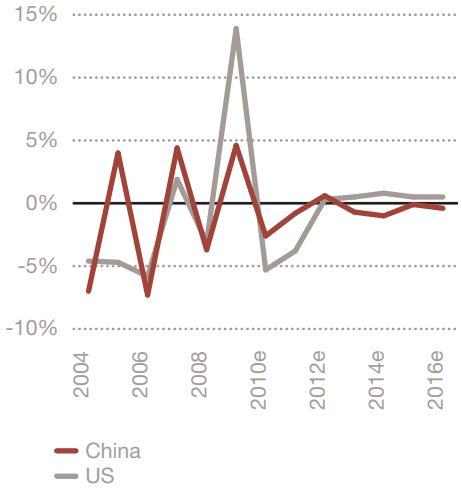
Southern United States: re-shoring magnet?

For companies moving manufacturing to the United States, the southern United States has been an attractive location for investment. Wages in right-to-work states in this region are typically lower than the national average, though it is noteworthy that wages are increasing in line with the average wage for all United States states. While these states will remain attractive targets for new manufacturing investment from a labor cost perspective, they are not likely to be immune from manufacturing labor inflation.

Figure 9: US and China hourly manufacturing labor costs, US dollars

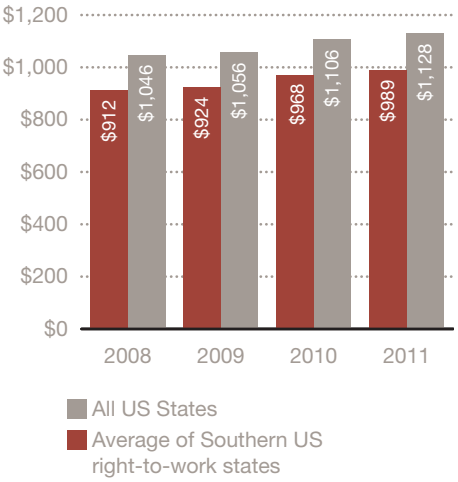
Source: *Economist Intelligence Unit, PwC Analysis*

Figure 10: US and China manufacturing unit labor costs, percent change



Source: *Economist Intelligence Unit, PwC Analysis*

Figure 11: Manufacturing sector average weekly wage



Source: *Bureau of Labor Statistics, PwC Analysis*

Factor 5: America's got talent

United States talent still highly competitive

As middle classes rise in economies such as India and China, so, too, has the level of education and training of those economies' labor forces. In the last four years, the gap in the level of higher education and training between the United States and China has narrowed somewhat, though the United States still holds a significant advantage (see Figure 12). However, despite high levels of domestic unemployment, manufacturers continue to report difficulty in finding qualified workers. In PwC's fourth-quarter 2011 Manufacturing Barometer, 20% of respondents cited a lack of qualified workers as a barrier to business growth over the coming 12 months.[13]

It seems likely that the United States workforce will remain competitive on a national basis for the foreseeable future, owing to institutional advantages in education and experience; however, strength in emerging economies, which is attracting more United States-educated foreign students home, is a growing risk. In particular, China and India send the most students to the United States[14], leading to a "reverse brain drain" when these students return to their home countries—and home labor markets. Workforce training has also been commonly cited as a driver in recent manufacturer capital expenditure decisions on which states to operate in, indicating that manufacturers are keen to locate where there are vocational programs in place to develop skilled workers, such as machinists, craft workers and operators. Consider Georgia's Quick Start program, which provides free, customized training and recruitment for employees hired by companies new to the state. The program has been cited as a major factor in attracting new manufacturing jobs to Georgia.[15] As public discourse surrounding the need for bolstering United States talent ranks in the hard sciences persists, consider that the number of doctoral degrees in engineering in the United States has nearly tripled since the early 1980s (see Figure 13). Additionally, engineering doctorates represent a rising share of all doctorates, edging past 15% in 2009.

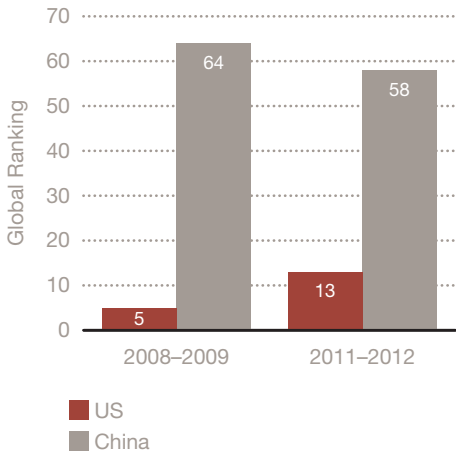
Despite the relative strength of the United States labor force, the aftermath of the housing bubble has slowed worker mobility and may well contribute to labor market friction. This may come about in the form of a geographic mismatch between the locations of job openings and an existing trained workforce within the United States, and could last for at least several years, or as long as the housing market crisis persists in slowing worker mobility nationally. Indeed, homeowners with underwater mortgages can have greater difficulty and cost in moving for a new job, a factor which supports suboptimal alignment of talent across the nation.

13 http://www.barometersurveys.com/store/docs/4Q11%20Manufacturing%20Barometer%20FINAL.pdf (April 2012)

14 http://www.iie.org/Research-and-Publications/Open-Doors/Data/Fact-Sheets-by-Country/2011 (May 2012)

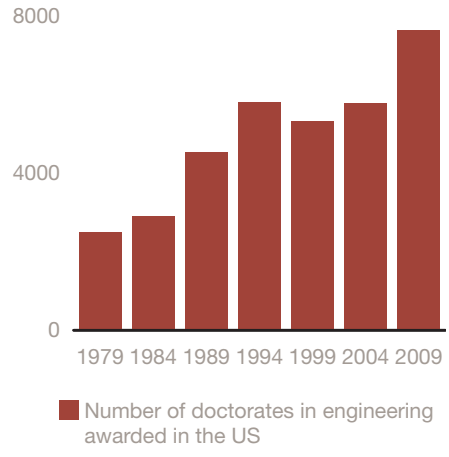
15 "Why did N.C. lose Caterpillar?" McClatchy-Tribune Regional News, February 17, 2012.

Figure 12: Higher education and training global rank



Source: *World Economic Forum Global Competitiveness Index*

Figure 13: A growing army of engineers?



Source: *NSF/NIH/USED/USDA/NEH/NASA, 2009 Survey of Earned Doctorates*

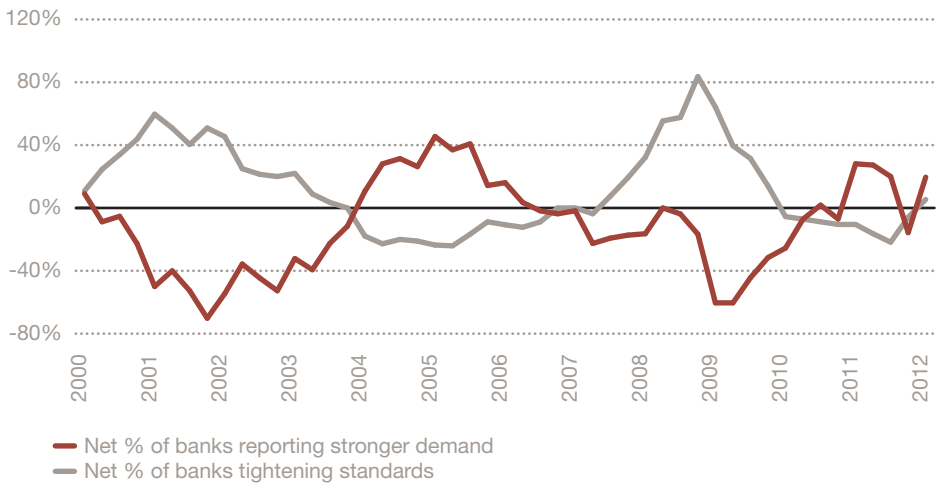
Factor 6: availability of capital—putting on the squeeze

The United States credit picture is showing signs of healing since the inception of the 2009 financial crisis. Commercial and industrial lending demand has recovered. Credit standards have come back down, from extreme levels reached during the financial crisis (Figure 14). Indeed, approximately 80% of banks were tightening standards on a net basis at the peak of the recession. However, the United States Federal Reserve's loan survey indicates that, after a brief hiatus, banks have resumed tightening credit standards. In addition, there is evidence that borrowing in China has become more difficult, due to increased capital requirements for banks [16] and tighter lending for exporters.[17] The prolonged period of tight credit after the recession, as well as the historic level of tightening, are factors that caused manufacturers to reassess their supply chain. The balance of risks favors some continued credit tightening in several key economies to stave off inflation. So while the United States could face lower availability of credit in the future, a possible knock-on effect of tightening credit across major economies could be that manufacturers shy away from maintaining longer supply chains and the risks they carry. These include extra inventory tied up in transit, particularly in industries with shorter product cycles or high spoilage. This could potentially lead to some augmentation of the advantages of United States-based production for United States-destined consumption.

16 Neil Gough, China's Biggest Banks Are Squeezed for Capital, http://www.cnbc.com/id/47150745/China_s_Biggest_Banks_Are_Squeezed_for_Capital (April 2012)

17 http://www.prnewswire.com/news-releases/us-importers-move-manufacturing-outside-of-china-146964205.html (April 2012)

Figure 14: Senior loan officer survey, bank lending practices for commercial and industrial loans to large and mid-market firms



Source: *Federal Reserve, PwC Analysis*

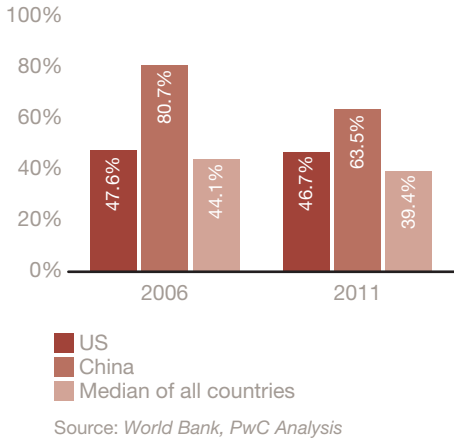
What makes the United States unattractive

Factor 7: tax and regulatory climates

The United States has not become more attractive from a tax standpoint. If anything, China and the rest of the world appear to have generally grown more competitive. This assessment is based on metrics of the World Bank's total tax rate (TTR), a measure that includes tax and mandatory contributions after allowable deductions and exemptions as a percent of commercial profits (see Figure 15).

It is noteworthy, however, that Mexico, which is historically viewed as a low-cost location in the region, still has a higher TTR than the United States It does not seem as if this trend will reverse soon, as the United States has moved into the position of having the highest statutory corporate tax rate among developed countries as of mid-2012. This change has spurred talk of tax reform in order to boost economic growth and employment. Proposals include a lower statutory rate, tax incentives for companies that move overseas operations back to the United States, and increasing—or making permanent—the R&D tax credit. However, uncertainty around the tax and regulatory environments is not conducive to the expansion of domestic manufacturing. On a related point, the relative strength and development of United States infrastructure versus other countries, is another factor influencing manufacturing investment.

Figure 15: US, China and global total tax rates



Source: *World Bank, PwC Analysis*

Implications for your business: think globally, act regionally

Just as multinational manufacturers have been eager to place their stake in the fast-growing markets in Asia-Pacific, Brazil, and even Africa, some manufacturing companies are rethinking their United States strategy. They are rethinking whether it makes economic sense in the long term to produce abroad and import back to United States buyers. They are also rethinking whether it makes sense to de-couple R&D (in the United States) and production elsewhere (for example, in China). And, for some manufacturers, it makes sense to follow a multi-nodal or multi-regional path—that is, developing and producing in the markets to which they sell.

While there was a distinct and clear advantage for some United States manufacturers to produce in China for the United States—or other far-flung markets—the conditions that made that attractive are in flux and tipping away from advantages. Naturally, re-transplanting production and, in some cases, even R&D from foreign domains back to the United States may not be the best choice for all manufacturing industries.

As discussed earlier, the advantages of re-shoring to the United States are more closely aligned with heavy manufacturers, such as the metals and chemicals subsectors. Light manufacturers, reliant less on transportation costs and more on labor costs, for instance—such as electrical equipment—may find re-shoring a less persuasive business strategy. This strategy is also influenced by the pace of commoditization within an industry, as well as industry structure, both of which can serve to dictate the relative importance of these costs. For example, a lack of economies of scale and scope among existing industry constituents can encourage the entrance of competition from new players, and lead to a greater focus on mitigating specific cost advantages. In addition, the relative levels of strategic and economic value should be considered in locating production.

While there isn't yet enough data to conclude that we are in the midst of a United States manufacturing resurgence, driven by the re-shoring of United States companies and greater domestic investment by foreign entities, our analysis indicates that a number of factors are making the United States more competitive for manufacturing expansion. This can include a combination of re-shoring and foreign inbound investment when primary customers are in the United States. Clearly, whatever approach companies choose to take, it seems that the United States is emerging, for manufacturers, as a more attractive market for their production in the long haul.

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To have a deeper conversation about how this subject may affect your business, please contact:

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