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The Oil & Gas Boom and What it Means for the Manufacturing Outlook

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ISM Manufacturing PMI (USA) & JP Morgan Global Manufacturing PMI

Diffusion (Net % Increase)



US Economic & Industrial Environment (Consensus)

% change on previous year (unless otherwise noted)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP	-0.3	-3.1	2.4	1.8	2.2	2.1	3.0	3.1	2.9	2.8
Housing Starts (000)	904	554	587	609	747	911	1,351	1,496	1,603	1,607
Light Vehicle Sales (mm)	13.2	10.4	11.6	12.7	14.2	14.6	15.1	15.7	15.9	15.8
Motor Vehicles & Parts	-31.6	-14.3	32.5	11.8	16.7	5.6	5.8	4.7	3.5	3.6
Aerospace	-2.5	-1.6	-2.3	8.9	8.6	12.5	11.3	9.5	5.6	4.3
Computers & Electronics	0.4	-7.5	10.9	7.9	0.5	4.9	7.3	8.5	7.9	7.4
Construction	-17.5	-15.3	3.9	5.5	5.6	7.1	12.3	10.3	5.8	3.8
Food & Beverages	-2.8	-0.7	-0.1	1.7	2.3	1.4	1.6	1.7	1.7	1.4
Textile Products	-17.1	-15.9	4.0	0.1	-0.4	-1.0	-1.1	-0.9	-2.2	-3.0
Total IP	-8.2	-7.0	5.4	4.1	4.1	2.3	3.2	3.5	3.0	2.7

Is Economic Uncertainty Holding Back US Business Investment?

% Change Y/Y (3 MMA) in Manufacturers' New Orders of Non-Defense Capital Goods excluding Aircraft



Our View on the Economic Outlook

The US economy is slowly recovering from the Great Recession. Exports and business investment are slowing but housing and light vehicles (and consumers in general) taking over, with bright spots in oil and gas. Unfortunately, there are still many dark clouds lingering over the economy. Uncertainties linger and global leaders are worried about several problems, including the:

- European debt crisis and recession
- Slowdown in China and other emerging market economies
- Looming US debt and deficit problems

At best a slow economy into 2013, with a gradual improvement but risks of US recession are high (~35%) and if Europe and China worsen further a US recession is likely

With a maturing population, slowing innovation, lackluster capital formation and uncertainty, the US economy is on a slow-growth track this decade; one more susceptible to shocks!

Background on Shale Gas

- Shale and other non-conventional gas always present, just not economically feasible to extract
- Fixed natural gas supply and rising demand from electric utilities in 1990s combine with supply constraints
- Prices rise from average of \$1.92 per thousand cubic feet in the 1990s to \$5.46 in 2004 and with the hurricanes an average of \$7.33 in 2005
- Natural gas production in the USA was supposed to decline
- Early-2000s were difficult period for industrial gas customers
 - Loss of over 40% of ammonia capacity and decimation of US methanol production
 - Concerns in early 2000s over long-term viability of US petrochemicals

Shale Gas Resources and the Enabling Technologies

- New way of gathering natural gas from tight-rock deposits of organic shale
- Horizontal Drilling
 - Drill horizontal wells 1 ½ miles beneath the surface
 - And lateral lengths of 10,000 feet
- Hydraulic Fracturing
 - Fracture the rock by using water pressure aided by chemistry (polymers, gelling agents, foaming agents, etc.)
 - Typical well requires 2 to 3 million gallons of water and 1.5 million pounds of sand
 - About 99.5% of mixture is sand and water
 - Computational modeling



Source: Energy Information Administration based on data from various published studies Updated: March 10, 2010



Technologies Push out the Supply Curve



2005-12: Energy Prices Falling in Either Absolute or Relative Terms



Oil-to-Gas Ratio: A Proxy for US Energy Competitiveness



Global Natural Gas Price Trends

\$ per million BTUs



Source: EIA, Petrobas, IMF, World Bank, various national statistical agencies

Shale Gas as a Manufacturing Game Changer

- Shale gas could also help revive American manufacturing and create hundreds of thousands of jobs, including some areas hardest hit by the recession, while strengthening national energy security.
- The new economics of shale gas create a competitive advantage for US manufacturers, which will lead to greater investment, job creation and industry (and economic) growth.
- Shale gas growth is helping to reduce natural gas and oil prices and create a more stable supply for fuel and power this will allow US manufacturers to become more competitive than producers in the rest of the world.
- It is also reducing electricity costs.
- Should oil prices remain high, affordable natural gas will continue to provide US manufacturers with a competitive advantage over global competitors that use more expensive, oil-based feedstock and energy supplies.
- This oil and gas boom represents a positive shock to the US economy (much like the Internet), which should be able to capitalize on these developments. Long-term economic growth potential could be boosted by 0.3 to 0.8% per annum.

Global Ethylene Supply Curve

(Petrochemical Production Costs by Country/Region)



US Industrial Outlook for Natural Gas Sensitive Industries (Consensus)

% change on previous year (unless otherwise noted)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Oilfield/Mining Machinery	9.5	-21.1	2.9	20.9	14.9	3.5	4.5	5.8	5.3	4.1
Iron & Steel	6.4	-35.6	30.0	9.1	7.8	2.2	4.5	4.8	4.0	2.4
Paper	-8.9	-6.3	2.1	-1.4	-2.2	0.0	0.8	1.1	1.0	1.0
Chemicals	-10.4	-12.1	10.3	1.5	2.3	2.3	2.3	2.6	2.3	2.0
Rubber/Plastics Products	-15.6	-10.2	8.9	8.4	3.0	2.0	2.7	2.8	2.5	2.4
Glass	-2.9	-14.5	2.8	-0.3	-3.8	2.9	3.5	4.1	2.8	1.9
Aluminum	-7.4	-18.1	19.0	6.8	1.9	2.7	2.9	3.0	2.3	1.9
Foundries	-14.4	-24.1	14.9	13.3	6.3	2.8	5.5	4.9	3.4	2.9
Fabricated Metal Products	-12.0	-15.7	6.9	10.0	8.0	2.6	4.8	4.8	3.2	2.7

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But economic models are demand-driven...what about the supply-side?

Incremental Supply-Side Gain in Shipments of Eight Gas-Intensive Manufacturing Industries

In Billions of 2010 Dollars



Current Outlook for Chemicals (excluding Pharmaceuticals)

Production Volume Index (Where 2007 = 100)



Outlook for Chemicals (excluding Pharmaceuticals) with Shale Gas Advantages

Production Volume Index (Where 2007 = 100)



US Outlook for Natural Gas Sensitive Industries with Shale Gas Advantages Scenario

% change on previous year (unless otherwise noted)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Paper	-8.9	-6.3	2.1	-1.4	-2.2	0.0	0.8	1.5	1.8	2.0
Chemicals	-10.4	-12.1	10.3	1.5	2.3	3.5	5.5	6.0	5.8	4.8
Rubber/Plastics Products	-15.6	-10.2	8.9	8.4	3.0	3.8	5.3	6.0	6.3	6.0
Glass	-2.9	-14.5	2.8	-0.3	-3.8	2.9	3.6	4.3	4.0	3.3
Iron & Steel	6.4	-35.6	30.0	9.1	7.8	2.4	4.9	5.3	5.5	3.8
Aluminum	-7.4	-18.1	19.0	6.8	1.9	2.7	3.9	4.8	4.6	4.2
Foundries	-14.4	-24.1	14.9	13.3	6.3	2.8	5.6	5.3	4.6	3.3
Fabricated Metal Products	-12.0	-15.7	6.9	10.0	8.0	2.6	4.9	5.2	4.0	3.1

Concluding Thoughts on Shale Gas and Manufacturing

- Forecasters' approaches are demand-based; need to recognize supply-side
- Shale gas has been a game changer in US natural gas markets with US first mover advantages
- With oil developments (and lower electricity costs) leading to a manufacturing renaissance
- Shale gas has improved the competitiveness of the US manufacturing, especially chemicals
 - Boosting exports
 - Over 50 major chemical industry projects have been announced
 - Location of shale gas may foster new greenfield investment
 - Generating new business, jobs, and tax revenues
- But challenges remain...



Questions?

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