

AFTER THE STORM

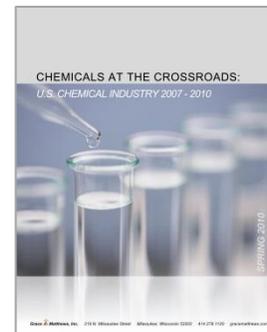
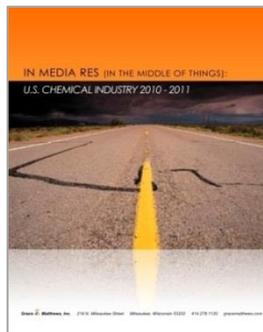
THE GLOBAL ECONOMY AND CHEMICALS: 2011 – 2013
CHEMICAL M&A: STRATEGIC BUYERS TRADE UP



GRACE MATTHEWS CHEMICAL WHITE PAPER

Beginning in 2010 with *Chemicals at the Crossroads*, and followed in 2011 by *In Media Res*, Grace Matthews has provided an in-depth analysis and preview of the economic forces shaping the chemical industry as a service to our clients and friends.

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GRACE MATTHEWS CHEMICAL PRACTICE

Grace Matthews' chemical investment banking group provides merger, acquisition, and corporate finance advisory services for basic and specialty chemical manufacturers worldwide.

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Grace Matthews' chemical investment banking practice is global in scope and well-known for its strong track record of successful chemical industry transactions dating back to the early 1990s. We have direct ties to chemical industry leaders worldwide, and have completed transactions with such companies as Akzo Nobel, 3M, DuPont, Sherwin-Williams, PPG Industries, Ashland, Ceradyne, DSM, ICI, Borregaard, Air Products, Landec Corporation, The Home Depot, Hexion Specialty Chemicals, Atofina Chemicals, Brush Engineered Materials, Becker Industrial Coatings, RPM International, Courtaulds, Domino Sugar, and Chr. Hansen Laboratories, as well as many of the world's leading private equity firms.

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KEY TAKEAWAYS

AFTER THE STORM

- ▶ The past two years have been extraordinary in terms of geopolitical events that have contributed to excess volatility in the global stock markets and acted as a constraint on the speed of the global recovery.
- ▶ Beginning in the second half of 2011 and continuing into 2012, a number of economic indicators have pointed to a slowdown in economic activity in the U.S.
- ▶ In the U.S., the level of national debt has risen dramatically since the recession of 2008-2009, and as shown by the debt ceiling crisis of 2011, a bipartisan solution that would reduce the debt to a more sustainable level will be difficult to achieve as we approach the upcoming “fiscal cliff”.
- ▶ Unlike the U.S., Europe lacks the national unity that could guide a coordinated policy response to the European sovereign debt crisis. Coordinating the separate fiscal policies of 17 Eurozone countries with the single monetary policy of the European Central Bank makes a solution that much more difficult to achieve.
- ▶ Paralleling trends in the general economy, the chemical industry has experienced a slowdown that began in the second half of 2011.
- ▶ Despite the recent slowdown, sectors such as the housing and auto industries are showing signs of a turnaround, which may indicate that growth will resume in 2013.
- ▶ Chemical manufacturers experienced significant cost inflation beginning in the second half of 2010 due to supply shortages. Manufacturers of specialty chemicals in particular have had difficulty passing along increased costs to customers.
- ▶ The development of new natural gas reserves in the U.S. is reshaping the chemical industry. The prospect of low energy costs and competitive feedstock pricing is giving chemical companies the confidence to invest in new capacity. The brightening prospects for chemicals may foreshadow a broader revival of manufacturing in the U.S.
- ▶ Our near-term expectations are for a continuation of slow growth, but longer term we are more optimistic, as our new-found energy resources provide U.S. manufacturing with a global competitive advantage.

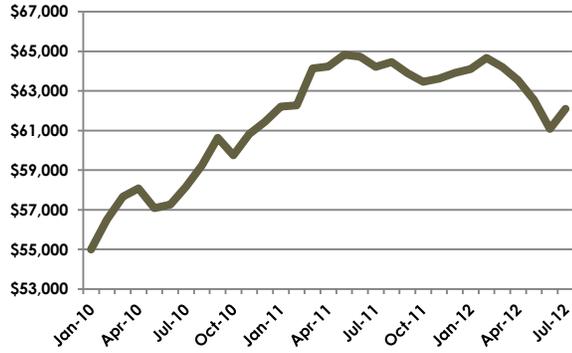
STRATEGIC BUYERS TRADE UP

- ▶ Strategic acquirers have dominated chemical mergers and acquisitions since the recovery began in 2009. Private equity buyers are finding it difficult to compete with well-financed strategics that target opportunities where they can achieve significant synergies.
- ▶ In 2011, a number of large strategic buyers, particularly diversified chemical companies that are making a push into higher margin specialty businesses, made exceptionally large “mega” transactions that have fundamentally altered the competitive landscape.
- ▶ Looking ahead, we expect that strategic buyers will continue to outpace private equity, and will focus more on “bolt-on” transactions that fit their existing businesses.

U.S. CHEMICAL INDUSTRY A GRAPHICAL OVERVIEW

CHEMICAL REVENUES

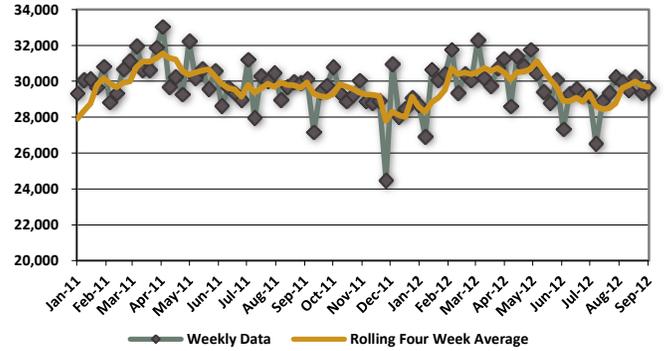
U.S. Chemical Industry Values of Shipments
2010 – 2012 (in \$ millions)



Source: U.S. Census Bureau

RAILCAR LOADINGS

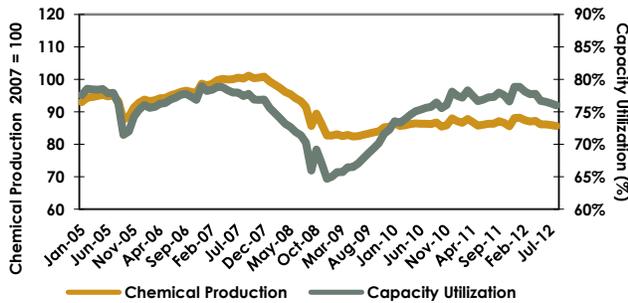
U.S. Chemical Railcar Loadings
2011 – 2012



Source: American Association of Railroads

PRODUCTION AND CAPACITY TRENDS

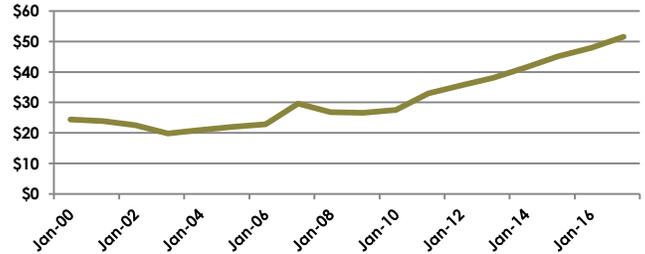
Chemical Production and Capacity Utilization
2005 – 2012



Source: Federal Reserve Board

CAPITAL SPENDING

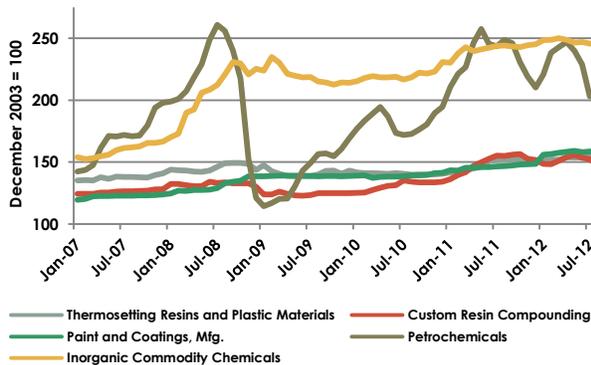
Chemical Industry Capital Expenditures
2000 – 2016 (in \$ billions)



Source: American Chemistry Council

PRODUCER PRICE INDICES

Selected Chemical Producer Price Indices
2007 – 2012



Source: Federal Reserve Board

INVENTORIES

Ratio of Chemical Industry Inventories to Shipments
2008 – 2012



Source: U.S. Census Bureau

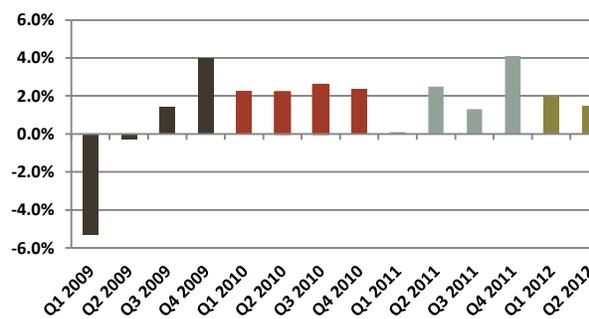
AFTER THE STORM: THE GLOBAL ECONOMY AND CHEMICALS 2011 – 2013

THE ECONOMY

Really, it wasn't supposed to be this way. 2011 and 2012, the third and fourth years of an economic recovery, were supposed to be a time of steady economic expansion, following a sharp "V" shaped gain in 2009 as the recovery got underway and a period of consolidation in 2010. After all, corporate profits are continuing to improve, and the process of balance sheet repair is nearly complete. But it hasn't been enough.

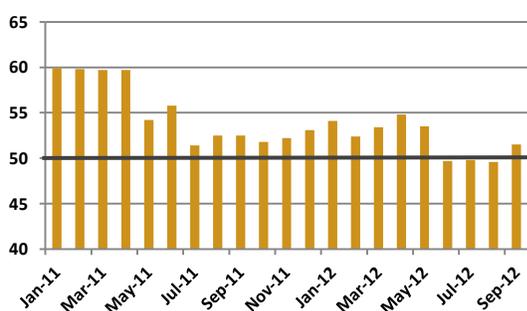
2011 started out well, yet by the second half of the year and continuing into 2012, a number of economic indicators revealed deterioration in economic growth. GDP growth estimates have been revised downward a number of times, and actual GDP growth has stayed below 2% for most of the period (Figure 1). The Purchasing Managers' Index started falling in the spring of 2011 and in the summer of 2012 dropped below 50 for three straight months, a signal that the manufacturing sector may be contracting (Figure 2).¹ As additional confirmation of a slowdown, railcar loadings were essentially flat in 2011 and in 2012 actually have declined from previous year levels (Figure 3).

Figure 1: U.S. Real GDP Growth 2009 – 2012
(Quarter over quarter, annual rate)



Source: Bureau of Economic Analysis

Figure 2: Purchasing Managers' Index

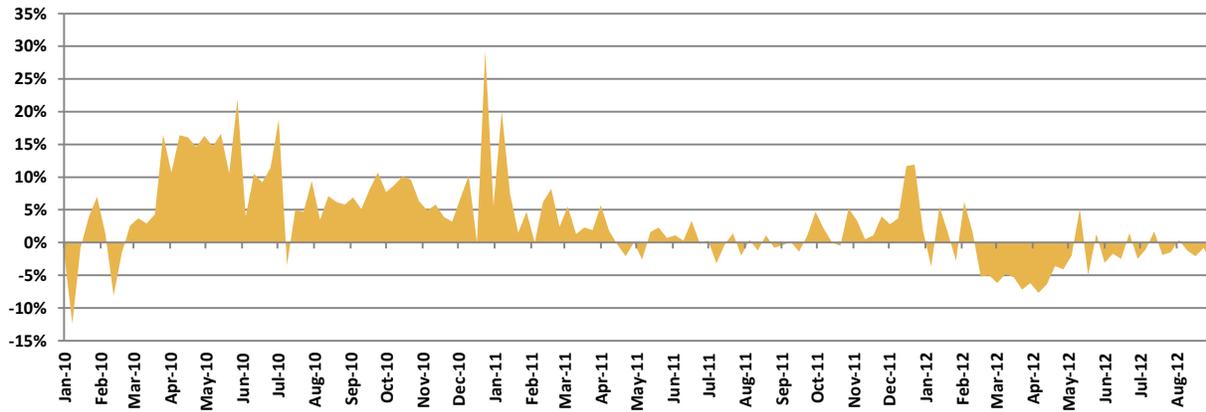


Source: Institute for Supply Management

The S&P 500 was flat for 2011, opening and closing the year at a level around 1257. But as everybody who was paying attention already knows, it was only flat if you looked at the end-points. Though it ended up more or less where it started, in between the S&P 500 ranged from a high of 1363 (on May 2) to a low 1074 (on October 4), a difference of more than 27%. Despite the lackluster economy, the S&P's 2012 performance has been better: from the October 2011 low through September 14, 2012, the index rallied 33.3% to reach a post-recession high of 1465.

¹ The Purchasing Managers' Index (PMI) is calculated by the Institute for Supply Management and combines data on new orders, inventories, supplier deliveries, production, and employment. A PMI value greater than 50 indicates that manufacturing activity is expanding, while a PMI value of below 50 signals that manufacturing is contracting. In June 2012, the PMI dipped below 50 and stayed below that level through August, before rising to 51.5 in September. When the index consistently comes in below 50 for an extended period, it may indicate that the economy is in recession. For example, the last such period lasted from December 2007 through July 2009, which almost exactly coincides with the Great Recession.

Figure 3: Year over Year Percentage Change in Weekly U.S. Railcar Loadings 2010 – 2012



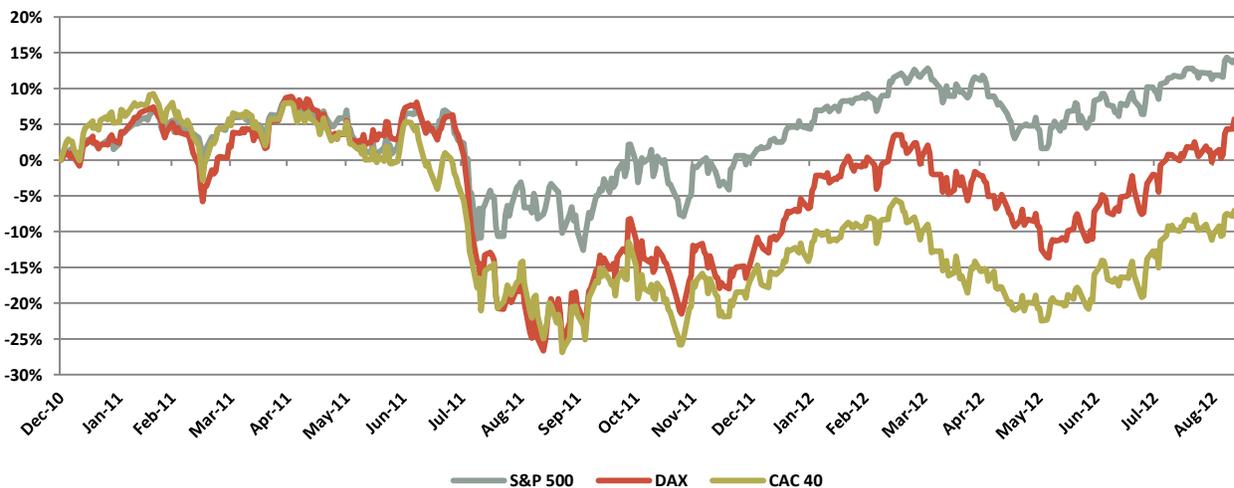
Source: American Association of Railroads

The S&P 500 has actually been one of the better performers of the global markets. The European Indices have fared worse: In 2011, the DAX (Germany) and the CAC 40 (France) closed down 14.7% and 17%, respectively, and though they have recovered in 2012, they have yet to surpass their 2011 highs (Figure 4).

Driving the performance of the global indices is the fact that the past two years have been truly extraordinary for market moving events and geopolitical/economic crises that have shaken the world economy. The “Arab Spring”, the Japanese tsunami and subsequent nuclear crisis, the U.S. debt ceiling debate and the upcoming “fiscal cliff”, and the on-going European sovereign debt crisis have all made this period a time of high drama that in turn seems to alternate between a tragedy and a farce.

The earthquake and tsunami in Japan on March 11 became the first major news story of 2011. The earthquake, measuring 9.0 on the Richter scale, was the biggest ever recorded in the nation’s history and the fifth largest since 1900. With its epicenter 80 miles east of the northern

Figure 4: Relative Performance of the S&P 500, DAX, and CAC 40 2011 – 2012



coast of the island of Honshu, the earthquake generated a huge tsunami that swept over the coastal and low lying inland areas of Honshu. Many residents received only minutes of notice before the tsunami hit, and thousands were killed or declared missing. Eventually the death toll would exceed 20,000. At the Fukushima Daiichi nuclear plant, the failure of backup emergency systems caused cooling failures in three reactors, increasing the risk of a meltdown and prompting the Japanese government to evacuate over 200,000 people from the area. Over the days that followed, the crisis escalated as plant workers, at great personal risk, attempted to cool the reactors.² Despite their efforts, all three reactors underwent full or partial meltdowns. By mid-April, Japanese authorities had to raise the INES (International Nuclear and Radiological Event Scale) rating to Level 7, putting the disaster on par with the Chernobyl nuclear accident in 1986.

Though the situation was brought under control by December³, the Japanese economy will take years to recover. Japan has long been plagued by stagnant growth, an aging population, and the rise of China as the dominant economic power in the Asia-Pacific region.⁴ Already having had its credit downgraded by Standard & Poor's in the months before the crisis due to its excessive sovereign debt, Japan now is struggling to recover from a catastrophe with an estimated economic cost of between \$280 and \$310 billion. To put these amounts into perspective, the latter number is nearly four times as much as the cost of Hurricane Katrina (\$81 billion) and about the size of Greece's GDP.⁵

In the week after the tsunami and as the nuclear crisis was unfolding, the global stock markets sold off, and cash flowed into the safe haven of U.S. Treasuries. On Monday, March 14, the Nikkei dropped by 6% and then 10% on March 15, before making a small gain on the 16th. In the United States, the S&P 500 lost 3% cumulatively in the days after the disaster, and the European markets fell by 4% - 5%. The Yen actually strengthened, reaching a record level (since surpassed) on March 16 as speculators and hedge funds anticipated that Japan would have to repatriate its foreign investments to finance the recovery.

In the months after the tsunami and nuclear crisis, economists expected that while the disaster would knock 0.2% to 0.5% off of Japan's GDP growth rate in 2011, growth would remain positive at around 1%. But as the longer term economic effects came into focus, growth estimates were reduced, with the government eventually reporting that the economy contracted by 0.7% in 2011.⁶

The effects of the tsunami on the Japanese and global chemical industries were mixed. Japan's chemical industry is a major player in the global supply chain, serving industries such as plastics, semiconductors, electronics, and autos. Even before the tsunami hit, Japan's chemical industry – as was true of the entire Japanese manufacturing sector – was struggling to recover from the

² Incredibly, though two workers inside the plant were killed by the tsunami, there were no fatalities associated with radiation exposure from the nuclear accident. Two workers in the plant were hospitalized when their clothes became soaked with irradiated water because they were not wearing rubber boots; both were released within four days. There are conflicting views on the long-term health effects of the crisis.

³ On December 16, 2011, the Japanese government and TEPCO (Tokyo Electric Power, the electric utility that owns the plant) announced that the damaged reactors had achieved a stable state of "cold shutdown." They also announced a plan for a full shutdown and decommissioning, which is expected to take 40 years.

⁴ In the second quarter of 2010, China surpassed Japan to become the world's second largest economy.

⁵ Dick K. Nanto, et. al. *Japan's 2011 Earthquake and Tsunami: Economic Effects and Implications for the United States*. Congressional Research Service, March 25, 2011. Greece's GDP is approximately \$300 billion.

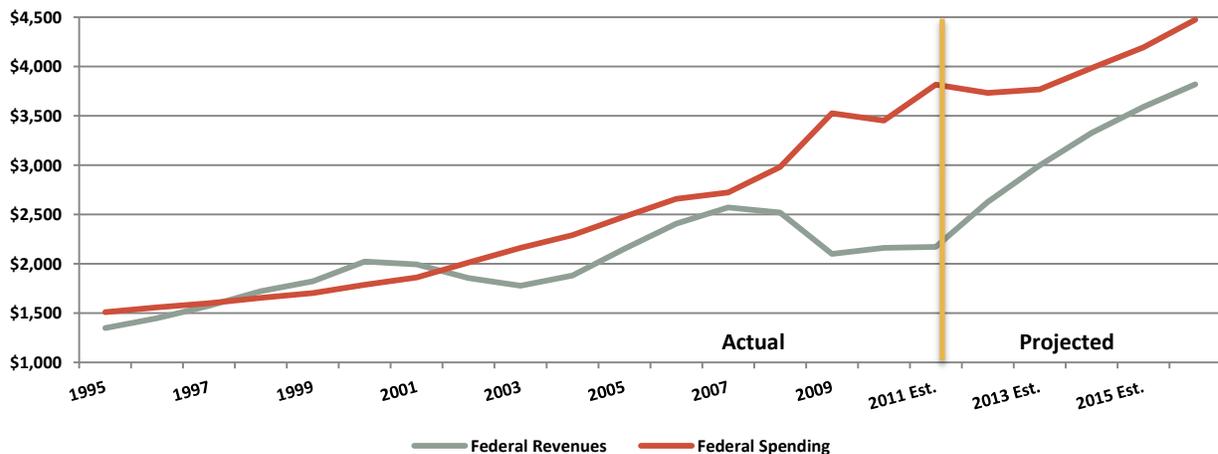
⁶ See World Bank data on global GDP growth by county: <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>

deep recession of 2008-2009. Though few facilities were severely damaged by the earthquake and tsunami, these events triggered an automatic emergency shutdown at many plants, including those owned by Mitsubishi Chemicals, Shin-Etsu Chemical, Sumitomo Chemical, and others. Through March and into April, many manufacturers were not able to restart operations due to aftershocks from the earthquake, supply disruptions, power outages, and damages to roads, port facilities, and other infrastructure. Some were able to shift production to plants in unaffected areas or to offshore operations. By the end of June, operations had been restarted at most facilities.⁷

The crisis also had international reverberations for chemical manufacturers. For example, Japan had been an exporter of caustic soda and chlorine into North America, but those exports dropped sharply in the wake of the tsunami, causing the prices of caustic soda and chlorine to rise in North America. The price increase actually benefited West Coast chlor-alkali plants that, for a time, were able to achieve higher margins.

In the United States, the major economic news story of the past two years has been the partisan standoff between Congress and the Obama administration over the debt ceiling of the federal government, and the subsequent downgrade of U.S. treasury debt by Standard & Poor's. Not that we shouldn't have seen it coming, but few anticipated just how acrimonious the debate would be. For most of the past 50 years, deficit spending and a steady rise in the total level of federal debt was the norm. In 2008, the gap between revenues and expenditures widened significantly (Figure 5), and the national debt began to climb at a truly alarming rate, reaching \$11.25 trillion by September 2012 or 72% of GDP, a level not seen since the 1950s.⁸ With the onset

Figure 5: Federal Receipts and Outlays 1995 – 2016
(in \$ billions)



Source: Office of Management and Budget

⁷ Jean Francois Tremblay, "Earthquake Rocks Japan's Chemical Industry", *Chemical & Engineering News*, March 14, 2011. See also "Industry Assesses Impact of Earthquake in Japan," *IHS Chemical Week*, March 21, 2011; "Many Plants Remain Offstream in Japan Following Earthquake," *IHS Chemical Week*, March 28, 2011; and "Japanese Firms Prepare to Restart Operations," *IHS Chemical Week*, April 11/18, 2011.

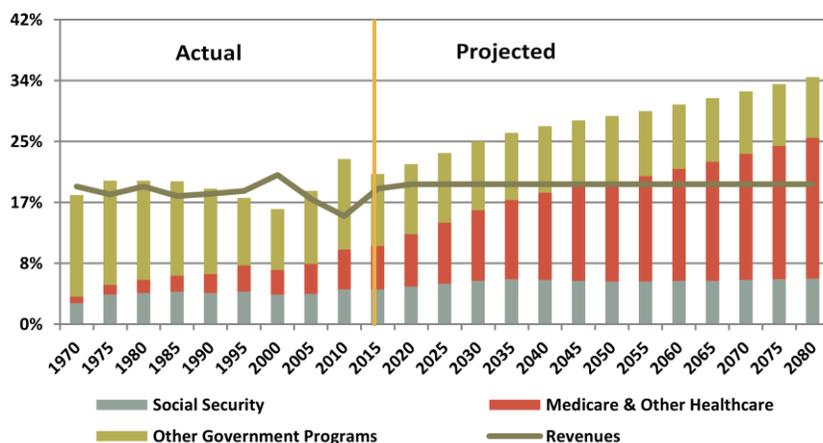
⁸ For the current level of U.S. debt, see <http://www.treasurydirect.gov/NP/BPDLogin?application=np>.

of the worst recession since the 1930s, federal tax revenues plummeted, falling 15.6%, from \$2.6 trillion in 2007 to \$2.2 trillion in 2010. During the same period, spending on safety net and stimulus programs caused total federal expenditures to rise dramatically, from \$2.7 trillion in 2007 to \$3.5 trillion in 2010, an increase of almost 27%.

The crux of the problem is that for the level of federal debt to be sustainable, it can't grow any faster than the economy, and we have habitually borrowed and spent faster than the economy has grown. Increased government borrowing leads to the crowding out of private investment, as funds that otherwise would be used to increase the nation's capital base are used instead to purchase treasury bonds and fund government programs. This crowding out effect would not occur if the government borrowed to finance public investments – roads, bridges, airports, and other infrastructure – that would add to the capital base and increase the productivity of labor and capital. Unfortunately, the projected growth in federal spending is being driven almost exclusively by transfer payments, mainly entitlement programs such as Medicare, Medicaid, and Social Security, all of which are mandated by law and are non-discretionary. By the government's own projections, spending on healthcare and social security will consume *all* of the nation's tax receipts and other revenues sometime between 2040 and 2050 (Figure 6).⁹

This is the context in which the debt ceiling debate unfolded. For years, pressures to bring the federal debt under control had been building within the political class. Things seemed to be moving in the right direction in the spring of 2010 when President Obama appointed the bipartisan Simpson-Bowles Commission to develop a plan for long-term deficit reduction. After much criticism of its draft recommendations from both parties, the Commission's final report was issued on December 1, 2010, but it failed to achieve a supermajority vote from the Commission's own members that would have been required for a formal endorsement. In the aftermath, the Commission's recommendations were largely ignored by both the President and Congress.

Figure 6: Federal Revenues and Spending by Category: 1970 – 2080
(As a Percent of GDP)



Source: Congressional Budget Office

⁹ *The Long Term Budget Outlook*, Congressional Budget Office, June-August 2010. The data in Figure 6 is based on the CBO's "alternative fiscal scenario" which anticipates certain changes in current laws to extend certain popular tax and spending policies; i.e., it assumes that Congress and the Executive Branch do not have the will to cut spending in a meaningful way. The CBO's "extended base case scenario" is based on current law and is less dire. However, it may not be realistic: for example, it assumes steadily growing tax receipts, such that tax revenues would reach 23% of GDP by 2035, much higher than the 18.5% historical average of recent years.

On April 4, 2011, Treasury Secretary Timothy Geithner sent a letter to Congress requesting an increase in the debt ceiling and explaining that should Congress fail to act before the ceiling was reached, he would resort to certain extraordinary measures that would allow the federal government to continue funding its

obligations without issuing new debt. But he also warned that these measures would soon be exhausted, and the government would be compelled to either default on its treasury debt or make immediate and deep cuts in critical spending programs.¹⁰ The date by which Congress had to act to avoid default was set at August 2, 2011.

In the weeks leading up to the deadline, various “bipartisan” solutions were floated, though none amounted to one that both sides would accept. The “Grand Bargain” negotiated by President Obama and House Speaker John Boehner in July initially seemed to break the impasse and even offered a larger than anticipated package for deficit reduction, but these talks ultimately failed over disagreement about whether to include tax increases in the package. At the 11th hour on July 31, the President announced that the administration and Congress had reached an agreement to increase the debt ceiling in exchange for \$1 trillion in immediate spending cuts and future cuts of at least \$1.2 trillion to be determined by a congressional bipartisan “Super Committee”.

Five days later on August 5, Standard & Poor’s downgraded U.S. Treasury debt – something previously considered inconceivable – from AAA to AA+. Standard & Poor’s cited the “political brinksmanship” that highlighted how American governance had deteriorated to the point “where further near term progress on containing the growth in public spending is less likely than previously assumed...” and that “the fiscal consolidation plan that Congress and the Administration agreed to falls short of the amount necessary to stabilize the general debt burden by the middle of the decade.”¹¹

The downgrade set off a tumultuous week in the stock market, with the S&P 500 index spiking up or down by more than 4% every day between August 7 and August 12. Over the next two months, volatility continued and the S&P 500 declined by more than 12%, wiping out its gains for the year until the onset of a rally at the beginning of October brought the index back to a little better than breakeven by year end.

Ironically, there was no sell-off in Treasury bonds following the downgrade. Instead, treasuries rallied, which just shows either how irrelevant the bond rating agencies really have become¹², or how much worse Europe’s problems were as compared with the U.S., such that Treasuries still reign as the world’s safe haven investment in a time of global economic trouble. An unexpected result of this rally is that it helped propel treasuries toward becoming the best performing asset class of 2011, with long maturity bonds gaining as much as 30%.

The final chapter in the debt ceiling debate, at least for 2011, was written in November, with the failure of the Super Committee to reach an agreement on a credible deficit reduction plan. The Committee was supposed to force a solution to the debt crisis, providing one final chance for a “grand compromise” whereby Congress would either pass the Committee’s proposals – no amendments or filibustering allowed – or accept mandatory across-the-board spending cuts divided evenly between defense and discretionary domestic programs (slated to begin in 2013).

¹⁰ Letter from Secretary Geithner to Senator Harry Reid, April 4, 2011.

<http://www.treasury.gov/connect/blog/Pages/letter-to-congress.aspx>

¹¹ Standard & Poor’s press release, August 5, 2011.

<http://www.standardandpoors.com/ratings/articles/en/us/?assetID=1245316529563>

¹² Recall that right up until the 4th quarter of 2008, the ratings agencies retained high credit ratings on the soon to be called “toxic” mortgage-backed securities that sparked the financial crisis. In the wake of this, several hedge funds were prompted to take short positions in the stocks of the rating agencies.

The unspoken idea was that the members of Congress would at last be forced to take a stand on a difficult and contentious issue – that is, actually do what they were elected to do.

The result? The Super Committee couldn't meet its November 23 deadline and was unable to even agree on the basic framework for a plan, convincing many Americans that Congress was even more dysfunctional than they had thought. In the wake of this, Congress's approval ratings, never that high to begin with, reached historic lows: at year's end, Congress had a 9% favorability rating according to a New York Times/CBS poll and a 14% approval rating according to a Gallup poll. By comparison, according to other polls, Congress is less popular than Paris Hilton (15% approval rating), Richard Nixon during Watergate (24%), but still more popular than Fidel Castro (5%).¹³

Congress has one last chance to act. At the end of 2012, the government faces what has been called the "fiscal cliff", when the mandatory spending cuts and tax increases called for by the debt ceiling / deficit reduction agreement go into effect. The Bush tax cuts will expire, along with the payroll tax cut of 2011 and other tax relief provisions. Simultaneously, the first installment of the \$1.2 trillion across-the-board spending cuts takes effect, forcing immediate deep cuts in defense and discretionary domestic programs. Congress also may have to raise the debt ceiling again, possibly triggering another confrontation between the two parties.¹⁴

Though the sovereign debt crisis in Europe developed differently from country to country, its root causes have much in common with the 2008 financial crisis in the U.S....

Of course, nothing is likely to occur until after the November elections, by which time the fiscal cliff will have morphed into the "fiscal cliff crisis", and any agreement will depend on which party takes control of Congress and the Executive Branch. With such a huge unknown out there, it's no surprise that the economy is in a holding pattern, meaning that any acceleration in economic growth may not come until mid-2013 at the earliest.

If it weren't for Europe's own financial troubles, the U.S. debt ceiling crisis and the upcoming fiscal cliff would dominate the economic news. Instead, the U.S. has had to share the stage with Europe, whose soap opera involving the sovereign debt and excessive government spending of the "PIIGS" (Portugal, Italy, Ireland, Greece, and Spain) has been running continuously since the second half of 2009.

Though the sovereign debt crisis in Europe developed differently from country to country, its root causes have much in common with the 2008 financial crisis in the U.S.: asset bubbles inflated by easy monetary policy, cheap credit encouraging a culture of consumption, an expansion of public entitlements at the expense of GDP growth, and the unrestrained growth of a banking and financial system oriented more toward the transfer of wealth than its creation.

¹³ Colorado Senator Michael Bennett gathered the poll data and assembled it in a chart he presented on the Senate Floor in November 2011. http://www.washingtonpost.com/blogs/the-fix/post/congress-approval-problem-in-one-chart/2011/11/15/gIQAkHmtON_blog.html

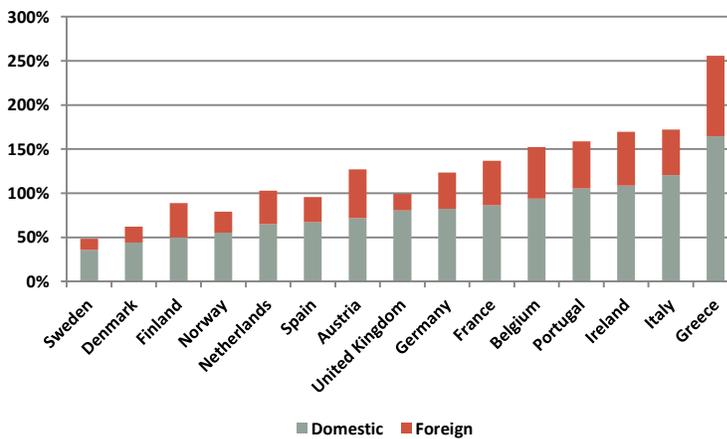
¹⁴ Speaking at a fiscal summit meeting in May 2012, House Speaker John Boehner said that the Republicans would oppose a new increase in the debt ceiling unless it were offset with large spending cuts. At the same meeting, Treasury Secretary Geithner said that the government could reach the statutory limit before year end, but that the Treasury could keep the government functioning using temporary measures into early 2013.

But the differences between the U.S. and European policy responses to their respective crises explain why the U.S. is in the midst of a (tepid) recovery while Europe seems to lurch from one half-hearted “solution” to another. In the U.S., when our overleveraged financial institutions came dangerously close to default, the federal government responded with a massive and controversial series of “bailouts” – asset purchases, debt guarantees, capital injections, and other measures – that in effect converted the private debt of the few into the public debt of the many. On the face of it, this was completely counter to the principles of capitalism, and gave rise to the popular expression of “privatized gains and socialized losses”. However unpalatable the solution may have been, and despite much dissension from both the left and the right, Congress and most Americans ultimately went along with the bailouts, if for no other reason than a sense that without them, the financial system might have collapsed and plunged the country into another Great Depression.

In Europe today, there is no sense of national purpose that could guide a coordinated policy response. The situation is made more complicated by the way the financial crisis has played out in different countries. In Greece, the problematic debt resulted from the government borrowing to support an unsustainable public sector and high levels of public expenditures. In Spain and Italy, the accumulated effect of years of deficit spending and low growth has led to increased borrowing costs for their sovereign debt. In Ireland, it is simply that the government made the decision to guarantee the debt of its overleveraged private banks.

Whatever the particular situation of each country, they all share an excess of “counterparty risk”, that is, the risk that a debtor nation would no longer have the means to repay its creditors, which often were the governments and banks of neighboring European Union (“EU”) countries (Figures 7 and 8). The systemic risk associated with potential defaults, as well as the increased cost of

Figure 7: Domestic and Foreign Held Government Debt of Selected European Countries as a % of GDP



Source: International Monetary Fund

credit associated with such potential defaults, could set off a chain reaction in which the creditor nations and banks, themselves leveraged across national boundaries, would be dragged into another country's financial mess. In fact, you could say that the economies of the Eurozone countries resemble nothing so much as the geopolitical landscape of Europe just prior to World War I: a dense web of inter-tangled alliances, the unraveling of any one of which would threaten the peace and stability of the whole (Figure 8).

Figure 8: Eurozone Inter-Bank Debt

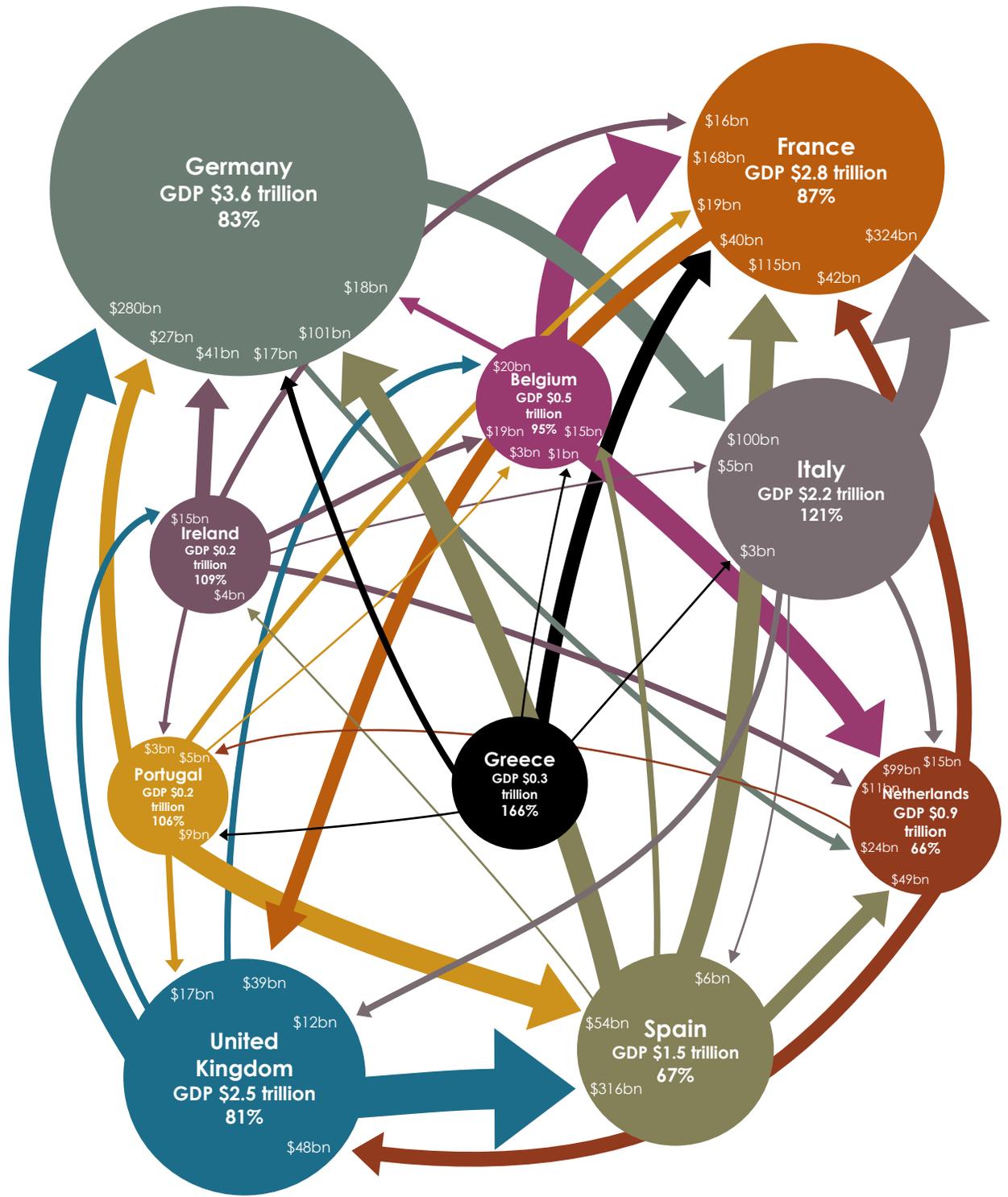


Chart Guide

Each disc represents the relative size (not to scale) of a country's gross domestic product. Numbers at the center of the disc show the country's GDP in trillions of dollars and the government's sovereign debt as a percentage of GDP. Numbers on the periphery of the discs show the amounts owed by debtor nations



Arrows point from debtor nations to creditor nations. Arrow widths are proportional to the amounts owed.

Source: Bank of International Settlements
 A version of this chart appeared in the New York Times, October 23, 2011

If this scenario isn't already worrisome enough, having the Euro as a common currency makes it even more so. In retrospect, it seems obvious that the idea of trying to align the separate fiscal policies of the 17 countries currently using the Euro as their sole currency with the centralized monetary policy of one central bank, the European Central Bank ("ECB"), would be problematic. The key tool central banks traditionally have used to manage recessions and financial crises is an increase in the money supply, which devalues the currency and allows the government and other creditors to repay their debts with cheaper money.¹⁵ Increasing the supply of cash in circulation also usually lowers interest rates while improving the country's trade balances, thereby further stimulating the economy.

This time tested method of getting out from under a heavy debt burden, however, isn't available to Eurozone countries with shaky financial prospects. With an inability to "devalue" the Euro, they have limited options: either a "disorderly" default on their debt, or to accept one or more loan packages and/or debt restructurings in exchange for commitments to reduce their deficits, implement austerity programs, and take other measures to improve their financial standing.

A "disorderly" default, resulting from a country essentially doing nothing and continuing on an unsustainable path, is the least desirable option. Equally as bad, a country could withdraw from the Eurozone and revert to using its own currency, but the new currency probably would trade at a deep discount to the Euro, triggering a level of inflation that would make an already weakened economy worse.

Taking Greece as the test case, either of these scenarios would be catastrophic: its banks would probably have to close and its citizens' bank accounts would be frozen. And since Greece runs a current account deficit, imports would grind to a halt – no small matter for a country that imports all of its oil and most of its food. Civil war, given the fractious nature of Greek politics and the reaction of Greek citizens to the increasing severity of austerity measures implemented since 2010, would not be out of the question.

Moreover, the spillover effect to other European economies would have unknown consequences. Payouts on credit default swaps suddenly would become due, and since the total volume of these derivative contracts is not known, the effects on European financial institutions would be unpredictable.¹⁶ In any case, with European banks suddenly finding that

¹⁵ A central bank accomplishes this by effectively "printing money", that is, by buying securities, usually the country's own government debt, on the open market with newly issued currency. So when you hear pundits talking about the Fed "expanding its balance sheet", this is what they mean: the new money in circulation is considered a liability on the Fed's balance sheet, and the offsetting assets are the newly purchased government bonds.

¹⁶ Credit default swaps (CDSs), which played such a prominent part in the U.S. financial crisis, are basically insurance contracts on bonds against their default. If you are, say, a manager of a pension fund, buying CDSs to insure the fund's bond holdings may seem like a good idea. The problem is unlike other insurance markets, the market for CDSs is unregulated; anyone can buy or sell them, including those who don't own the underlying bonds. Traders, for example, use CDSs to create synthetic short positions, i.e., to bet against a company whose performance is sliding. As the company's balance sheet gets weaker and its risk of default rises, the value of CDSs written on its bonds increases. Moreover, the amount of CDSs that can be issued is not limited to the notional value of the underlying bonds. CDSs also can be issued on "baskets" of securities, including other derivative products, such as the collateralized debt obligations (CDOs) that became famous as the so-called "toxic assets" of the 2008-2009 financial crisis. The Bank of International Settlements, as of June 2012, estimated the total global value of CDSs to be about \$28.6 trillion, which is approximately the value of the combined GDPs of the United States, China, and Japan, the three largest economies in the world. *Bank*

their holdings of Greek debt were nearly worthless, many would be severely undercapitalized, and would have to seek bailouts from...whom exactly?

The other option, debt restructuring and other backstops in exchange for deficit reduction and fiscal austerity, is the choice that the Europeans have favored to date. Greece has received a number of bailout packages from the EU and the International Monetary Fund ("IMF") since early 2010, and in return has been forced to cut its bloated public sector and implement harsh austerity programs. In the latest of these, in February 2012, the EU agreed to provide Greece with a €130 billion loan package, provided that Greece would take additional steps to cut its spending and debt burden. Subsequently, the Greek government and its private bondholders agreed to restructure their debt. Since the alternative was an outright default, bondholders were forced to take a 53.5% "haircut" on the face value of their bonds, and accepted a lower interest rate and longer maturities. It was the largest debt write-down in history.

Longer term, some type of large scale default by Greece may be inevitable...

For now, in return for continuing to receive financial assistance, Greece appears determined to follow the path set for it by the so-called "troika": the European Commission (the executive body of the EU), the IMF and the ECB. Following the elections held in June 2012, the current prime minister of Greece, Antonis Samaras of the moderate New Democracy party, formed a coalition government and pledged to maintain Greece's involvement in the Eurozone while seeking to ameliorate the austerity measures. At this point, Greece's future is uncertain, since its on-going contraction worsened over the summer, which will detract from its ability to service its debt obligations. At this writing, Samaras is seeking passage of new austerity measures in order to receive the next installment of the bailout.

Longer term, some type of large scale default by Greece may be inevitable, since there may be limits to how much austerity its citizens will endure. The effect of the austerity programs on the Greeks is difficult to appreciate from the outside. With unemployment at record levels of about 23%, many rightly feel that further spending cuts will only make living conditions worse. In several instances, the Greeks' anger with austerity has erupted into violence.¹⁷ In this respect, it shouldn't be forgotten that the Samaras's New Democracy party achieved only a narrow plurality in the June elections. Running a close second was the left-wing Syriza Unionist Social Front (SYRIZA), which received 27% of the popular vote to New Democracy's 30%. Alexis Tsipras, leader of the SYRIZA, had advocated the unilateral cancellation of the February 2012 bailout agreement and the installation of a leftist government that would increase public expenditures.

of *International Settlements, Quarterly Review*, June 2012, Table 19, page A-131
<http://www.bis.org/statistics/otcder/dt1920a.pdf>.

¹⁷ On May 5, 2010, there were nationwide strikes and demonstrations in response to proposed tax increases and spending cuts by the Greek government in order to secure loans from the EU. In Athens, there were an estimated 500,000 demonstrators. Some tried to storm the parliament building, but were pushed back by riot police using tear gas, pepper spray, and flash bombs. Protesters also set fire to the finance ministry and a bank with Molotov cocktails; three employees of the bank were killed in the fire. There were also violent protests on June 29, 2011 and on February 12, 2012 in front of the parliament building as new austerity measures were debated and voted on.

To a large degree, Greece's experience exemplifies the plight of other EU countries under financial stress. As Michael Lewis's excellent 2011 book *Boomerang* makes clear, the crisis in Europe is not purely financial: more fundamentally it is a cultural phenomenon rooted in each country's national character. European style social democracy, put in place after World War II, is now showing its downside; in too many cases, the balance between the benefits of the welfare state and the collective responsibility to pay for those benefits has been upset.¹⁸ In the end, a collision between the conflicting needs of a generous welfare state and a sustainable private economy may be inevitable. And while a pure financial crisis may, in theory, be resolved with the right combination of fiscal and monetary tools, the mindset of a culture that has become too dependent on government largess remains much more difficult to turn around.

THE CHEMICAL INDUSTRY: 2011 – 2013

As we described in the previous section, beginning in the second half of 2011, anemic end-market demand in North America, a recession in parts of Europe, and slowing growth in emerging markets have caused the global recovery to lose momentum. Such changes have affected manufacturing disproportionately compared to less cyclical sectors, and chemical manufacturing has been no exception.

By the spring of 2011, chemical industry revenues had almost completely recovered to pre-recession levels, but the growth trend had begun to flatten out, and since January 2012 has been trending downward (Figure 9). Industry revenues over the past 18 months become a somewhat more complicated story when examining the underlying numbers. Some chemical manufacturers have been reporting higher revenues due to price increases and strength in selected end markets, but they also have reported weaker volumes due to recessionary conditions in Europe and mixed performance in other regions.¹⁹ A stronger dollar also has contributed to slower overall revenue growth through unfavorable currency exchange rates that have "devalued" overseas sales.

Figure 9: Chemical Products – Value of Shipments 2010 – 2012
(in millions of dollars, seasonally adjusted)

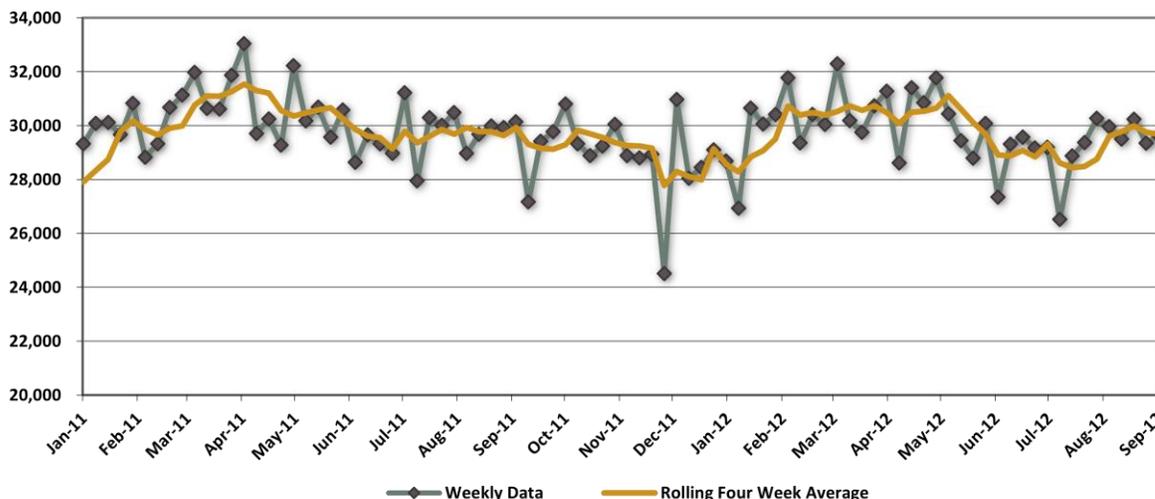


Source: U.S. Census Bureau

¹⁸ See Lewis's chapter in *Boomerang* on Greece. As an example, consider that tax avoidance in Greece was, and still is, a way of life: often, if you are caught underpaying your taxes, it's common to just bribe the tax officials rather than pay your back taxes.

¹⁹ See *IHS Chemical Week*: "Diversified Commodity Firms Show Mixed Results," Jan 30, 2012, page 9; "Early Reporting Companies See Earnings Increases," January 16/23, 2012; page 13; and "Specialty Chemical Firms Report Stronger Earnings," February 6/13, 2012, page 13.

Figure 10: Chemical Railcar Loadings: 2011 – 2012

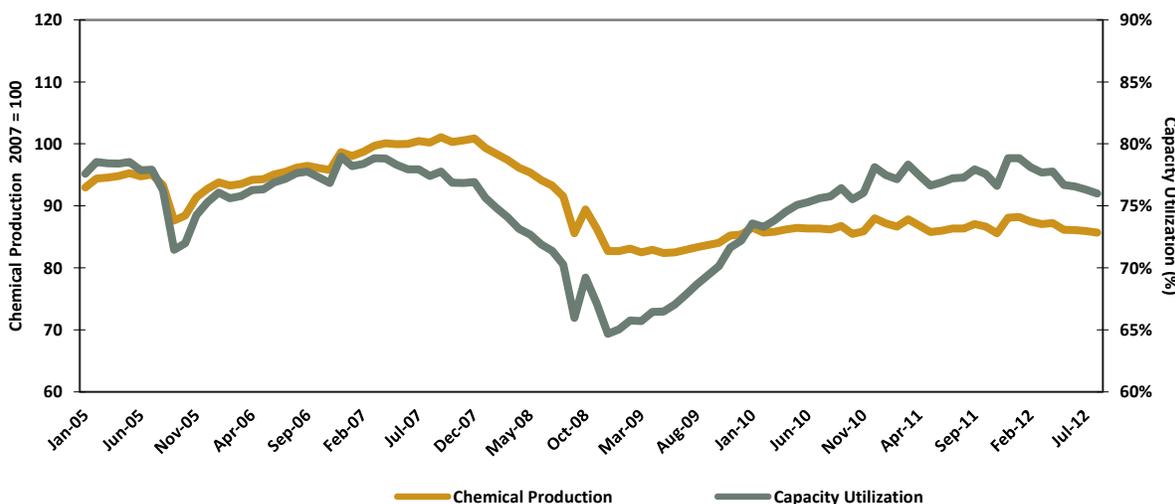


Source: American Association of Railroads

Other fundamental measures of industry activity confirm that industry performance has been relatively soft. Railcar loadings of chemicals, measured weekly by the American Association of Railroads, were strong at the beginning of 2011, rising to a four week average of over 31,000 railcars by the end of March, but then falling back close to the 28,000 level by the end of the year. 2012 railcar loadings also started out in an uptrend, but year-to-date have failed to reach the high point of 2011, and in the second half of the year have averaged fewer than 30,000 railcars per week (Figure 10).

Chemical production began to level off in early 2009, and capacity utilization followed, although with a lag of nearly a year, likely due to the tail end of downsizings at the end of the

Figure 11: Chemical Industry Production and Capacity Utilization



Source: Federal Reserve Board

recession as manufacturers shut down underperforming plants (Figure 11).

The increase and subsequent leveling of capacity utilization may signal that the industry is operating efficiently given the level of demand. Even if demand is not growing, or growing slowly, this should allow the industry to maintain profitability. However, the flip side to operating efficiency is that it

makes the system more sensitive to exogenous shocks. For example, in late September 2012, an explosion at a Nippon Shoukubai plant in Japan shut down the facility's production of acrylic acid, an ingredient used in SAP (Super Absorbent Polymer). SAP is the absorbent material used in disposable diapers, and since the plant accounts for 10% of global production of acrylic acid,

it's likely that 4th quarter 2012 pricing for acrylic acid (and diapers) will rise.

Total U.S. industrial production is still rising, suggesting that the recovery is still underway, albeit at a very slow pace. Based on the current trend, production may not hit pre-recession highs until early 2013. There is actually a divergence in total industrial production and chemical production, a signal that general manufacturers are now bringing down their

Figure 13: Chemical Inventories to Shipments Ratio 2008 – 2012

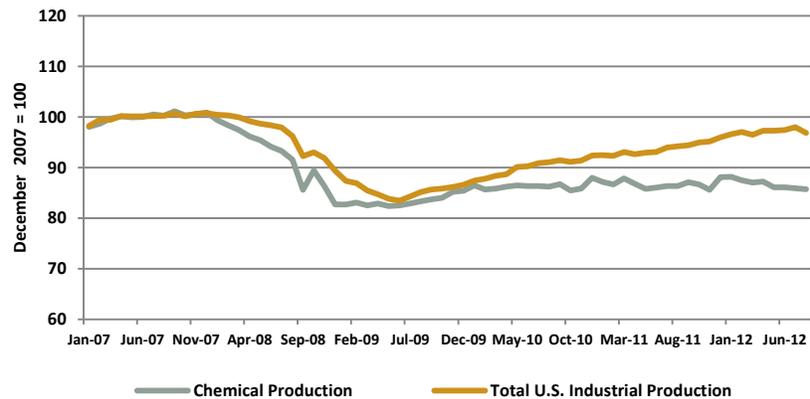


Source: U.S. Census Bureau

inventories of chemical products after restocking during the initial phase of the recovery (Figure 12). As we noted in our previous white paper, inventory restocking was a key growth driver early in the recovery. Now that purchasing managers have a better sense of near-term demand, inventory levels are keeping pace with shipments (Figure 13).

While overall industry performance may be lackluster, some sectors and end markets have been doing well. One bright spot for chemicals is the automobile and light truck industry, which has come back from the dead after almost going under during the recession. Chemical products have myriad applications in vehicles, including everything from hydraulic fluids to molded plastic cup holders. According to the American Chemistry Council, an average automobile or light

Figure 12: Total U.S. Industrial Production and Chemical Production 2007 – 2012



Source: Federal Reserve Board

truck contains about \$3,000 of chemical products, including over 340 pounds of polymers.²⁰ With over 14 million units sold annually in the United States, light vehicles would then represent a \$42 billion market for chemicals.

...an average automobile or light truck contains about \$3,000 of chemical products and chemicals account for nearly \$15,000 of the cost of the average new home...

The use of chemical products in autos and trucks is likely to increase in the future, given the advances in engineered polymers and need to replace metal components with lighter weight plastics and composites to improve fuel efficiency. Except for a brief dip during the economic slowdown in second half of 2011, total light vehicle sales have steadily increased since the recession ended (Figure 14).

Yet even with this uptrend, the total number of vehicles on the road has declined from a peak of 242.1 million in 2008 to 240.5 million in 2011, implying that more cars have been scrapped than new cars sold. At the same time, the average age of vehicles on the road has been rising. In 2011, the average age increased to a record 10.8 years, with light trucks averaging 10.4 years and passenger cars 11.1 years.²¹ The need to replace these cars cannot be deferred much longer, and an upsurge in auto sales could be near. A number of automotive researchers have been revising their 2012 sales forecasts higher, to an annual run rate ranging between 14.4 and 14.9 million vehicles, which would represent an increase of 10% to 14% over 2011.²²

Construction and housing, another important market for chemicals, may be on the verge of a turnaround. As we suggested in our previous white paper, an improving housing market is key to a sustained recovery in the broader economy, not only because of its direct contribution to GDP, but also because a depressed market acts as a drag on consumer spending and employment.²³ Chemicals account for nearly \$15,000 per new housing start.²⁴ Based on a current annual run rate of about

Figure 14: Total Light Vehicle Sales, Annualized Run Rate
(in millions of vehicles, seasonally adjusted)



Source: Bureau of Economic Analysis

²⁰ 2012 Guide to the Business of Chemistry, American Chemistry Council, page 1.

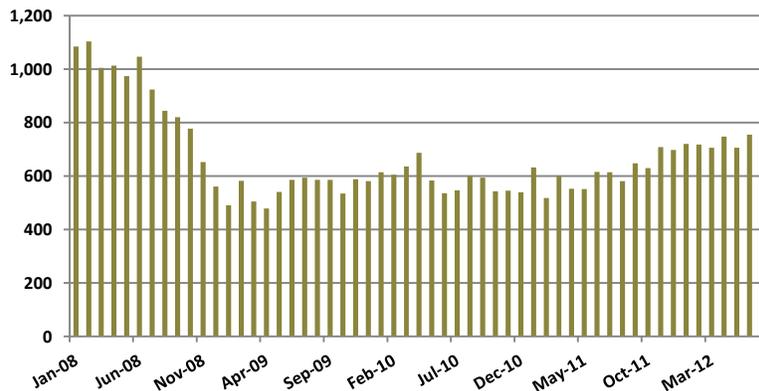
²¹ R.L Polk & Co. January 2012. See "Average Age of U.S. Cars Up Again in 2011, May Head Down", USA Today, January 17, 2012. <http://content.usatoday.com/communities/driveon/post/2012/01/average-age-of-us-cars-up-again-in-2011-may-now-head-down/1#.JBhQ32FDx8E>

²² See "Auto Researchers Raise 2012 Sales Forecast 13%" Chicago Tribune, May 24, 2012 http://articles.chicagotribune.com/2012-05-24/business/chi-auto-researchers-raise-2012-sales-forecast-13-20120524_1_sales-forecast-light-vehicle-sales-new-car-sales

²³ In our Spring 2011 white paper, we noted how unemployed home owners with "underwater" mortgages are constrained in their employment opportunities: since they can't pay off their mortgage from the sale of their home, they often can't move to take a job in another region.

²⁴ Mid-year 2012 Situation and Outlook, American Chemistry Council, June 2012. Page 1.

Figure 15: Housing Starts
Annual Run Rate 2008 – 2012



Source: U.S. Census Bureau

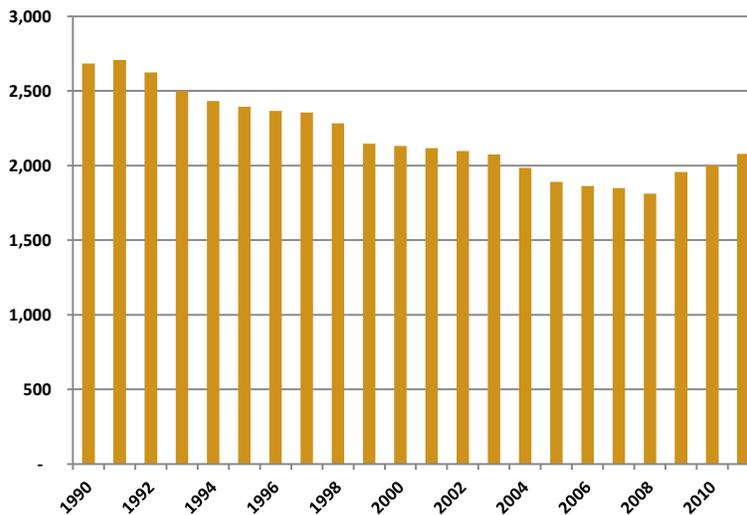
750,000 units, new residential housing would represent an \$11.3 billion market for chemicals.

New housing starts, after languishing for most of 2009 and 2010, began to trend up beginning in the second half of 2011 (Figure 15). The Case-Schiller Indices of Home Prices also have shown improvement through the first half of 2012, and a continuation of this trend through the summer and fall

would provide a clear signal that housing is on the mend.²⁵ All this is welcome news to the home builders and owners, as well as to the chemical manufacturers who sell into the construction markets. However, the question of the sustainability of a recovery in housing has to remain open, since it can't be determined to what extent the housing market's recovery reflects historically low mortgage rates. It could be that once interest rates begin rising, the increasing cost of mortgages will slow or even choke off the incipient rebound.

Oilfield process chemicals, currently one of the better performing sectors of the chemical industry, is another business that doesn't fit into "flat" or low growth mold. A 2011 report by BCC Research estimated that the oilfield process chemicals market was approximately \$6.25 billion in 2010 and is forecast to grow at a 5.7% annual rate between 2010 and 2015. Specialty chemicals represent nearly 25% of the total oilfield process chemicals market and are valued at approximately \$1.65 billion. The remainder of the market is made up of commodity chemicals, polymers, and gases. Specialties are forecast to grow 15% annually between 2010 and 2015, significantly outpacing the rest of the oilfield process chemicals market.²⁶

Figure 16: U.S. Crude Oil Production
(millions of barrels)



Source: Energy Information Agency

²⁵ Home Prices Rose in the Second Quarter of 2012 According to the S&P/Case-Schiller Home Price Indices, Press Release, August 28, 2012.

<http://www.standardandpoors.com/indices/sp-case-schiller-home-price-indices/en/us/?indexId=spusa-cashpidff-p-us--->

²⁶ Oilfield Process Chemicals, a BCC Research Report, January 2011.

The reason oilfield chemicals are doing so well is that the domestic oil and gas industry is booming again. Oil prices bottomed in February 2009, and have since trended upward. In the summer of 2012, WTI (West Texas Intermediate Crude) traded in a range between \$77 and \$96 per barrel, after hitting a year-to-date high of \$109 per barrel in February. Domestic crude oil production has reversed a long-term downtrend and is now higher than it was in 2003 (Figure 16).

High oil prices impact the demand for oilfield chemicals in two ways. First, oil companies increase their exploration and production activities, and thus their need for oilfield chemicals. Second, closed wells that were unprofitable when oil prices were low can be brought back online as the rising price of crude offsets their higher costs. The latter is particularly significant for oilfield chemicals, since wells with the highest production costs typically are those that use the most chemicals. Wells with high production costs usually are located in fields with low quality oil due to excess water or contaminants, or in older, mature fields that produce more water and fewer hydrocarbons, thus requiring more chemicals to maintain yields. Heightened activity in oil production also drives downstream demand for oilfield chemicals, as refineries seek to maintain the reliability of production facilities and maximize plant run-time.

While high oil prices are good for some companies, manufacturers producing specialties based on petrochemical intermediates have been significantly challenged by such increases. From its bottom in December 2008, the price of oil rose more or less steadily until May 2011, when it once again approached the “bubble” levels of spring/summer 2008. Commodity petrochemicals, the foundation of so many downstream chemical products, followed the changes in oil pricing, with an especially steep rise between July 2010 and May 2011 (Figure 17).

Because of this, specialty manufacturers using petrochemicals as raw materials experienced significant cost inflation in the latter part of 2010 and the first half of 2011, and many firms had difficulties passing through higher costs to their customers. The problem can be traced to the different pricing and market dynamics for commodity (upstream) producers on one hand, and specialty (downstream) manufacturers on the other.

Figure 17: Crude Oil and Petrochemical Pricing 2007 – 2012



Source: Energy Information Administration and Bureau of Labor Statistics

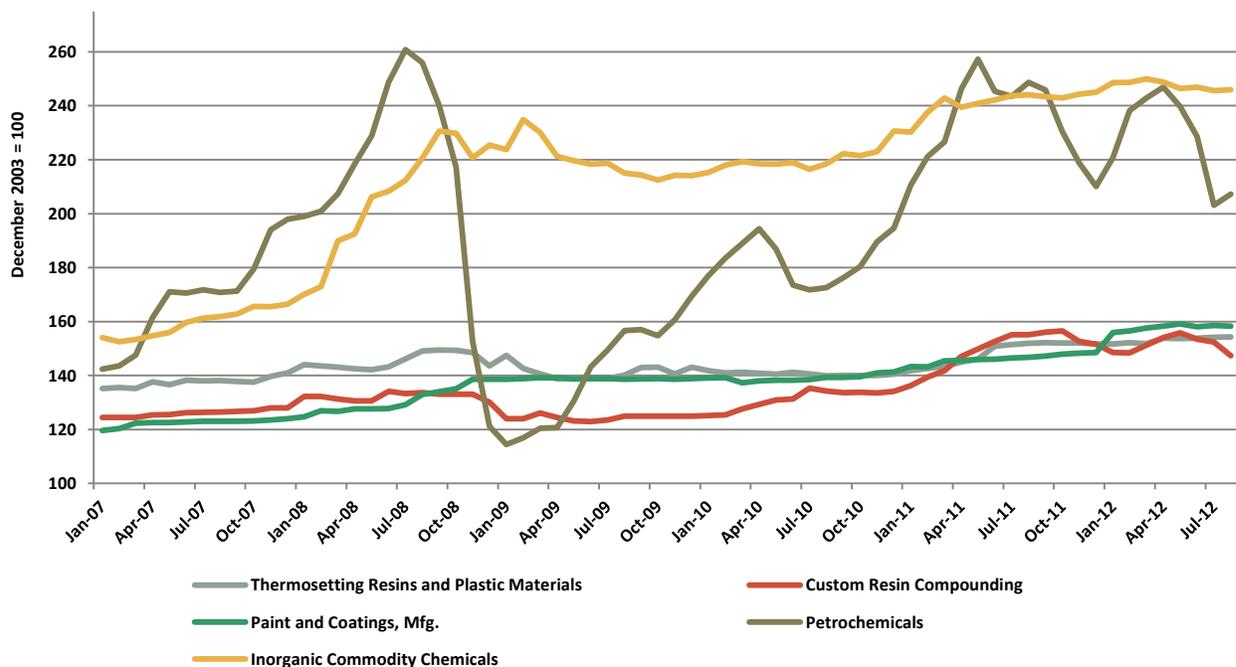
The business model for the upstream commodity manufacturers is based on being a low-cost producer, which usually translates into large volumes and thin margins. This model gives them pricing power in the marketplace, since all industry participants more or less have to raise prices simultaneously as their input costs rise. In the wake of the last recession, producers shut down underperforming plants, to such an extent that once demand picked up again during 2010 and 2011, supply shortages developed and price increases followed.

This pricing dynamic wasn't limited to petrochemicals, but also affected other manufacturers of commodity chemicals. For example, some analysts have estimated that 4% of the global capacity of titanium dioxide – the key pigment used in plastics, coatings, and paper – was taken offline in 2008-2009, and as a result prices have risen with the onset of the recovery. And because it takes three to four years to bring new plants online, prices are likely to continue rising at least through 2013, until global capacity matches growing demand.²⁷

Downstream manufacturers of specialties are usually hit the hardest by rising raw material prices. In effect, specialty manufacturers are caught in a double bind when it comes to pricing issues. On one hand, their upstream suppliers of basic and intermediate chemicals have pricing power, and on the other, their customers, who are often large multi-national sellers of consumer and industrial goods, have purchasing power.

As a result, specialty manufacturers have less ability to pass through price increases from their suppliers, which compresses their margins during a recovery. Analyzing how various components of the Chemicals Producers Price Index (PPI) have fared since 2007 shows this clearly (Figure 18). In the run-up to the financial melt-down in the fall of 2008, commodities –

Figure 18: Selected Components of the Chemicals Producer Price Index 2007 – 2012



Source: Bureau of Labor Statistics

²⁷ See "Titanium Dioxide Prices Soar on Short Supply, Strong Demand," *IHS Chemical Week*, July 28/25, 2011, page 32; and "Paints and Coatings Demand Grows as Costs Rise," *IHS Chemical Week*, April 16/23, page 22

petrochemicals and inorganics – advanced rapidly, with petrochemicals collapsing along with the price of oil in October 2008. The pricing of inorganics didn't peak until February 2009, and then underwent a short and shallow decline until October. However, both resumed climbing and were hitting pre-financial crisis levels by the spring of 2011.

By contrast, the price changes in specialty chemicals were less volatile and more compressed. As seen in the price indices for thermoset resins, paints and coatings, and custom compounders, manufacturers were able to raise prices, but only marginally and after a lengthy flat period that lasted from the spring of 2009 until the beginning of 2011. Custom resin compounders, probably because of their focus on unique solutions, enjoyed better pricing than other specialty producers, with their PPI increasing 23% over the 18 month period January 2009 – June 2011. In comparison, the PPI for thermoset resin manufacturers advanced only 2% over the same period.

Given that growth in most developed countries currently barely matches inflation, it would be tempting to conclude that the world economy is in a holding pattern. In the absence of robust end market demand, the best corporate strategy may be to bide time and wait for the recovery to pick up enough steam so that we can get back to a pre-recession

*In terms of capital investment,
the chemical industry is not
sitting on the sidelines.*

“normal”, whatever that may mean. This mindset may reflect why U.S. corporations have accumulated so much cash on their balance sheets, currently \$1.76 trillion according to the Federal Reserve.²⁸ In short, they really have few opportunities to reinvest their cash into their own industries, which if they did might create jobs and help stimulate end market demand.

While this kind of thinking may be true of many sectors of the economy, it is not entirely true of manufacturing, and it most definitely is not true in the case of chemicals. In terms of capital investment, the chemical industry is not sitting on the sidelines. Chemical manufacturers are reinvesting, and indeed are being compelled to do so because the economic underpinnings of the industry are undergoing fundamental change. These changes are a consequence of an important technological breakthrough in energy: the ability to tap vast reserves of natural gas previously locked up in what heretofore was considered inaccessible shale formations. In fact, it wouldn't be a stretch to claim that shale gas has the potential not only to revolutionize the chemical industry, but to revive the entire manufacturing base of the U.S. and significantly boost our GDP.

Included among the current and projected economic benefits of shale gas are²⁹:

- 600,000 direct and indirect jobs generated by the shale gas industry, growing to 870,000 by 2015, and 1.6 million by 2035;
- Direct contributions to GDP of \$76 billion in 2010, \$118 billion in 2015, and \$231 billion in 2035;
- Average reduction in electricity prices by 10% through 2035, as lower cost gas-fired power plants replace coal-fired plants;

²⁸ Flow of Funds Accounts of the United States, First Quarter 2012, Board of Governors of Federal Reserve System, June 7, 2012.

²⁹ From *The Economic and Employment Contributions of Shale Gas in the United States*, IHS Global Insights, December 2011.

Case Study: PChem

Syrgis Performance Chemicals, or "PChem", is a chemical manufacturer that is being positively impacted by the revival of oil and gas production in North America. PChem is known for its expertise in custom formulating oilfield chemicals that match the unique characteristics of oil and gas deposits in specific geographic areas. In 2011, Grace Matthews was engaged by PChem's parent, Syrgis Holdings, Inc., to sell PChem and its sister specialty chemical companies.

The timing for a sale was excellent, as the company was posting record sales and earnings due to the development of shale oil and gas deposits in United States and Canada. PChem also was expanding its overseas footprint with sales in Russia and Central and South America.

Numerous potential buyers, both strategic and private equity, expressed a strong interest in acquiring this high quality asset. Weatherford International, a worldwide provider of equipment and services used in all phases of oil and gas production, proved to be the strongest buyer and acquired the company in June 2012. The acquisition has very positive implications for PChem's future, since its custom formulation capabilities will benefit from Weatherford's global reach and exceptional marketing resources.



- Average annual savings of over \$900 per household between 2010 and 2015 due to lower natural gas costs;
- More than \$900 billion in extra federal, state, and local tax revenues over the next ten years; and
- Higher levels of industrial production, estimated to be 4.7% higher than it would be without low-cost natural gas.

The development of North American shale gas reserves is growing rapidly. The technology for extracting shale gas using hydraulic fracturing, or "fracking" as it is more popularly known, has been around since the 1970s, but it is only in the past five years that fracking shale gas deposits has taken off due to improvements in drilling and extraction methods. In 2007, shale gas production was 1.3 trillion cubic feet; in 2008, production increased 63% to 2.1 trillion cubic feet and by 2010, production was 5.0 trillion cubic feet, 23% of total U.S. gas production. Current estimates have production more than doubling to 13.6 trillion cubic feet by 2035, representing 49% of total domestic natural gas production. If we assume 15.0 trillion cubic feet of peak demand and total domestic reserves of recoverable gas of 482 trillion cubic feet, there would be a minimum of a 32 year supply of domestic natural gas.³⁰

Driving the rapid growth and investment in shale gas production is the fact that shale gas wells are more productive than conventional wells: although the initial capital investment is higher, the full cycle cost is estimated to be 40% to 50% less than the cost of a conventional well.³¹

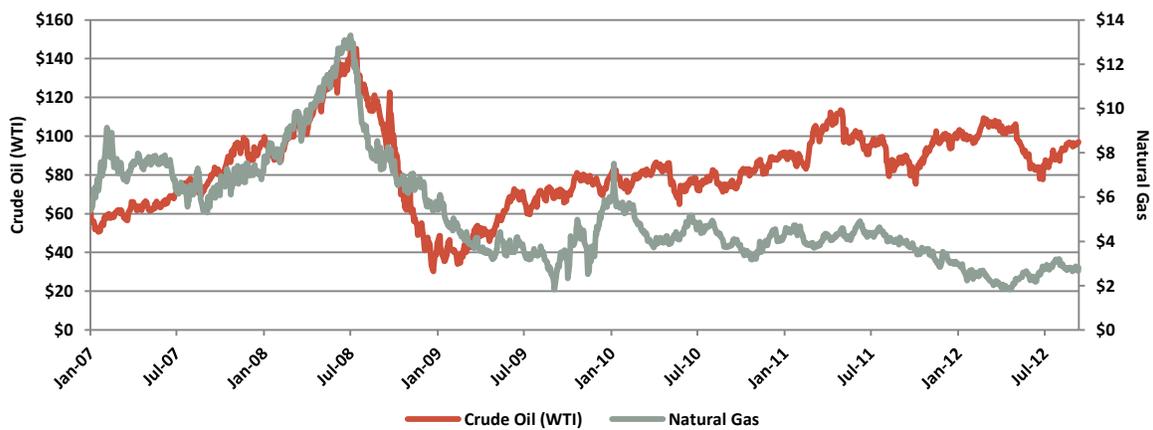
Of course, hydraulic fracturing is controversial, and legitimate concerns have been raised over the potential contamination of groundwater by fracking chemicals and gases, the degradation of air quality around production sites, and the possible mishandling of waste streams. Our view is that, whatever side you come down on relative to the environmental issues, the economics will ultimately outweigh any environmental

³⁰ Estimates from Energy Information Administration. See *Annual Energy Outlook 2012 Early Release Overview*, Energy Information Administration.

³¹ *The Economic and Employment Contributions of Shale Gas in the United States*, page 8.

GM Chemical Index Companies: 3M Company, A. Schulman Company, Aceto Corp., Air Products and Chemicals, Akzo Nobel, Archer Daniels Midland, Ashland Chemicals, Avery Dennison Corp., BASF, Church and Dwight, Clariant Inc., Clorox Co., Cytec Industries, DuPont de Nemours, Eastman, Ecolab, Ferro, Georgia Gulf, H.B. Fuller, Henkel, Honeywell Intl, Huntsman, International Flavors and Fragrance, Materion Corporation, Olin Corp., OM Group, PolyOne Corp., PPG Industries, Proctor and Gamble Co., Quaker Chemical Company, Sensient Technologies, Sika AG, Sherwin Williams, Valspar, Westlake Chemical, W.R. Grace & Co., Zep, Inc.

Figure 19: Domestic Prices of Crude Oil and Natural Gas 2007 – 2012



Source: Energy Information Administration

concerns, which can be addressed with appropriate technology and regulation. To be sure, government regulations will be put in place to balance the concerns of the competing interests, but the benefits are just too great for U.S. reserves not to be developed. It should also be kept in mind that there are environmental considerations that promote the increased use of natural gas: as a cleaner burning fuel with fewer carbon emissions than oil or coal, natural gas could go a long way toward reducing the greenhouse gases associated with global warming. Indeed, the use of natural gas as a replacement fuel in the power generation industry has already begun, for economic reasons as well as environmental ones.³²

As production of shale gas has ramped up and supply has outpaced demand, prices have come down and decoupled from the price of crude oil (Figure 19). Moreover, because of the size of available reserves and the lower effective cost of drilling new wells, some analysts believe that pricing has become inelastic: that is, the available production resources can absorb significant increases in demand without the need for rising prices to stimulate new exploration and production.³³ In fact, over the past three years, natural gas prices have fallen so quickly and so far that some natural gas drillers are cutting back production until such time that demand catches up with supply.

...over the past three years, natural gas prices have fallen so quickly and so far that some natural gas drillers are cutting back production until such time that demand catches up with supply.

The prospect of low-cost gas for decades to come is causing manufacturers in North America to have the confidence to invest in new capacity. Whereas all energy-intensive industries (e.g., steel, wood and forest products, cement, petroleum refining, etc.) will benefit from lower energy costs and become more globally competitive, chemical manufacturers will be doubly advantaged, since they can use inexpensive natural gas both to lower production (energy) costs and as a feedstock.

³² Ibid, page 32-33. In addition to having a smaller carbon footprint, gas-fired plants are less expensive and can be constructed more quickly than coal-fired plants. IHS Cambridge Energy Research Associates estimates that gas-fired plants will account for 60% of new capacity additions in the power industry by 2035.
³³ Ibid, page 8.

Natural gas is composed of hydrocarbon gases plus smaller amounts of other gases such as carbon dioxide, nitrogen, and hydrogen sulfide. The hydrocarbon component consists primarily of methane gas and evaporated natural gas liquids (NGLs) that include ethane, propane, and butane.

As a feedstock, natural gas provides the most efficient way to produce ethane and its derivative ethylene, the world's most widely produced petrochemical and a key raw material used in the production of polymers and major plastic materials such as polyethylene (PE), polyvinyl chloride (PVC), and polyethylene terephthalate (PET). Ethylene can also be derived from crude oil, but steam cracking ethane from natural gas yields a mixture rich in ethylene, whereas steam cracking the heavier hydrocarbons in crude oil yields a diverse mixture of propylene, butadiene, and aromatics (benzene, toluene, and xylene), along with relatively smaller amounts of ethylene.

Shale gas reserves in the United States contain significant quantities of "wet" gas,³⁴ which contain high levels of ethane and other NGLs, such that the U.S. is on its way to becoming one of the lowest-cost producers of ethylene worldwide and a net exporter of petrochemicals. The relative cost advantage U.S. manufacturers enjoy depends in large part on the spread between natural gas prices and crude oil. Whereas U.S. manufacturers can use low-cost natural gas as their feedstock, overseas manufacturers with less access to natural gas reserves have to rely to a greater extent on crude oil.

The key to developing the petrochemical industry is capacity, because as we have noted, the available supply of ethane has outrun our cracking capacity. Though new plants will take several years to bring online, many petrochemical manufacturers are building new facilities, reopening closed ones, or have announced plans to do so. Included among these companies are Dow Chemical, Sasol, Westlake Chemical, Royal Dutch Shell, LyondellBassell, Chevron Phillips Chemical, and Eastman Chemical.

The benefits of cheap natural gas are not limited to ethylene. Ammonia, which with its derivatives, is used primarily to manufacture fertilizer, also uses natural gas as a feedstock. While the return on investment does not justify new capacity additions, more competitive feedstock pricing has led some companies to restart shuttered ammonia plants in Texas, Louisiana and Oklahoma.³⁵

Low-cost natural gas also benefits chemical value chains that are not based on organic feedstocks. Chlor-alkali producers make caustic soda and chlorine, respectively the second and fourth most widely-used chemicals in the world today. Caustic soda and chlorine production is an exceptionally energy-intensive industry, with the three inputs consisting of water, salt and electricity. Since electricity accounts for approximately 50% of production costs, low-cost natural gas has lowered production costs considerably. Moreover, in combination with low-cost ethylene, chlorine is the feedstock for ethylene dichloride, the basis for polyvinyl chloride (PVC), one of the most versatile and popular plastic materials in the world. Partly because of lower ethylene dichloride costs, the global competitiveness of PVC products made in the U.S.

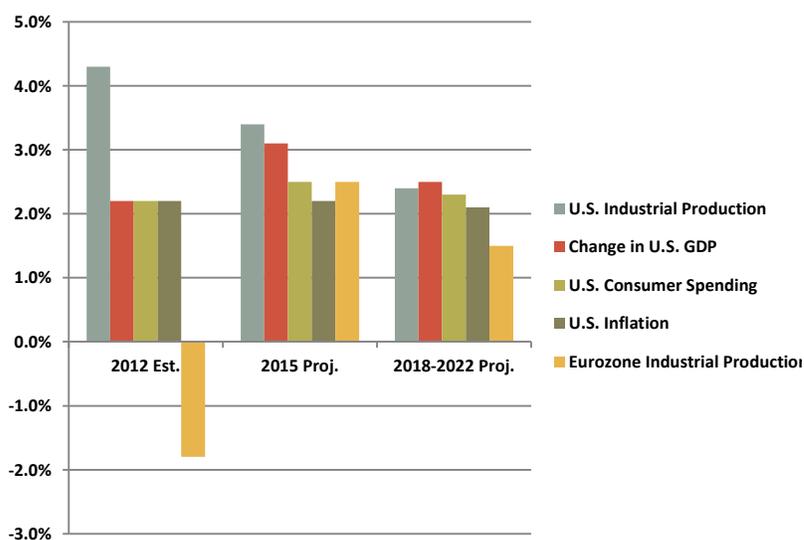
³⁴ Natural gas with higher concentration of methane is referred to "drier" or "dry" gas. If the gas contains higher concentrations of NGLs (ethane, propane, and butane) it is referred to as "wetter" or "wet" gas. NGLs are separated from the gas and sold as a by-product. The Energy Information Administration estimates that wet gas accounts for 21% of U.S. gas reserves.

³⁵ *The Economic and Employment Contributions of Shale Gas in the United States*, page 31.

has improved rapidly. Since 2007, exports of PVC products have increased by 405% to about 3.0 million tonnes, or about 40% of total domestic production.³⁶

The examples of chlor-alkali and fertilizer demonstrate that the low cost of natural gas has reverberations throughout all the chemical value chains. But some effects are more subtle, and may illustrate how shale gas could, over time, transform the economic structure of the entire industry.

Figure 20: Projected Annual Change 2012 – 2022



Source: American Chemistry Council

For example, in 2000 polypropylene (PP) was one of the world's most popular polymers, in part because its feedstock, propylene, was inexpensive relative to other feedstocks. Since that time, U.S. ethylene manufacturers have increasingly turned to using natural gas-derived ethane to produce ethylene instead of using naphtha, which is derived from crude oil. But since ethane crackers produce significantly less propylene than naphtha crackers, shortages of propylene have developed and prices have risen, just at the time when ethylene prices were falling. As these price differentials worked through the value chain, ethylene derivatives such as high-density polyethylene (HDPE) and polystyrene (PS) eroded PP's cost advantage, such that the price of PP now is equal to or less than the price of HDPE and PS. What this means is that HDPE and PS can now be substituted for polypropylene in certain applications, which over time will lead to faster growth for the ethylene-based materials.³⁷

So, how does this all tie together? What do our out-of-control national debt, the financial crisis in Europe, or any of the other current macro-economic "crises" have to do with the state of the chemical industry and its future prospects? Just this: in general, there is and has been far too much hand-wringing about what's going wrong with the global economy, and too little about what may be going right. It is increasingly clear to us that today the chemical industry is going right.

³⁶ Ibid, page 32. See also "US Chlor-Alkali to Benefit from Shale Gas",

<http://www.icis.com/Articles/2011/06/20/9470803/us-chlor-alkali-to-benefit-from-shale-gas.html>

We acknowledge that the increase in PVC exports cannot be solely attributed to lower ethylene dichloride prices. Other supply/demand factors also have played a role, including increased demand from emerging markets in Asia combined with lower U.S. demand, as well as the need for PVC producers to run their plants at full capacity in order to cover their large fixed overhead costs.

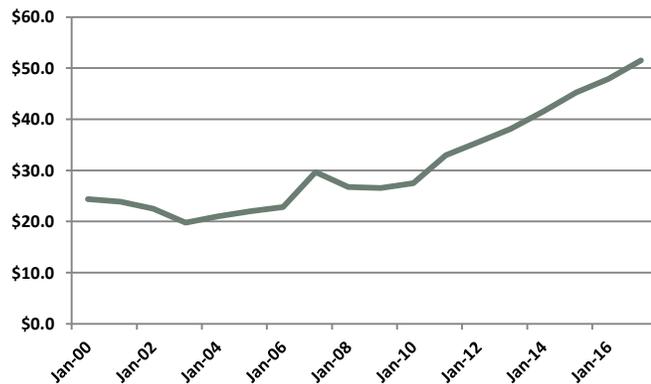
³⁷ John W. McCauley, "The Risk of Polypropylene's Declining Competitiveness", *Plastics News*, November/December 2011, pages. 10-12.

In looking to the future of both the economy and the U.S. chemical industry, it's important to look beyond the near-term. In the short run, meaning perhaps the next one to three years, there is likely to be more pain. GDP growth will be low, perhaps at times below the rate of inflation. There is no quick way to clear the oversupply in the housing market or complete the cycle of deleveraging that began with the recession.

But the seeds of a revival have been planted, and their origins lie in energy and manufacturing. And by "revival" we mean something more than a mere "recovery", something that is more sustainable and transformative. We can already see its beginnings in how growth in U.S. industrial production, with the exception of fast growing emerging markets, is exceeding growth in other sectors of the global economy (Figure 20).

With shale oil and gas driving lower energy and other input costs, U.S. manufacturing is developing a global competitive advantage that it did not have before.

Figure 21: Chemical Industry Capital Expenditures (in millions)



Source: American Chemistry Council

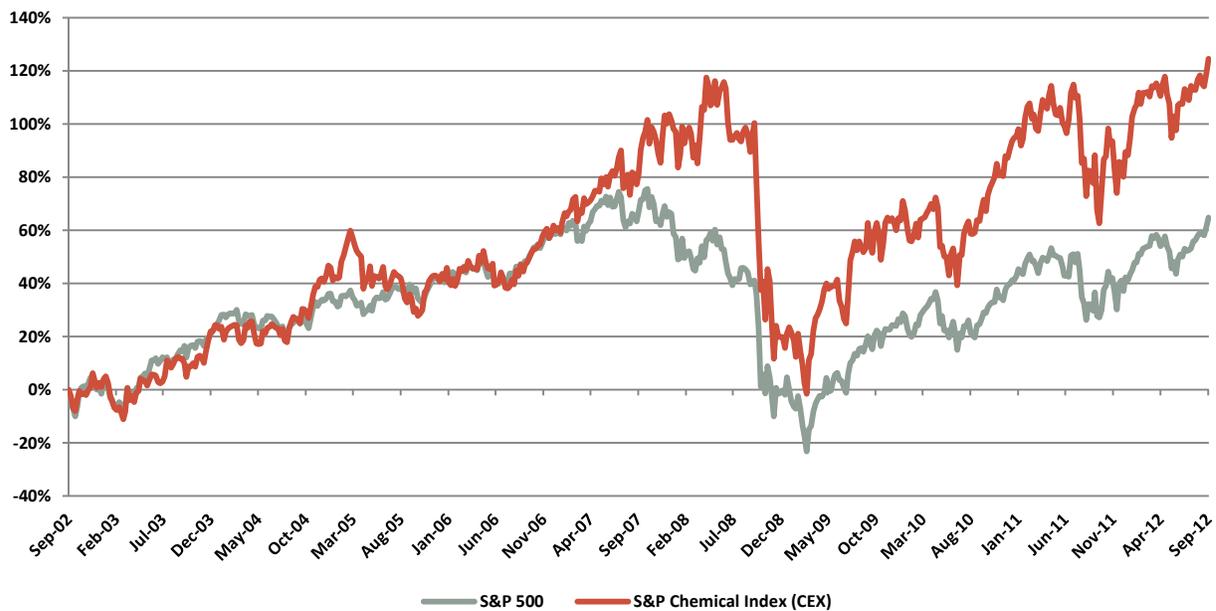
As we develop our new-found energy resources, U.S. manufacturing will make a come-back, reviving core businesses – steel, aluminum, chemicals and other heavy industries – that not too long ago were thought to be lost to offshore competitors with access to cheaper labor and raw materials. With shale oil and gas driving lower energy and other input costs, U.S. manufacturing is developing a global competitive advantage that it did not have before.

The chemical industry will be at the forefront of this development. As we have noted, many chemical companies are expanding capacity to take advantage of low energy costs; capital spending in the chemical industry is projected to grow from \$35.5 billion this year to \$51.5 billion by 2017, a 44% increase (Figure 21).³⁸

But to see the future of the chemical industry, perhaps we don't have to look further than collective wisdom of the stock market, considered by many to be one of the most reliable leading economic indicators. Though typically more volatile than the broader stock market indices, the S&P Chemical Index closely tracks the S&P 500. Yet over the long-term, the Chemical Index has outperformed the S&P 500. Over the past decade, from September 2002 through September 2012, the S&P 500 delivered a 64.7% gain, but the Chemical Index almost doubled that with a 124.6% gain (Figure 22). Because we believe the prospects for chemicals look even brighter now than they did ten years ago, we expect this pattern of long-term outperformance to continue.

³⁸ Mid-Year 2012 Situation & Outlook, American Chemistry Council, June 2012.

Figure 22: S&P Chemical Index and S&P 500 Relative Performance



STRATEGIC BUYERS TRADE UP

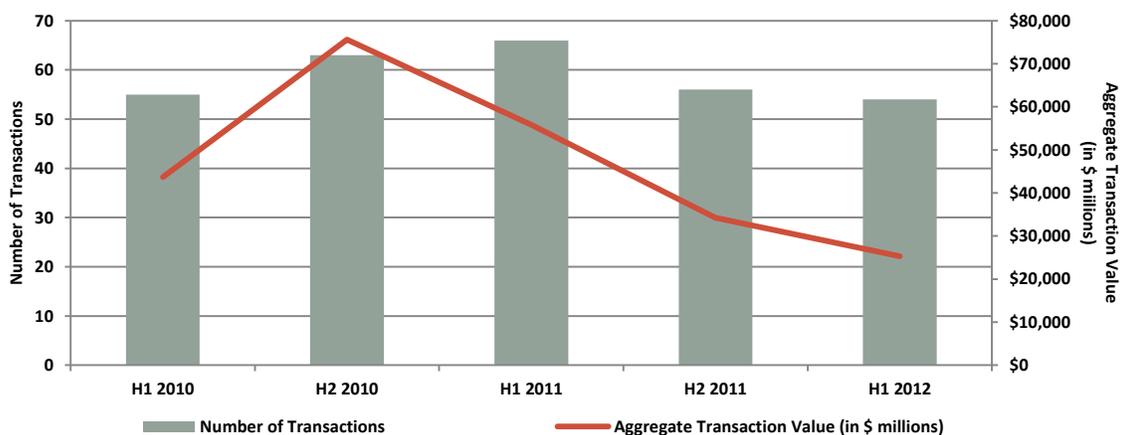
CHEMICAL M&A 2011 – 2013

As it became clear in the second half of 2009 that the worst of the financial crisis was behind us, we believed that the stage was being set for an extended period of high activity in chemical M&A. Our thinking was based partly on the idea that strategic buyers, after years of having to compete with private equity, would probably come back into the market in a big way. Despite all the continuing “headline” turmoil in the global economy, many chemical firms had emerged from the recession with the classic profile of a strategic acquirer: plenty of cash, low debt, and relatively reliable streams of free cash flow. With organic, internal growth difficult due to the slow pace of the recovery and shareholder pressures to create value, acquisitions seemed to be the most viable option for growth.

We also believed that strategic buyers in the post-recession period would be relatively risk-averse, and would focus on smaller or mid-sized targets with readily identifiable strategic fits and synergies. We were right about the strategic focus, but wrong about the timing and sizes of the deals. In 2010 and 2011, there were several large, diversified chemical companies that were willing to accept the risk of larger (\$5 billion plus) transactions in order to grow and upgrade their product portfolio to become a higher margin business. In 2012, this trend has broadened: though there have been fewer deals overall and their average values have been less than half of what they were in 2010 and 2011, strategic buyers still greatly outnumber financial buyers and account for a disproportionate share of total aggregate deal value.

As reported by PricewaterhouseCoopers (PWC), counting deals with a value in excess of \$50 million, there were 118 chemical industry transactions with an aggregate value of \$119 billion in 2010, and 122 transactions in 2011 with an aggregate value of \$90 billion. With 54 transactions with an aggregate value of \$25 billion in the first half of the year, 2012 is on track to come in well below 2011 levels (Figure 1). However, 2011 was characterized by a number of exceptionally large transactions, including Berkshire Hathaway’s acquisition of Lubrizol (\$9.7 billion), Ecolab’s purchase of Nalco (\$8.1 billion), and DuPont’s acquisition of Danisco (\$7.2 billion), which skewed the measurement of average transaction values upward.

Figure 1: Chemical Transactions 2010 – 2012
Transactions > \$50 million



Source: PricewaterhouseCoopers

Figure 2: Chemical Transactions with a Value Greater than \$1 Billion 2011 – 2012

Buyer	Target	Date	Value	EBITDA Multiple
BASF	Becker Underwood	Sept-12	\$1.0 billion	N/A
Carlyle Group	DuPont Performance Coatings	Aug-12	\$5.2 billion	11.7 x
Georgia Gulf	PPG's Commodity Chemicals	Jul-12	\$2.1 billion	5.1 x
Cabot	Norit NV	Jun-12	\$1.1 billion	12.0 x
Agrium	Vitera Inc. - Ag Products	Mar-12	\$1.8 billion	N/A
Molycorp	Neo Materials Technologies	Mar-12	\$1.3 billion	4.7 x
Eastman	Solutia	Jan-12	\$4.7 billion	9.0 x
Ecolab	Nalco	Dec-11	\$8.1 billion	10.9 x
Cargill	Provimi	Nov-11	\$2.2 billion	8.6 x
Sealed Air	Diversey Holdings	Oct-11	\$2.6 billion	9.5 x
Lonza	Arch Chemicals	Oct-11	\$1.2 billion	10.3 x
Tronox	Exxaro Resources	Sept-11	\$1.0 billion	N/A
Berkshire Hathaway	Lubrizol	Sept-11	\$9.7 billion	7.2 x
OM Group	Vacuumschmelze GmbH	Aug-11	\$1.0 billion	8.6 x
Ashland	ISP	Aug-11	\$3.2 billion	8.9 x
Solvay	Rhodia	Aug-11	\$4.8 billion	7.1 x
Rhone Capital and Triton Partners	Evonik's Carbon Black Business	Jul-11	\$1.3 billion	N/A
DuPont	Danisco	May-11	\$7.2 billion	12.8 x
Clariant	Süd-Chemie	Apr-11	\$2.7 billion	10.5 x
DSM	Martek	Feb-11	\$1.1 billion	N/A
Average				9.4 x
Average (Excludes Commodity Deals)				9.8 x
Median				9.0 x

Source: Grace Matthews

To keep growing, strategic buyers have been willing to pay a full value for quality assets. Excluding transactions involving more commodity-oriented products, the average EBITDA multiple (Enterprise Value/EBITDA) since the beginning of 2011 for large strategic chemical deals (values greater than \$1.0 billion) has been 9.8 times (Figure 2).

For the most part, the large strategic deals over the past two years have been driven by a desire to optimize product portfolios, minimize exposure to cyclical markets, expand geographically, or gain access to faster growing emerging markets. Using acquisitions to achieve these goals and grow the bottom line seems only logical given the overall weakness in the global economy. When the recovery began in 2009, chemical companies initially were able to grow profits because they had aggressively cut costs during the recession. Yet there is a limit to the growth you can get from cutting costs; eventually you have to grow the top line as well. But for many chemical companies, it is difficult to grow revenue faster than GDP, which lately has barely cracked 2%. However, you can accelerate growth if you shift your product mix to higher margin products or target faster growing markets. Investing internally to implement these strategies can take years, but acquisitions may offer a short-cut. A well-executed strategic deal often can be completed in less than a year, even including the time it takes to integrate the acquired business into existing operations.

Eastman's acquisition of Solutia, announced in January 2012 and completed in July, is typical of recent large strategic transactions. Over the past decade, Eastman has steadily strengthened its portfolio, acquiring higher-margin businesses, divesting less profitable ones, and increasing capacity in markets where it had a competitive advantage. At the end of 2011, the company had more than \$750 million in cash on its balance sheet, and the capacity to borrow more to fund transactions. Having already made a number of smaller bolt-on deals, including

Genovique Specialties in 2010 and Sterling Chemical in 2011, Eastman paid \$2.7 billion in cash and issued 14.7 million shares in common stock to acquire Solutia. The combination immediately gave Eastman additional presence overseas, especially in Asia and other emerging markets. From a product perspective, the acquisition will augment Eastman's fast-growing specialty plastics business, which will be combined with Solutia's performance films and glass interlayers business in Eastman's new Advanced Materials segment. The combined operations will make Eastman a leader in polyvinyl butyral glass interlayers. Solutia's strength in rubber additives and heat-transfer and hydraulic fluids also will give Eastman added depth in transportation applications. Eastman believes it can generate at least \$100 million in annual savings through cost reduction synergies and expects that the deal will be immediately accretive to earnings.

The Eastman/Solutia deal may be an example of a classic synergistic transaction, but other high profile deals show that there are other, more circuitous, paths to building a higher margin business through acquisitions. Like Eastman, PPG in recent years has focused on building a higher margin specialties business. Why then, in 2011, did PPG buy Equa-Chlor, a West Coast producer of commodity chlor-alkali products? Chlor-alkali manufacturing was a legacy business for PPG, but one that many analysts thought the company was more likely to divest rather than expand. Equa-Chlor was an attractive business, as it had a strong competitive advantage due to its Pacific Northwest location, where PPG has customers but no plant. Equa-Chlor also had few regional competitors and, in an energy intensive business, it was able to take advantage of low-cost hydro-electric power. But it still was a cyclical, capital intensive business – not at all like PPG's growing core competency in paints and coatings – and the acquisition seemed counter to PPG's stated focus on specialties.

In July of this year, PPG announced that it was going to merge its commodity chemical business, which includes its chlor-alkali assets, with Georgia Gulf. Using a structure designed to maximize tax efficiency, PPG's commodity business will be spun off to shareholders and then immediately merged with Georgia Gulf. PPG shareholders will own 50.5% of the merged companies; Georgia Gulf shareholders will own 49.5%.

PPG's acquisition of Equa-Chlor now appears to be a logical move, as it will give the merged company greater geographic reach, a stronger portfolio of chlor-alkali plants, and hence, a higher valuation in the marketplace. To be clear, it's not likely that PPG's management acquired Equa-Chlor in anticipation of the merger with Georgia Gulf, especially given Westlake Chemical's unsuccessful bid for Georgia Gulf earlier this year. However, it does seem that the Equa-Chlor acquisition was part of a strategy to create a stronger overall business that would bring a higher value in a spin-off or divestiture.

The transaction appears to be a win-win for both PPG and Georgia Gulf. PPG shareholders get greater flexibility since their holdings in commodity and specialty chemicals will be separated and can be managed independently. From the perspective of the Georgia Gulf shareholders, they are getting a more integrated company that has not only economies of scale in chlor-alkali (Georgia Gulf will become the third largest producer), but also a more comprehensive downstream portfolio of chlorine derivatives that includes VCM (vinyl chloride monomer) and PVC (polyvinyl chloride).

A transaction that really exemplifies the advantage strategic buyers have today over private equity is PolyOne's acquisition of ColorMatrix Group. ColorMatrix, an innovative manufacturer of

liquid colorants and plastic additives, was put up for sale by its parent Audax Group in January 2011. Over 100 strategic and private equity buyers bid for the company in a multi-step auction process. A strategic buyer, PolyOne Corporation, won the process, paying \$486 million for ColorMatrix, or more than 11 times ColorMatrix's EBITDA of \$43.6 million. Private equity had also made strong bids for the company, but not strong enough: without strategic synergies, none probably could have paid that kind of multiple and achieve the returns on equity that their charters demand.

And why could PolyOne pay such a high value? It's simple really: ColorMatrix was a perfect strategic fit. For several years, PolyOne has been transforming itself into a fast-growing specialty chemical company focused on delivering highly engineered polymers and services to the plastics manufacturing industry. ColorMatrix, for its part, was one of those rare companies that targeted what was a commodity market – in this case, colorants for plastic materials – and essentially reinvented the category as a specialties market. The company had pioneered liquid colorants for consumer packaging in the 1990s, and by the time of the sale it had become a worldwide leader in the market for liquid colorants and other high performance plastic additives. For PolyOne, in terms of business fit, strategic direction, and growth opportunities, there could not have been a better addition to its portfolio, and the combined potential of the two companies more than justified the price.

The one transaction that does not fit the recent trend of large strategic deals is also the largest year-to-date: the \$5.15 billion purchase of DuPont's Performance Coatings business by the Carlyle Group, one of the largest private equity firms in the world. The acquisition of Performance Coatings, comprised primarily of aftermarket and OEM automotive coatings, is the largest coatings industry transaction in over a decade.³⁹ The sale possibly could only have been made to private equity because of regulatory considerations. Automotive coatings has always been the province of the biggest players in the coatings industry, since the nature of the business means that extreme customer concentration is a given and that when a customer as large as General Motors decides to buy your product, they are going to buy a lot of it. Because of this, a sale to any of the most obvious synergistic strategics – PPG, BASF, or Akzo Nobel – would most likely have required some product portfolio realignment in order to get around anti-trust considerations. The remaining large coatings manufacturers, Sherwin-Williams and Valspar, are doing well enough in architectural and non-automotive OEM industrial coatings, and the Performance Coatings business probably would have been just too big of a bet for a business in which they weren't already a major player.

Performance Coatings is expected to generate about \$500 million in EBITDA in 2012. Carlyle appears to have paid an EBITDA multiple of a little over 10 times, which is approximately in line with the long term average of 9.7 times EBITDA for coatings deals above \$100 million in value.⁴⁰ On a pro-forma basis, the multiple may be lower, at around 7.8 times EBITDA based on the elimination of certain corporate or "residual" costs that DuPont will retain and eliminate over the next year.⁴¹

³⁹ Zachary R. Mider and Jack Kaskey, "Carlyle to Buy DuPont's Auto-Paint Unit for \$4.9 Billion," August 30, 2012, <http://www.bloomberg.com/news/2012-08-30/carlyle-to-buy-dupont-s-auto-paint-unit-for-4-9-billion.html>

⁴⁰ Ibid.

⁴¹ Ibid. See also the transcript of DuPont's conference call announcing the transaction, <http://investors.dupont.com/phoenix.zhtml?p=irol-eventDetails&c=73320&eventID=4830536>

The rationale for DuPont follows a common theme in recent, large strategic deals: “trading up” by shedding a lower margin business in order to focus on faster growing, more profitable segments. DuPont will probably use the cash from the transaction to reduce debt in the short term, but long term it intends to deploy its capital to focus on growing its bio-based businesses in agriculture and nutrition, bio-fuels, bio-chemicals, and advanced materials.

Carlyle is acquiring Performance Coatings at an attractive time in the business cycle. The business is strong in auto refinish coatings (44% of segment sales), and as we noted in the previous article, the average age of autos and light trucks on the road in the U.S. is at record levels. The aftermarket coatings segment then would be well positioned to capitalize on the aging fleet of vehicles in North America if the recovery continues at a slow pace and consumers delay purchasing new cars. The business also is heavily exposed to Europe, which currently may be in recession due to the ongoing sovereign debt crisis. This too would imply a healthy market for aftermarket coatings as consumers elect to defer purchasing new vehicles, and instead repaint or repair their older model cars. When the market recovery begins to accelerate in both North America and Europe, the business also will be positioned to participate, as its OEM automotive coatings comprise about 31% of sales. Additionally, Carlyle may be betting on stronger growth in Asia-Pacific and other emerging markets due to the ongoing development of the middle class in those areas.

Longer term, the story of strategics with strong balance sheets needing M&A to grow will still hold, especially so in North America because of Europe's financial crisis and slowing growth in Asia.

Looking ahead to 2013, the data showing there has been a slowdown in chemical M&A activity suggests that we may be on the backside of an M&A cycle that peaked in the second half of 2010 or the first half of 2011. Alternatively, we may not be, since many observers haven't seen a slowdown, and it may be that there are simply fewer “headline” deals and more activity lower down the value spectrum in the middle market.

Longer term, the story of strategics with strong balance sheets needing M&A to grow will still hold, especially so in North America because of Europe's financial crisis and slowing growth in Asia. With fewer “transformational” opportunities due to consolidation over the past few years, strategics likely will focus on “bolt-on” transactions that fit their existing businesses, and will be especially attracted to assets that will enhance their margins and growth, either through a providing a competitive advantage in their targeted markets or through differentiating product lines focused on an emerging market or industry.

A transaction announced just as this white paper goes to press confirms this trend. On October 1, 2012 3M (NYSE: MMM) reported that it will acquire Ceradyne (NASDAQ: CRDN) for \$35 per share, a 43% premium over Ceradyne's closing price prior to the announcement. Ceradyne will fit neatly into 3M's Energy and Advanced Materials Division, and will provide 3M with a portfolio of advanced technical ceramics that it can market across a broad spectrum of growth industries.

Also, as a by-product of recent transformational acquisitions over the past few years, we should continue to see divestitures of non-core assets, especially of commodity chemicals as a few large diversified chemical companies continue their push into specialties. This will create

opportunities for consolidation in the commodity space as manufacturers seek to improve their standing in terms of scale and market share.

Private equity firms, despite their recent low rate of participation in the chemical M&A markets, still have money to place, and will acquire chemical assets opportunistically when it makes sense. It's probable that a number of private equity chemical deals will be strategic transactions in disguise, as private equity groups acquire businesses that overlap with existing portfolio companies. Alternatively, private equity may follow the example of Berkshire Hathaway in its purchase of Lubrizol, buying a quality chemical company that can become a platform for later synergistic transactions.

2011 - 2012 CHEMICAL INDUSTRY SELECTED TRANSACTIONS

DATE	ACQUIRER	TARGET
Pending	PROSOL Lacke + Farben	BASF's RELIUS COATINGS Business
Pending	3M	Ceradyne
Pending	Ecolab	Quimiproducos
Pending	Arsenal Capital	IGM
Pending	BASF	Becker Underwood
Pending	The Carlyle Group	DuPont Performance Coatings
Pending	Georgia Gulf	PPG Commodity Chemicals
Pending	Cabot	Norit NV
Pending	First Reserve, SK Capital	TPC Group
Pending	Syngenta	DuPont Professional Insecticides
Pending	Rockwood Holdings Inc.	Talison Lithium Inc.
Pending	PMC Group	Arkema Tin Stabilizers
Sept-12	Technip	Shaw Group's Energy and Chemicals Business
Sept-12	RPM International	Kirker Enterprises
Aug-12	BASF	Novolyte Technologies
Aug-12	Lycus Management	Lycus, Ltd.
Aug-12	United Initiators	Syrgis Performance Initiators
Aug-12	Olin	KA Steel
Jul-12	Brenntag	ISM/Salkat Group
Jul-12	Lubrizol	Lipotec
Jul-12	Sun Chemical	Benda-Lutz Werke GmbH
Jul-12	Eastman Chemical	Solutia
Jun-12	RPM International	Viapol Ltda.
Jun-12	Weatherford International	Syrgis Performance Chemicals
Jun-12	Calumet Specialty Products	Royal Purple
Jun-12	Tronox	Exxaro Resources Ltd.
May-12	Royal Adhesives & Sealants	Clifton Adhesives
May-12	Arsenal Capital	Plasticolors, Inc
May-12	Arsenal Capital	Evonik's Global Colorants Business
May-12	BASF	Equateq
May-12	Current Management	Arkema's Peninsula Polymers Business
Apr-12	Royal Adhesives & Sealants	Extreme Adhesives
Apr-12	EuroChem	BASF's Fertilizer Assets
Mar-12	General Chemical	Southern Water Consultants
Feb-12	Mexichem	Wavin
Jan-12	Celanese	Ashland's PVA Homopolymer and Copolymer Business
Jan-12	AkzoNobel	Boxing Oleochemicals
Jan-12	The Jordan Company	HIG's Vantage Specialty Chemicals
Dec-11	Nuplex Industries	Viverso GmbH

DATE	ACQUIRER	TARGET
Dec-11	Ecolab	Nalco
Dec-11	PolyOne	ColorMatrix
Nov-11	Royal Adhesives & Sealants	Craig Adhesives & Coatings
Nov-11	Cargill	Provimi
Nov-11	Michelman	Clariant's Licomer Business
Nov-11	Quest Specialty Chemicals	Patriot Paint's coatings Business
Nov-11	Praxair	American Gas Group
Nov-11	Lubrizol	Merquinsa
Nov-11	Eastman Chemical	TetraVitae Bioscience
Oct-11	Vision Capital	United Initiators (majority position)
Oct-11	Sealed Air	Diversey Holdings
Oct-11	Halliburton	Multi-Chem Group
Oct-11	Lonza	Arch Chemicals
Oct-11	PPG	Dyrup A/S
Oct-11	Protex International	Northern Specialty Chemicals
Oct-11	Milliken & Company	SiVance LLC
Oct-11	AkzoNobel	Schramm Coatings
Oct-11	Solutia	Southwall Technologies
Oct-11	Quaker Chemical	G.W. Smith & Sons
Oct-11	Paramelt	Remy Adhesives
Oct-11	Yule Catto	Quality Polymer
Sept-11	RPM International	Legend Brands Group
Sept-11	Paramelt	Evonik's Dilavest® Wax Business
Sept-11	Ineos Melamines	DSM's Amino Resins Business
Sept-11	Berkshire Hathaway	Lubrizol
Sept-11	DAK Americas	Wellman's PET Business
Sept-11	RPM International	Fuhr Industrial
Sept-11	Univar	Arinos Quimica (Brazil)
Sept-11	Eastman Chemical	Scandiflex do Brasil S.A. Industrias Quimicas
Aug-11	Ashland	International Specialty Products (ISP)
Aug-11	Solvay	Rhodia
Aug-11	H.I.G. Capital	Dow Chemical's Haltermann Products
Aug-11	Braskem	Dow's Polypropylene Business
Aug-11	Eastman Chemical	Sterling Chemicals
Aug-11	OM Group	Vacuumschmelze GmbH
Aug-11	Ineos	Tessenderlo's European Chlor-Vinyls Business
Aug-11	Eastman Chemical	Dynaloy
Jul-11	Sika	Technokolla
Jul-11	3M	Advanced Chemistry & Technology
Jul-11	New Mountain Capital	NuSil
Jul-11	Arkema	Total's Coatings Resins and Photocure Resins Business
Jul-11	Rhône Capital and Triton Partners	Evonik's Carbon Black Business

DATE	ACQUIRER	TARGET
Jul-11	Hydrite Chemical	Choice Chemical
Jun-11	Chemtrade	Marsulex Inc.
Jun-11	Clariant	Süd-Chemie
Jun-11	Investindustrial's PCCR USA	Momentive's US Composites and Coatings Business
Jun-11	Hempel	Crown Paints
Jun-11	CABB	KemFine
Jun-11	ICL	Cosmoceel
Jun-11	Aditya Birla	Columbian Chemicals
May-11	Lanxess	DSM Elastomers
May-11	DuPont	Danisco
May-11	PPG	Equa-Chlor
May-11	HallStar	B&T S.r.l
May-11	Agrium	CerealToscana
Apr-11	TPG Capital	Ashland's Distribution Business
Apr-11	Altana	Watson Standard Adhesives Can-end Sealants Business
Apr-11	Mitsui Chemicals	Acomon
Mar-11	China Bluestar Co.	Elkem AS
Mar-11	Audax	Quest Specialty Chemicals
Mar-11	Olin	PolyOne's 50% stake in Sunbelt JV
Mar-11	Axens	Criterion's Catalytic Reforming Catalyst Business
Mar-11	Clariant	Octagon Process
Mar-11	Evonik	Boehringer Ingelheim's RESOMER® Business
Feb-11	DAK Americas	Eastman's PET Business
Feb-11	DSM	Martek
Feb-11	Behn Meyer Chemical	Solutia's DTCs and TBzTD Rubber Businesses
Jan-11	H.I.G. Capital	Cytec's Building Blocks Chemicals Business
Jan-11	Lubrizol	Nalco's Performance Products Business
Jan-11	Mexichem	Rockwood's AlphaGary Plastic Compounding Business
Jan-11	Valspar	Isocaot Tintas e Vernizes Ltda. (Sao Paulo, Brazil)
Jan-11	Hallstar	Biochemica International
Jan-11	Lanxess	Darmex (Buenos Aires)
Jan-11	Pinova Holdings	LyondellBasell's Flavors and Fragrances Business
Jan-11	Quaker	Summit Lubricants
Jan-11	PolyOne	Uniplen Industria de Polimeros
Jan-11	BASF	SHELL's Styrene Catalyst Business
Jan-11	K+S	Potash (majority stake)
Jan-11	ITW	Celeste Industries
Jan-11	Blackstone Capital Partners	Polymer Group

GRACE MATTHEWS CHEMICAL TEAM: STRONG COMMITMENT TO CHEMICAL M&A



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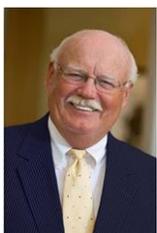
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SELECT GRACE MATTHEWS CHEMICAL TRANSACTIONS

PCHEM
has been acquired by
Weatherford
Grace Matthews, Inc. advised
Syrgis Performance Products

Andax Group
has sold its portfolio company
ColorMatrix
to
PolyOne
Grace Matthews, Inc. advised
The ColorMatrix Corporation

SYRGIS
PERFORMANCE INITIATORS
has been acquired by
UNITED INITIATORS
driving your success
Grace Matthews, Inc. advised
Syrgis Performance Products

LANDEC
INTELLIGENT MATERIALS
has acquired
LIFECORE
BIOMEDICAL
from
WARBURG PINCUS
Grace Matthews, Inc. advised
Landec Corporation

columbia paint & coatings
merged with
SHERWIN-WILLIAMS
Grace Matthews, Inc. advised
Columbia Paint & Coatings

Brockway Moran & Partners
has sold its portfolio company
celeste
Helping you create a great impression
to
ITW
Grace Matthews, Inc. advised
Brockway Moran

ColorMatrix Corporation
has been recapitalized by
Andax Group
Grace Matthews, Inc. advised
ColorMatrix Corporation

Beckers
Beckers Industrial
has acquired the stock of
specialty coatings company, inc.
Grace Matthews, Inc. advised
Specialty Coatings Company

LORD
has sold its Resilient Floor
Coatings Business to
AkzoNobel
Grace Matthews, Inc. advised
LORD Corporation

AKZO NOBEL
has acquired
Chemcraft International, Inc.
Grace Matthews, Inc. advised
Akzo Nobel nv

ceradyne, inc.
has acquired
MINCO
Grace Matthews, Inc. advised
Minco

3M
has acquired
NorthStar
Chemicals, Inc.
Grace Matthews, Inc. advised
NorthStar Chemicals, Inc.

ASHLAND
has acquired
Northwest Coatings
Grace Matthews, Inc. advised
Northwest Coatings, LLC

LANDEC
INTELLIGENT MATERIALS
has sold its
specialty chemical subsidiary
DOCKRESINS CORPORATION
to
LUBRIZOL
Fluid technologies for a better world™
Grace Matthews, Inc. advised
Landec Corporation

HEXION
Specialty Chemicals
has acquired the assets of
pacific
Epoxy Polymers, Inc.
Grace Matthews, Inc. advised
Pacific Epoxy Polymers, Inc.

AKZO NOBEL
has acquired
The Flood
Do something amazing®
Grace Matthews, Inc. advised
Akzo Nobel nv

RAABE Corporation
has been acquired by
QUEST SPECIALTY CHEMICALS™
HURON CAPITAL PARTNERS
Grace Matthews, Inc. advised
Raabe Corporation

AIR PRODUCTS
has licensed exclusive fields of
Intelimer technology from
LANDEC
INTELLIGENT MATERIALS
Grace Matthews, Inc. advised
Landec Corporation

GSI GENERAL MATERIALS, LLC
has been acquired by
White Cap CONSTRUCTION SUPPLY
a subsidiary of
THE HOME DEPOT
Grace Matthews, Inc. advised
GSI General Materials, LLC

Technologies, Inc.
Committed To Performance
has acquired certain assets of the
Foam Latex operations, located in
Calhoun, G.A. of
BOSTIK FINDLEY
Grace Matthews, Inc. advised
Bostik Findley, Inc.

Grace  Matthews

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