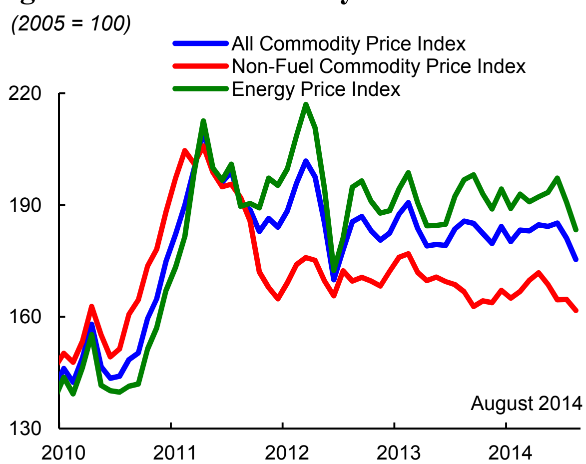
Quarterly Review of Commodity Markets

Research Department, Commodities Team*

Global Economy & Commodity Markets

Figure 1: IMF Commodity Price Indices –

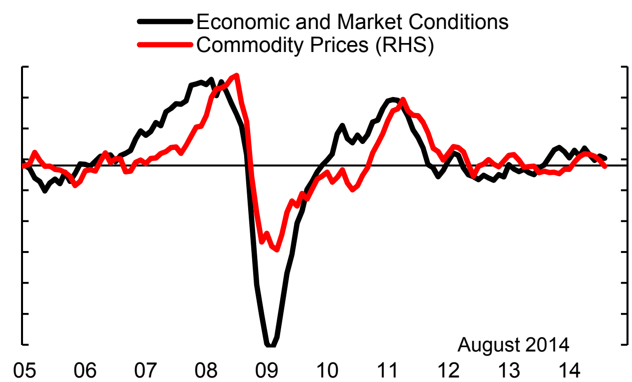


Source: IMF, *Primary Commodity Price System*.

Most commodity prices have fallen since May. The IMF primary commodity price index fell by 4.8 percent in August from May 2014. Despite ongoing geopolitical issues, oil prices have declined 5.3 percent with ample supply. Food prices have fallen by 8.9 percent amid favorable global harvest prospects. Metal prices increased 2.2 percent on some supply concerns. Commodity prices were in line with economic and market conditions in June, but a relatively large decline in August brought commodity prices lower than the level that economic conditions indicate. Currently, the global economy is growing at a steady pace with some signs of weakening and persistent risks, which affect confidence.

In this section, we look at commodity prices and global economic and market conditions using principal components analysis. The first principal components of commodity prices have been lagging the first principal components of the global economic and market conditions, the latter which are derived from industrial production indexes, purchasing managers index, and equity indexes of many advanced and emerging economies as in Figure 2.

Figure 2: First Principal Components of HP-detrended Series



Sources: IMF, *Primary Commodity Price System*, and staff calculations.
Note: principal components are unit-free.

Figure 3 depicts the first principal components of commodity prices and the economic and market conditions of emerging economies. Strong pickup of economic and market conditions in emerging economies in the last few months contrasts with the observed weakness in commodity prices.

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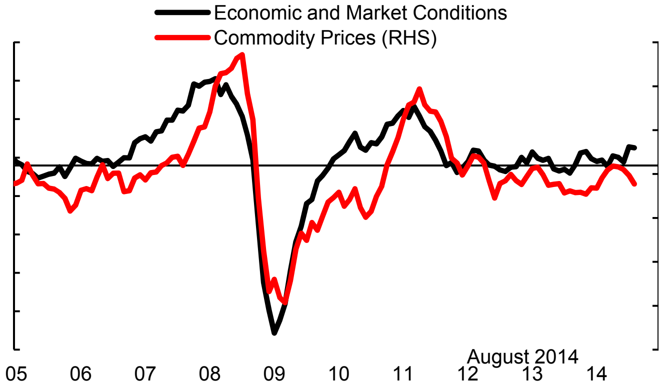
For detailed commodity market analysis, please refer to the Commodity Market Monthly available at http://www.imf.org/external/np/res/commod/index.aspx

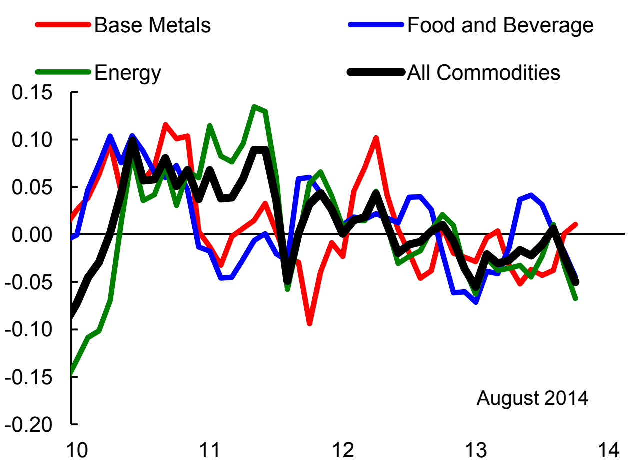
Figure 3: First Principal Components of HP detrended series (Emerging Economies)



Sources: IMF, *Primary Commodity Price System*, and staff calculations.
Note: principal components are unit-free.

Regressing IMF commodity price indices on the first principal components of global economic and market conditions confirms the high degree of co-movement between the global economy and commodity prices with a correlation of 0.74.

Figure 4: Regression Residuals



Sources: IMF, *Primary Commodity Price System*, and staff calculations.

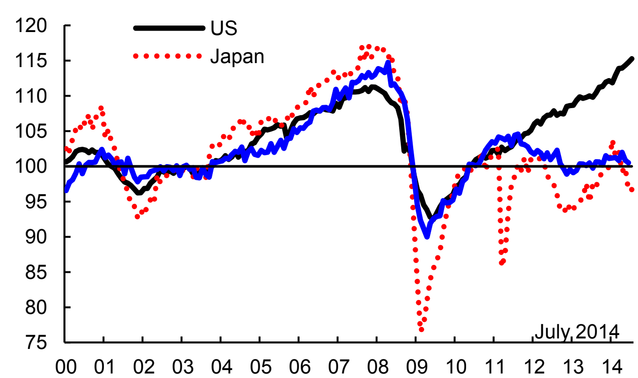
The residuals shown in Figure 4 indicate that commodity prices have been broadly in line with economic conditions for the last few months but the relationship deteriorated sharply in August. Indeed, the residual on all commodities approached its lowest level since the global financial crisis. The negative residuals imply that commodity prices have been lagging economic and market conditions. Residuals appeared to lessen after November 2013 but they are now widening again. This is probably due to supply side effects as food and energy are expected to have ample supply, while some metals have increasing supply concerns.

Economic Situation Overview

The global economy shows signs of recovery albeit with regional differences. Among advanced economies, the euro area's slump persists, Japan's recovery has stalled with a consumption tax hike, while the U.S. maintains relatively steady growth. Emerging economies rebounded after the financial crisis but are experiencing a broad-based slowdown amid both slowing export and domestic demand, and surplus capacity. Russia's business confidence is suffering from sanctions but industrial production is growing.

Overall, advanced economy did not show strong growth in the second quarter. In the U.S., despite a weak first quarter caused by abnormally severe weather, the relatively strong recovery is expected to continue. In Japan, GDP fell by 7.0 percent (annualized) in the second quarter after growing by 6.7 percent in the first quarter as Japanese consumers rushed to spend in advance of a consumption tax hike. Meanwhile the Euro area did not grow in the second quarter.

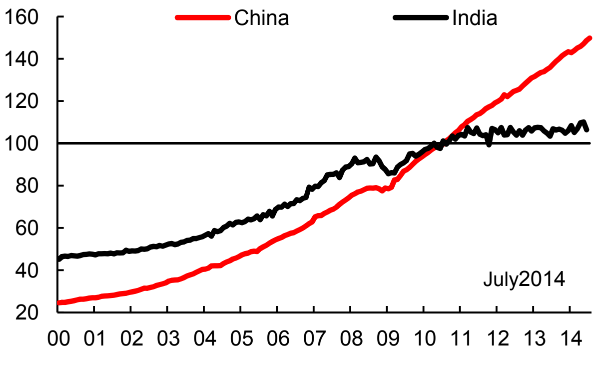
Figure 5: Industrial Production (Select Advanced Economies)



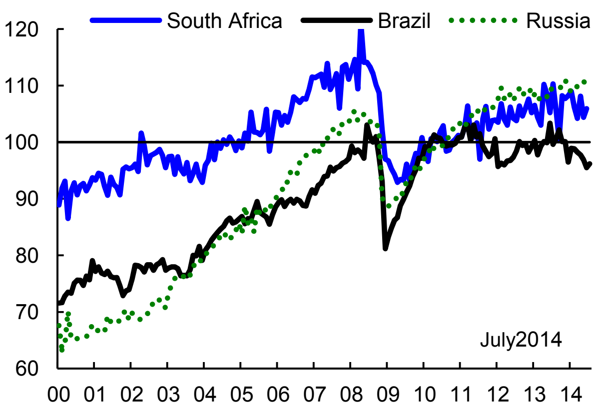
Source: IMF, *Global Data Source*.

Overall, production in the emerging economy production grew relatively strongly in the second quarter. However, signs of weakening appeared last year in anticipation of the U.S. tapering its stimulative quantitative easing. In China the pace of growth is slowing. India has recovered from last year's weakness, while Russia grew in the second quarter even although it still faces a risk of recession amid capital outflows and sanctions imposed by western countries.

Figure 6: Industrial production (BRICS)



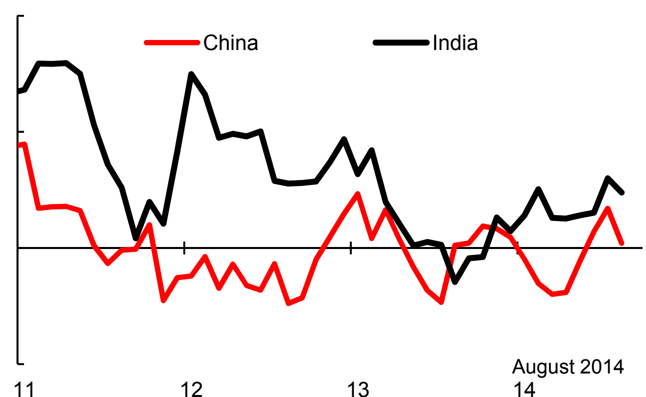
Source: IMF. *Global Data Source*.



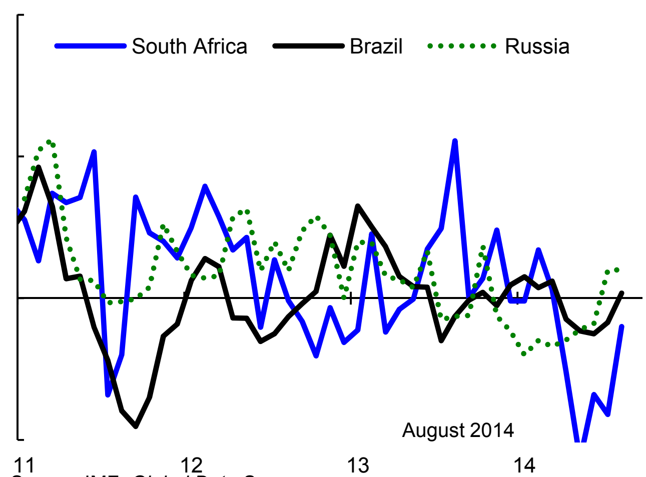
Source: IMF, *Global Data Source*.

Among BRICS countries, Brazil slipped into a recession while others expand at various speeds. China's production grewat around 9 percent (annualized) for the last couple of months. India is showing signs of improvement, while South Africa is recovering from a bout of labor disputes. Russia's economy grew in the second quarter despite western sanctions and persisting geopolitical tensions. Business confidence (as measured by PMI) is improving in Brazil, South Africa, and Russia. India and China, on the other hand, showed some deterioration of confidence in August although it has been improving since the middle of last year.

Figure 7: PMI (BRICS)



Source: IMF, *Global Data Source*.



Source: IMF, *Global Data Source*.

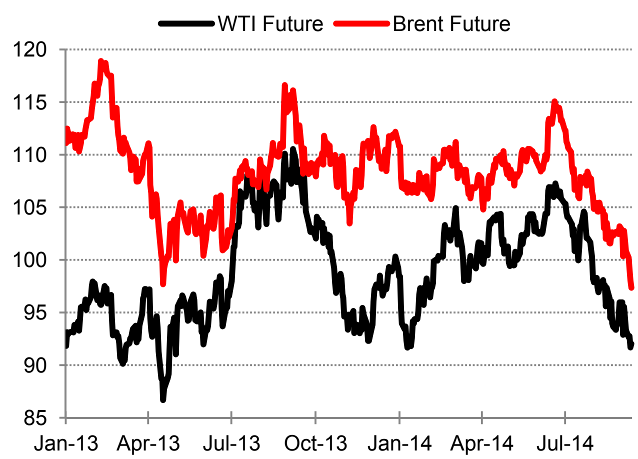
Commodity Markets

Commodity prices have broadly dropped except for a few metals and agricultural groups, such as beverages and meat.

Energy

Crude oil prices dropped to the lowest level since April 2013 with ample supply and weak demand. Geopolitical tensions in Ukraine and Iraq as well as numerous supply outages (namely in Libya) have not impacted prices, due to strong oil production growth, mainly from shale in the U.S..

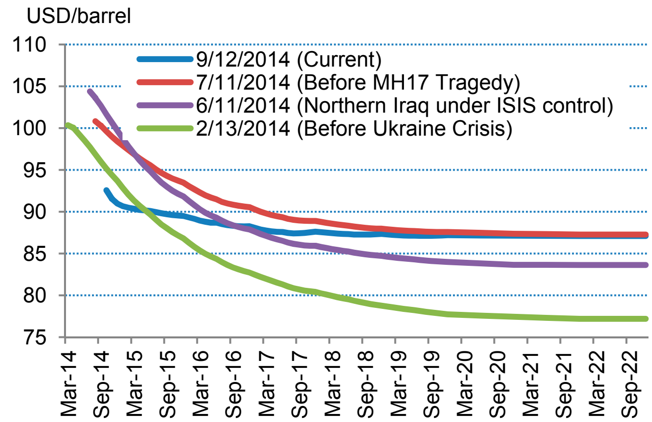
Figure 8: Daily Brent and WTI Front Month Future Prices



Source: Bloomberg, L.P.

Oil futures curves for WTI (Figure 9) reflect the weakness and become flatter as a result. However, there has also been a shift higher in the medium term outlook. Tensions in Iraq will affect investment plans in the country's oilfields. Iraq was expected to be one of the largest contributors of capacity growth in OPEC. Sanctions against Russia also affect its medium-term investment and production, as sanctions make it difficult for Russian oil companies to obtain financing and acquire western technologies to develop arctic oilfields and unconventional oil resources. As a result, WTI future prices 5 years ahead are much higher than earlier this year while spot prices are the lowest in 17 months.

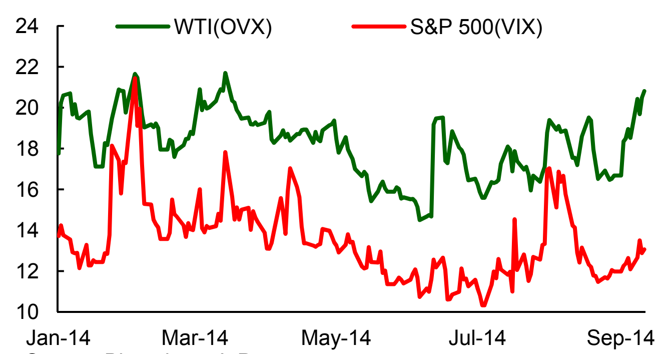
Figure 9: WTI Futures Curves



Source: Bloomberg, L.P.

Oil VIX (OVX) is slowly creeping up near its highest level this year reflecting large declines in oil prices. However, the volatility is still at low levels by historical comparison as it was rare to see OVX below 20 before 2013.

Figure 10: Equity and Oil Market Volatility Indices

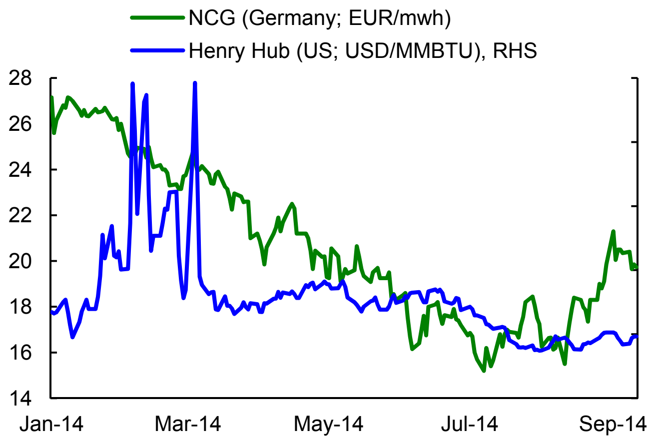


Source: Bloomberg, L.P.

Henry Hub natural gas prices have been stable at relatively low levels due to ample U.S. supply and relatively low demand during summer due to unusually mild weather. European natural gas market shows signs of tightness as spot prices are slowly increasing as winter demand approaches and supply risks remain. Ukraine will have a difficult time this winter if it fails to reach a natural gas supply deal with Russia, as their storage is only half full as of September 10. The European Union is accumulating gas, and most countries are at over 90 percent of storage capacity. Ukraine has received reverse gas flows from Poland, Slovakia, and

Hungary; however, the volumes are not sufficient to replace lost supply. Moreover, Poland has stated that it has to stop the reverse flow amid reduced supply from Russia.

Figure 11: Daily Natural Gas Prices

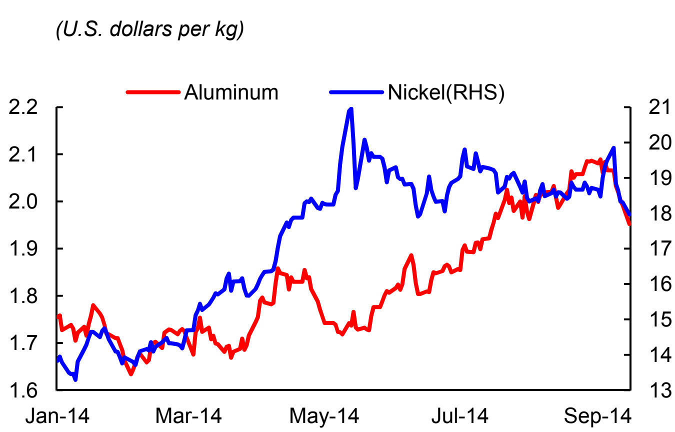


Source: Bloomberg, L.P.

Metals

Metal prices rebounded from their recent lows on expectation of tighter supplies. Nickel prices have declined from their highs but remain elevated due to Indonesia's export ban of unprocessed ores. Aluminum prices rebounded due to tightening supply conditions outside China and declining stock levels. Zinc prices also climbed due to recent and expected closure of several large mines. Copper prices remain stable despite ongoing gains in new capacity.

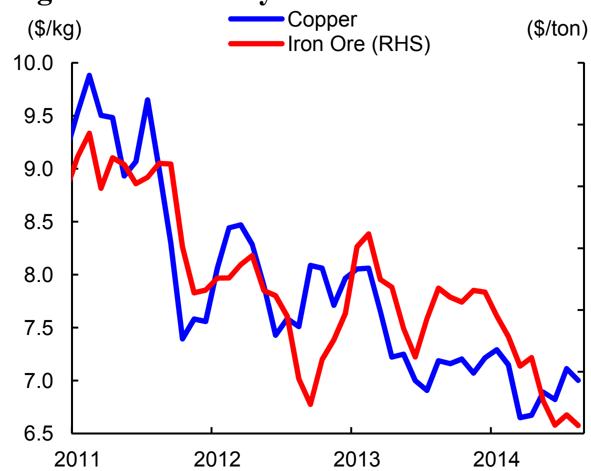
Figure 9: Daily Base Metal Prices



Source: Datastream

Iron ore prices have declined to their lowest level in 5 years due to large increases in new capacity, mainly in Australia, and further gas are expected in the next two years.

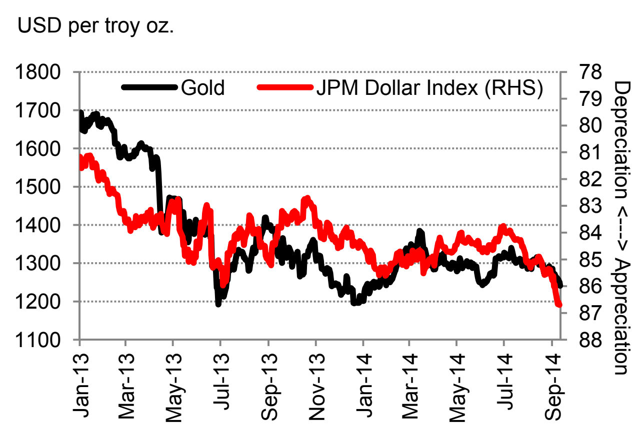
Figure 10: Monthly Base Metal Prices



Source: IMF, *Primary Commodity Price System*.

Precious metal prices, which are not currently included in the IMF commodity price indexes, have declined although palladium prices remain at an elevated level. The weakness in gold and platinum reflect concerns of monetary policy tightening and stronger dollar as shown in Figure 12.

Figure 12: Precious Metal Prices

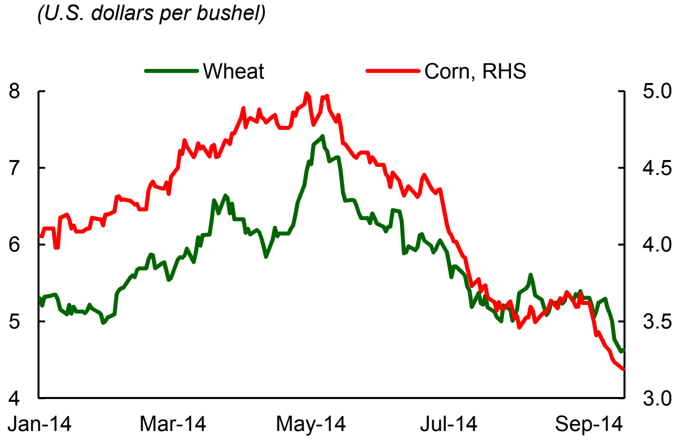


Source: Datastream

Food and Beverage

Food prices fell sharply from May as record or near-record harvests are expected for key crops. Wheat prices fell 21.3 percent since May on expectation of a record global harvest. Meanwhile corn prices fell 18.7 percent and soybean price fell 16.5 percent, on projections of record U.S. crops for both commodities.

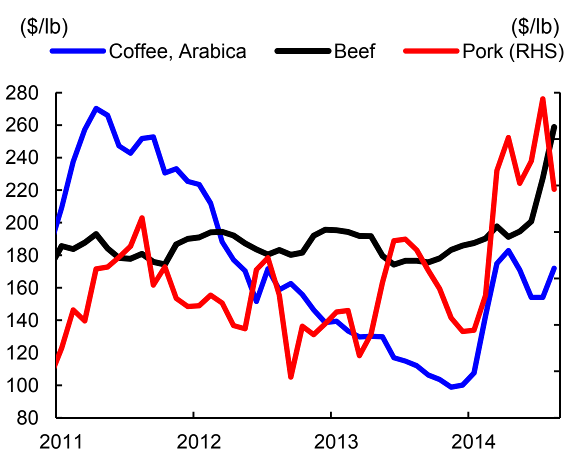
Figure 13: Grain Front-Month Futures Prices



Source: Datastream

Beverage pries increased 3.2 percent since May due to rising cocoa prices due to strong demand and as productions in Ivory Coast and Ghana are expected to be low. Both coffee and pork prices increased sharply this year due to supply problems (drought in Brazil and porcine virus in the U.S.) but have receded from their high levels reached earlier this year. Beef prices jumped by 33.1 percent since May due to strong demand and supply tightness in the U.S. The strong demand was partly due to elevated pork prices.

Figure 14: Coffee and Pork Monthly Prices



Source: IMF, *Primary Commodity Price System.*

Special Topic: U.S. Energy Boom

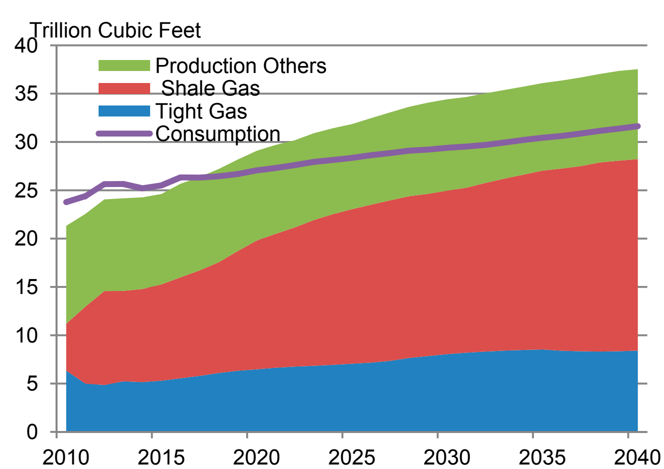
The U.S. became the largest natural gas producer in the world in 2009, and may become the largest oil producer in a few years. This is due to the so-called shale revolution which first happened in natural gas and then in tight oil. In this section, we review the development of the U.S. energy boom and its impact on the energy prices, international energy trade, and the broader economy including competitiveness and the current account.

The Shale Revolution and Energy Boom

U.S. natural gas production started to reap the benefits of the shale revolution in mid-2000s. Shale gas is natural gas trapped in shale rock, which is more difficult to extract economically. However, combining two existing technologies, hydrofracturing (also called "fracking") and directional drilling, in conjunction with higher gas prices it became economically viable to extract shale gas.

The shale gas production reduced U.S. natural gas imports and also U.S. natural gas prices. Figure 15 shows U.S. natural gas production and consumption projected by the U.S. Energy Information Administration (EIA). The EIA expects that the U.S. will become a net exporter of natural gas in 2018.

Figure 15: U.S. Natural Gas Production and Consumption



Source: EIA Annual Energy Outlook 2013, 2014.

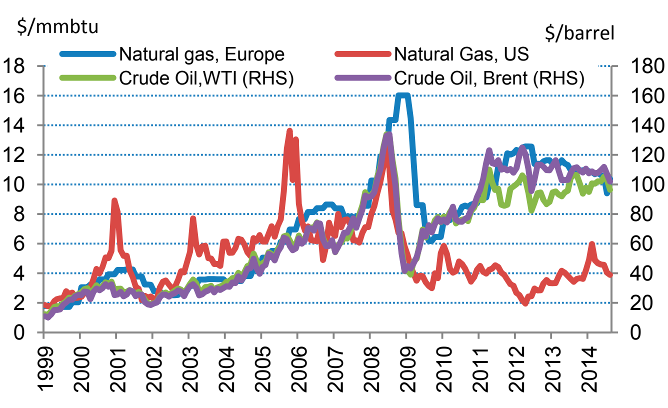
Fracking technology was also adopted in oil extraction, which has increased U.S. tight oil production. Tight oil is a light crude oil which has been extracted aggressively, particularly in North Dakota and Texas. U.S. crude oil imports have dropped dramatically as a result.

The impact on prices

In the past, international natural gas prices appeared to co-move with each other. This is partly due to the fact that the U.S., Europe and Japan all were large importers of natural gas. Because of the shale revolution, U.S. gas imports declined, and the country is expected to become a net exporter within a few years. Consequently natural gas prices in the U.S. have plunged, and the law of one price for natural gas has been dismantled as shown in Figure 16.

Natural gas prices also appeared to co-move with crude oil prices, partly because of energy substitution and also because of the market structure whereby imported natural gas prices in Europe and Asia were indexed to crude oil prices under long term contract. This relationship between natural gas and crude oil prices is changing in Europe but average prices still remain well above U.S. prices where oil price indexation does not exist.

Figure 16: Selected Energy Prices



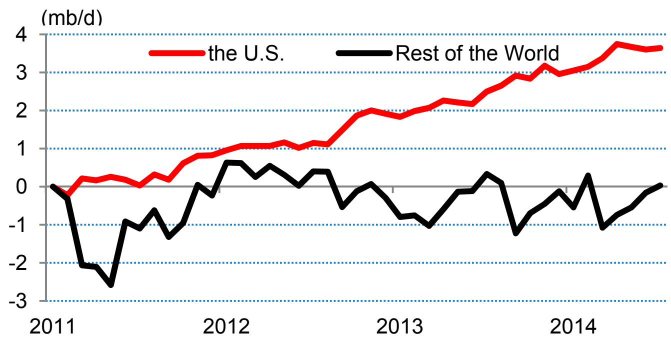
Source: IMF, *Primary Commodity Price System*.

There a few reasons for this price behavior. First, the U.S. has only a limited capacity to export its supply. The U.S cannot export natural gas to Asia or Europe where prices are much higher as the U.S. does not have a LNG export facilities except in Alaska. While pipelines exist, the network connects to Canada and Mexico only. Canada is a large natural gas producer and does not need to import in net terms though eastern part of Canada imports from the U.S. Indeed, Canada's natural gas prices have fallen to compete with the shale gas and the U.S. is still importing from there in net terms though the volume is declining sharply. Mexico also imports some U.S. natural gas, and exports are projected to keep rising. But so far, the demand is not strong enough to impact the U.S. prices. Once the U.S. exports LNG in the end of 2015, then it will help equalize natural gas prices gradually in the U.S., Europe, and Asia up to the point of processing and transportation costs.

The other reason was that energy substitution between gas and oil could not take place to re-establish a close link between the two fuels. While there is some use of compressed natural gas in vehicles, it probably needs government interventions for natural gas vehicles to become more common. Petroleum is still the dominant choice of vehicle fuel, as petroleum makes up 93 percent of energy consumption in the transportation sector while natural gas makes up only 3 percent. Thus, the slow pace of energy substitution also allowed natural gas prices to decouple from crude oil prices.

The increase in U.S. tight oil production has helped stabilize crude oil prices. While the U.S. tight oil production itself would reduce global crude oil prices *ceteris paribus,* with its record production increase, it just happened to offset production outages in a number of countries. Indeed, most of the growth in oil production since 2011 has been in the U.S as shown in Figure 17. The stability of oil prices – both WTI and Brent – has been the notable feature of the oil price behavior in the last few years.

Figure 17: Oil Production Growth Since January, 2011



(Sources) International Energy Agency

The price of WTI has been lower than Brent as shown in Figure 16 partly due to strong production of light crude in the U.S., pipeline bottlenecks moving oil to refining centres, and the effective ban on U.S. crude oil exports. In the medium-term, WTI and Brent crude prices are expected to decline due to strong production.

The impact on energy trade

Low natural gas prices in the U.S. affect domestic energy use as well as that in Europe and Asia. With declining natural gas prices, the U.S. increased the use of natural gas for electricity generation displacing coal. Surplus coal was exported and thus contributed to weaker international coal prices. In Europe, high natural gas prices made gas uncompetitive for power generation. As a result, the use of coal in Europe rose and reduced the need for natural gas, including LNG from the Middle East. It also provided European countries with bargaining power in natural gas price negotiations with Norway and Russia. In turn, it lessened Europe's demand for LNG. Before the shale revolution, the U.S. was also expected to import increasing volumes of LNG, but the shale boom negated this trend. Reduced LNG demand from the U.S. and Europe allowed Japan to secure LNG supplies when it suffered from the Fukushima nuclear disaster. Thus, the U.S. shale gas benefited not only the U.S. but also Europe and Japan, even though the U.S. cannot yet export its natural gas to these locations.

The surge in U.S. tight oil production also contributed to the reduction in U.S. oil imports (along with reduced oil demand, increased use of biofuels, and higher oil product exports). Crude oil varieties differ greatly in quality. West African crude oil is very close to the U.S. tight oil in quality, and imports from West Africa have fallen dramatically. U.S. imports of crude oil and products fell from 12.9 mb/d in 2008 to 5.5 to 9.9 mb/d in 2013. Among them, imports from sub Saharan African countries declined by 1.6 mb/d to 0.8 mb/d from 2.4 mb/d in 2008.

While the U.S. has an effective ban on crude oil exports, products (such as gasoline) can be exported. U.S. refineries benefit from lower priced WTI and cheaper priced natural gas, which is also used in refining. The U.S. became a net product exporter of refined petroleum products in 2011. U.S. net exports of refined products were 1.4 mb/d in 2013 compared to net imports of 1.4 mb/d in 2008.

Impact on the U.S. current account

Changing energy trade patterns have improved the U.S. balance of payments. The trade deficits of fossil fuels roughly halved from 2008 to 2013 as shown in Table 1. The improvement in these fossil fuels balances accounts roughly for two-thirds of the total improvement in the trade balance.

Table 1: U.S. Balance of Payments

(Billions of Dollars)	2008	2013	Change
Current Account	-686.6	-400.3	526.4
Trade Balance	-832.5	-701.7	306.3
Total Fossil Fuel	-417.1	-227.9	189.2
Crude	-341.6	-269.6	72.0
Petroleum products	-49.8	36.4	86.2
Coals and related fuels	3.9	11.0	7.1
Natural gas	-29.5	-5.7	23.9

Source: U.S. Bureau of Economic Analysis

Table 2: Impact of Unconventional Energy on the Economy

	2011	2012	2013	2014	2015	2020	2030	2040
Production (million barrels per day)								
Tight Oil	1.31	2.25	3.48	4.07	4.49	4.79	4.17	3.20
Production (trillion cubic feet)								
Shale Gas	7.94	9.72	9.35	9.63	9.96	13.33	16.92	19.82
Price (EIA's Projection)								
Brent (Per Barrel)	111.26	111.65	108.11	102.20	101.95	109.37	160.19	234.53
Henry Hub Natural Gas (Per MMBTU)	4.00	2.75	3.66	3.86	3.93	4.96	8.12	12.69
Value of Production (Billion USD)								
Tight Oil (Using Brent price)	53.4	91.9	137.1	152.0	167.3	191.2	243.7	273.6
Shale Gas (Using Henry Hub Price)	32.5	27.3	35.0	38.0	40.0	67.6	140.6	257.3
Shale Gas (Using 1/10 of Brent as its price)	90.4	111.0	103.4	100.6	103.9	149.1	277.2	475.6
GDP (Trillion USD)	15.08	15.68	16.21	16.97	17.79	21.89	32.83	51.02
Impact in terms of GDP								
Tight Oil (Using Brent as its price)	0.4%	0.6%	0.8%	0.9%	0.9%	0.9%	0.7%	0.5%
Shale Gas (Using EIA projected Price)	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.4%	0.5%
Shale Gas (Using 1/10 of Brent as its price)	0.6%	0.7%	0.6%	0.6%	0.6%	0.7%	0.8%	0.9%

Another way to evaluate the impact is to calculate the value of production from unconventional sources, as shown in Table 2. The value of tight oil production in 2013 was 137.1 billion U.S. dollars by using the Brent price. The price of WTI was significantly discounted to Brent due to rising supply in the U.S. and transportation/export constraints. However, if it were not for these constraints, then the average price U.S. refiners would have paid for imported oil would be closer to the Brent price. Shale gas production is valued at 35 billion dollars using the Henry Hub gas price. However, the U.S. would have paid more for domestic and imported gas but for the jump in shale gas production. While it is hard pin down the counterfactual price, the natural gas price (per MMBTU) would have been at least 1/10 of one barrel of Brent (e.g 10.81 dollar per MMBTU instead of 3.66 in 2013.) This is roughly what Europe is paying now for the natural gas, although Europeans also would have paid more but in the absence of for shale gas. If we evaluate natural gas prices in terms of energy, then the price in 2013 would be roughly 18 dollars per MMBTU. (Conversion factor is 1/5.8) These relative prices can be verified in Figure 16. Note that while natural gas is not exported from the U.S. to Europe, the lack of U.S. import demand makes European prices lower than they would be otherwise. Then, the value of shale gas production would equal 103 billion U.S. dollars in 2013. If we use these numbers, then the sum of impacts from tight oil and shale gas adds up to 1.4 percent of GDP in 2013.

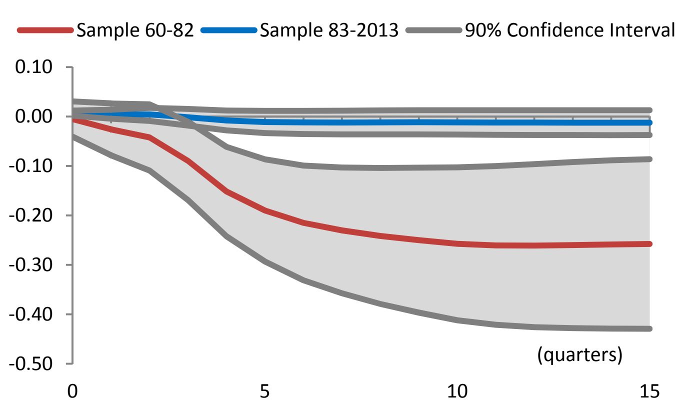
The sum of these impacts from unconventional sources stays around 1.5 percent of GDP for next 25 years or so, implying that direct growth effects on GDP from unconventional energy sources are relatively small. However, the indirect effect from the energy boom, such as low energy costs, can be greater than we are observing now. While the U.S. LNG export, which is expected to begin at the end of 2015 or early 2016, will help to equalize international natural gas prices, the cost of liquefaction, transportation, and gasification, widens the gap between LNG-importing countries and the U.S., while the gap between international crude oil prices would probably not last so long.

Impact on Competiveness

While direct impact on growth from unconventional energy production will be probably small in the future, energy prices have their broad impact on the global economy. Indeed, the impact on the economy from the energy boom should be analyzed through the energy price channel in addition to its direct impact.

In the literature on energy, the U.S. GDP growth rate and crude oil prices have been the center of attention. We estimate a typical bivariate VAR using crude oil prices and GDP growth. Impulse response functions of GDP to a one-unit crude oil price shock show that a 10-percent increase in crude oil prices reduce the growth rate by 2.6 percent in using the sample from 1960-1982, while using the sample from 1983 to 2013 it basically does not affect the growth rate. This result is in line with the literature and a few explanations have been provided. For example, Blanchard and Gali claim that this is due to better macroeconomic policy while Killian explains that supply-driven oil price shocks dampen growth more than demand-driven oil price shocks. Hamilton emphasizes the role of nonlinearity in oil shocks.

Figure 18: IRF (Real GDP to Oil Price Shock)



(note) Bivariate VAR of GDP and oil prices (first log difference, quarterly). Figures shows cumulative orthogonal impulse response function to a unit shock. 4 lags

We would like to propose an additional explanation, which is not mutually exclusive to existing explanations. That is the emerging role of natural gas price shocks. As explained, natural gas prices moved together with crude oil prices. Thus, oil prices provide proxies for natural gas prices. However, natural gas prices in the U.S. have decoupled from crude oil prices in the last couple of years. To the extent that the U.S. economy relies on natural gas, the different movements between natural gas and crude oil prices would add more noise, which reduces statistical significance.

The problem with defining the role of natural gas is that there are relatively short periods where natural gas and oil prices moved differently in the U.S. The periods after 2006 are also affected by the global financial crisis. However, if one can take oil price shocks and financial crisis shocks as common shocks to Euro area and the U.S affecting the two economies in a similar way, then one can evaluate the role of natural gas in relative terms. More explicitly, assume that

$$y_t^i = a(L)\, y_t^i + b(L)\, w_t + c(L)\, g_t^i + \varepsilon_t^i$$

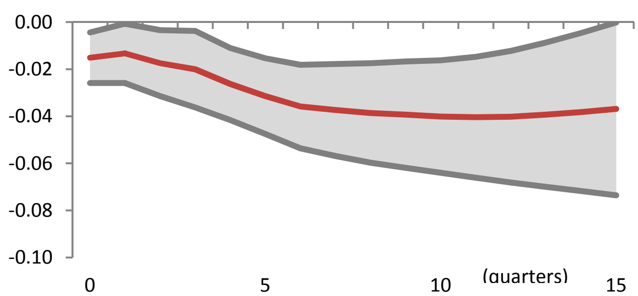
for country *i*, which is either the U.S. or Euro Area. w_t denotes global conditions such as oil prices and financial conditions. g_t^i denotes natural gas prices in country *i* denominated in a common unit. Then, we can estimate relative variables, in the following specification:

$$y_t^R = a(L)\, y_t^R + c(L)\, g_t^R + \varepsilon_t^R$$

without much worrying about the global conditions where variables with superscript *r* indicate the difference between countries *i* and *j*. Since global conditions can affect countries in a different way, countries should be chosen so that the effect of global shocks on the economy is similar so that *b(L)* terms are not significantly different between countries *i* and *j*. Here, Euro area and the U.S. are relatively similar in terms of size, development, dependency on oil, structure of asset markets, and so on.

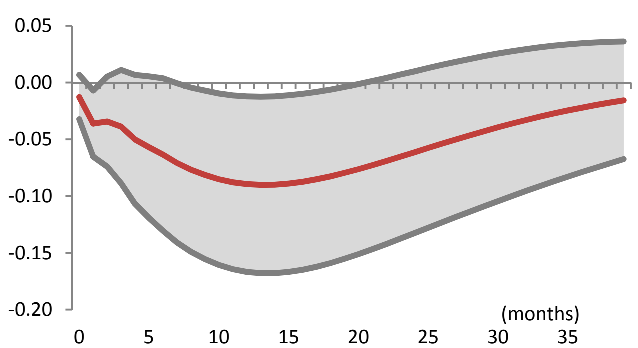
Using the sample from 2006, we find that relative GDP will decline 0.3 percent in response to a 10 percent relative gas price shock while relative industrial production will decline 1 percent. While the impact on GDP is smaller than that of the oil price shocks before 1982, they are statistically significant. The effects on the industrial sector are not negligible. This implies that the U.S. will probably benefit from relatively low energy costs for a relatively long time. This is because the cost of liquefaction and so on will leave the price gap between the U.S. and other advanced countries importing natural gas.

Figure 19: IRF (Relative GDP to Relative Natural Gas Price Shock)



(note) Bivariate VAR of relative GDP and relative natural gas prices (log difference). Figure shows the orthogonal impulse response function to a unit shock. 4 lags

Figure 20: IRF (Relative IP to Relative Natural Gas Price Shock)



(note) Bivariate VAR of relative industrial production and relative natural gas prices (log difference). Figure shows the orthogonal impulse response function to a unit shock. 4 lags.