The "Shale Gale": What It Is and How It Will Reduce the U.S. Trade Deficit and Make Some American Companies More Competitive In World Markets.

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Abstract

Linear changes in the environment, based on observable trends, are obviously easier to anticipate than non-linear events. A non-linear change is taking place with respect to U.S. domestic energy production. This change, resulting from employment of a new technology for extraction of petroleum and natural gas, has the potential to dramatically reduce the U.S. Trade Deficit, increase domestic employment, and make American companies heavily dependent on energy or on hydrocarbons for raw material more competitive on the world stage. This is an information paper describing that change.

Key Words: Trade Deficit, Energy, Competitiveness, Technology, Petroleum, Energy Independence, Shale, Non-linear Events.

Introduction

1. Linear changes in the environment, based on observable trends, are obviously easier to anticipate than non-linear events. A non-linear change is taking place with respect to U.S. domestic energy production. This change, resulting from employment of a new technology for extraction of petroleum and natural gas, has the potential to dramatically reduce the U.S. Trade Deficit, increase domestic employment, and make American companies heavily dependent on energy or on hydrocarbons for raw material more competitive on the world stage. This is an information paper describing that change.

1.1. Non-linear events come in all shapes and sizes. Their impact can be severe or trivial. The OPEC oil embargo in 1973 was clearly a non-linear event. Auto producers and consumers were taken by surprise. The price for gasoline jumped from approximately thirty cents a gallon to over a dollar, and then went higher. Auto advertising stretched the truth a little (one manufacturer promoted a days-long an economy run across the desert by one of its sedans) to tell potential buyers that their particular models were really quite economical. Consumers scrambled to unload large "gas-guzzling" autos and buy smaller ones. The term "Peak Oil", introduced by M. King Hubert, came into vogue. According to this concept, which featured a graph sometimes called Hubert's pimple, oil production – for the entire planet or for an individual country – could be represented by a curve rising to a peak and then inexorable declining to zero. For almost four decades a declining trend in production, corresponding to the back side of Hubert's pimple, has been our guide for thinking about the future of oil production in the United States.

1.2. Recognizing that abundant energy is the foundation for an advanced economy, five years ago the authors prepared a paper summarizing the situation of the United States at that time with respect to energy needs and supplies. Although not hopeless, the situation appeared grim. A nation dependent on its power grid for manufacturing, commerce, and personal health and comfort, had built no new generating plants, nuclear or conventional, in twenty five years. Although many nations around the world were making heavy use of coal for electricity generation and the U.S. possessed an ample supply of coal for that purpose, continued use of coal was threatened by concern over generation of carbon dioxide and a widely held fear of anthropologic global warming. Construction of nuclear power plants was held back by fear of radiation and catastrophe. Alternative, more unconventional sources of electricity, primarily wind generators and arrays of solar collectors, were costly and heavily dependent on taxpayer subsidies for viability. The nation's transportation network depended heavily – as it still does– on gasoline and diesel fuel refined from petroleum.

1.3. The Political-Legal environment is shaped by the Socio-Cultural environment: what people believe to be desirable and permissible feeds over into the arena where laws are enacted and regulations promulgated that determine what resources may be used and which may not. Although rich petroleum sources existed, federal restrictions had put the two most promising U.S. sources of conventionally-extracted petroleum – the small area in Alaska Congress set aside for exploration when it established the Arctic National Wildlife Refuge (ANWR) and the U. S. continental shelf – off limits. The nation's view of the future of petroleum was one of continued dependence on imports and vulnerability to events in an increasingly unstable Middle East.

Energy Supply and Demand

2. In the economic sense, it could be argued that there has never been an energy shortage. In a free market, the price mechanism is expected clear the market - equating the quantity demanded and the quantity supplied. Newspaper writers and others sometimes view increasing quantities of petroleum purchased in the marketplace year to year as "demand" and maintain that demand has grown inexorably. Demand however, is a schedule of quantities that will be purchased at various prices. While long run demand in the United States has proven to be more elastic in the long run than in the short run, world demand grows stronger, as countries such as India and China industrialize and their consumers purchase automobiles and other energy-consuming accouterments of a modern economy. Consequently a rightward shifting global demand curve pushes against an up-sloping supply curve, driving energy prices higher.

2.1. China, for example, is the world's fourth largest oil producer, pumping more oil than Iran, Canada, or Mexico, but demand is exploding there. Annual sales of automobiles are expected to reach 17 million vehicles by 2015, making China the world's largest auto market. In less than two decades, China has gone from a position of self sufficiency to importing fifty percent of its petroleum. The Persian Gulf Region was believed until recently to hold over half of the world's proven oil reserves and has tremendous reserves of natural gas, but these resources see increased demand from internal industrial development projects fed by petro-dollars. Only six years ago a prediction was made that unless new reserves were located, substitutes for petroleum must be found or the world could easily go to war for energy (Seager), 2007).

2.3. In the United States, energy use per dollar of economic output has been decreasing since 1970. We use less energy because energy costs money. The free market's constant search for efficiencies has made us stretch every BTU further (Prendergast, 2001). With respect to automobile fuel consumption, federal Corporate Average Fuel Economy (CAFE) standards have forced manufacturers to build more fuel efficient vehicles. We should not forget that these mandates have secondary costs, first in complexity and resultant higher costs to consumers for purchase and repair, and second, a toll in lives and suffering. One study estimated the cost in lives at some two thousand per year (Coon, 2001). Although safety features in autos have improved the safety of small cars " … the bad news is that small and minicars as a class still have higher fatality rates per million registered vehicles than most larger vehicles" (White, 2008). CAFÉ standards also increase the incentive to put more ethanol into auto fuels because of a loophole in these standards encouraging the use of a renewable fuel credit.

The Dynamics of Energy Have Changed

3. An old adage of the market reads this way: The cure for low prices is low prices and the cure for high prices is high prices. What does this mean? From the producer's point of view, it means that in a free market, low prices lead to lower levels of production for the good in question. This eventually leads to tighter supplies and rising prices. From the consumer's point of view, high prices provide incentives to bring forth greater supplies – and possibly lower prices. Unhampered by excessive rules and barriers erected by governments, the system works – sometimes not smoothly – but it works. In this case high petroleum prices have stimulated interest in a new production technique – extraction of oil from "tight" shale formations.

The Advent of Hydraulic Fracturing

4. Only five years ago it appeared that the only way to increase the domestic supply of petroleum would be to ease drilling restrictions on the continental shelf and open the area previously set aside by Congress for exploration on the coastal plain at the northern edge of ANWR. However, neither of those happened. Something else happened however – an entrepreneurial response to high oil prices using rapidly developing technology - hydraulic fracturing or "Fracking".

4.1. In this technique, which is often combined with horizontal drilling, oil or gas is extracted from shale rock by pumping a mixture of sand, water, and chemicals into the rock at high pressure. This development has brought about a non-linear event in the arena of energy supplies, the first since 1973. Thanks to this new technology, the U.S., a nation that thought itself doomed to a future of increasing dependence on imported petroleum, has suddenly seen petroleum production within its borders increase significantly. The declining tail of "Hubert's Pimple" has turned upward. Eventually we would expect these new sources of petroleum (and natural gas) to eventually peak and decline also. That would be the case with any extraction of natural resources using a given technology. However new technology has pushed that new peak decades into the future.

4.2. As recently as five years ago, geologists looked for drilling "plays" that could turn into "Oil Fields" – structural traps where liquid oil accumulated. Typically there was a defined water contact toward the bottom of the oil reservoir. Today, the sought-after drilling locations tend to be extensive rock formations of low permeability that require hydraulic fracturing so the oil can drain out. Examples include the Barnett Shale and Eagle Ford formations in Texas, the Bakken formation in North Dakota, and the Marcellus formation in the Eastern U.S. (Lots to Discuss, 2013).

4.3. Hardly anyone saw what has been termed the "shale gale" coming. Its impact is only now being recognized. The Independent Energy Agency, an autonomous agency established in November 1974, (Its members include the United States, the United Kingdom, Germany, France, and Canada) indicated in its 2012 World Energy Outlook that by 2018 North America will provide 40 percent of new supplies through the development of tight oil and oil sands. Production from OPEC exporting countries will slip to 30 percent.

4.4. The agency goes on to say that an unexpected steep rise in U.S. shale oil reserves will change the global balance of power between existing producers and new producers. According to IEA executive director Maria van der Hoeven "North America has set off a supply shock that is sending ripples throughout the world" (Holmes, 2013) (World, 2012).

The head of British Petroleum was quoted as saying that the rise in U.S. oil production, largely due to shale oil, will make the United States "… completely independent of imported oil, probably by 2030". Interestingly, Lord Brown went on to say that that the amount of shale natural gas in the United States is "effectively infinite" (Smale, 2012). As a symptom of abundance, oil storage backlogs above ground have become a concern for many companies because there are not enough pipelines to get crude supplies to the market.(Carter, 2013).

Energy for Transportation

5. The nation's most difficult energy problem has been fuel for transportation. It has been almost totally reliant on gasoline, diesel fuel, and jet fuel from petroleum. All three can be made from coal by the Fischer-Tropsch process invented in Germany in the 1920s, which uses heat, pressure, and catalysts to transform carbon monoxide and hydrogen into liquid fuels, but the process is costly. As a result, the nation has depended on imported petroleum to help fuel its transportation infrastructure. Shale oil shows promise of ending that import dependency, but an even more significant development may be on the horizon – natural gas from shale.

5.1. When one of the authors was driving cross country in July 2012, he pulled into a truck stop in Oklahoma City and was surprised to find on one of the pump islands a device to dispense compressed natural gas to vehicles equipped to use it. While gasoline was well over three dollars a gallon, a sign on this device indicated that the gasoline gallon equivalent price was $1.59. In mid 2013 the price differential between natural gas and diesel fuel was $1.75. Cost savings like this do not go unnoticed. T. Boone Pickens' Clean Energy Fuels, Royal Dutch Shell, and China's private ENN Group are moving to build natural gas fueling stations along U.S. highways. In late 2013, Cummins-Westport Inc will begin selling a 12-liter natural gas engine to power the biggest trucks on the road (Groom, 2013). Waste Management, the nation's largest waste recycler, already owns 1,700 natural gas trucks and has stated that 80 percent of the new trucks it buys will run on natural gas. Annual savings will run in the millions. Dozens of other companies, including Wal-Mart, Coca-Cola, and UPS are making the switch. Caterpillar is producing mining vehicles that run on natural gas. Warren Buffett recently announced that the Burlington Northern Santa Fe Railroad (BNSF – owned by Berkshire Hathaway) will be testing Caterpillar-EMD and GE-made locomotives using liquefied natural gas for performance and reliability. "The process is real enough, so we're spending real money." Buffett continued, "When you look where oil is… you've got to look at converting any kind of an engine to natural gas" (Jenkens, 2013).

5.2. Presently about one percent of the vehicles in the world run on natural gas. In the U.S. the proportion is five hundredths of a percent. If the U.S. did nothing but catch up with the rest of the world, the number of natural gas vehicles would increase by twenty times. With an abundance of natural gas however, it appears that the shift will be much greater. One authority has stated that "The majority of the nation's 18-wheeler truck fleets will be fueled by natural gas in seven years" (Curzio, 2013).

Producing Natural Gas for the Market

6. There are two kinds of natural gas, "dry" and "wet". Dry gas occurs in the absence of condensate or liquid hydrocarbons, or has had condensable hydrocarbons removed. Dry gas is essentially Methane and not much else. Wet gas (such as that extracted from Marcellus Shale in southwestern Pennsylvania), in addition to methane, contains compounds like ethane and butane. These "liquid natural gasses" –can be separated and sold separately.

6.1. Increased domestic gas production has driven down the price for which drillers can sell their products. To increase profit, they are turning their attention to wet shale plays, where they can extract ethane and other LNGs in addition to dry gas. The revenue generated from LNG sales helps offset the low price of natural gas (Schlumberger (gas)) (Pennsylvania State Impact). Economic reality is reflected in a recent shift of the U.S. drilling rig fleet away from dry natural gas to oil and wet natural gas, which indicates that the production of oil and other liquids will continue to climb. Data indicate that many rigs with horizontal-drilling capabilities are being redeployed from plays rich in dry natural gas to those that can produce crude and other liquids, because these have greater value under current market conditions. Horizontal drilling, associated with tight formations, is increasing. In February 2011, 45 percent of the on-shore rig fleet was drilling horizontal wells. By September 2012 that figure had increased to 58 percent, illustrating the rapidity with which the market system can bring about change in response to price incentives (Petroleum, October 2012).

Needs Versus Reserves: Where Do We Stand?

7. The level of U.S. oil imports is both hotly debated and loosely defined. Discrepancies arise chiefly because it is imported primarily as crude but consumed as refined products. However defined, it has experienced a dramatic decline since it peaked in 2005. By the broadest measure – Net oil imports (crude and products) as a share of total demand – U.S. dependence on imports fell from 60.3 percent in 2005 to 49.3 percent in 2010. There was a further decline by 2012, when, according to the U.S. Energy Information Administration, in an update issued May 10, 2013 net imports had dropped to approximately 40 percent of U.S. consumption (Energy in Brief, 2013). Slightly over half of these imports come from the Western Hemisphere. Note: The U.S. was third in crude oil production in 2012.

Astonishing Possible Reduction of the U.S. Trade Deficit

8. During 2012 the U.S. consumed 18.6 million barrels per day (MBD) of petroleum products. Because there is an expansion of crude during the refining process, liquid fuel is captured in the processing of natural gas, and some small amount of biofuels are entered into the equation, to this figure can be added 4.8MBD, for a total of 11.3 MBD from domestic sources. The U.S. imported 11.0 MBD of crude oil and refined petroleum products in 2012 and exported 3.2 MBD of crude and petroleum products. Net imports then were 7.4 MBD. (7.4 / 18.6 = .3978 or about forty percent) (Schlumberger) (Energy in Brief, May 2013).

8.1. Although environmental concerns, delayed permits, and regulations have held up construction of new refineries, and unprofitable refineries on the East Coast have had to close, those on the Gulf Coast have been expanded and upgraded to the point that U.S. exports of refined products have increased. Much as Chinese manufacturers are able to produce many goods using cheap labor and cheap materials and undersell potential U.S. manufacturers, U.S. refiners also have two advantages over foreign refiners: Cheap, abundant natural gas and relatively cheap oil. Natural gas is a key ingredient in this mix as a fuel to operate refineries. Midwest and Gulf Coast refineries are built to handle cheaper West Texas Crude and can process the shale oil coming out of Texas and North Dakota (Philips, 2012). It is clear that completion of the Keystone Pipeline, taking heavy crude to these Gulf Coast refineries, would add to the supply available to these Gulf Coast refineries and add to the potential to further reduce the U.S. trade deficit. If the Keystone pipeline is not completed, the Canadians have made it clear they will build a pipeline to their West Coast and sell the crude directly to petroleum-hungry China (Stafford, 2013).

8.2. It is unknown how much crude production will expand from tight oil but even if we assumed no expansion, it would be interesting to speculate as to how much natural gas might fill the gap. How much natural gas does the nation possess? M. King Hubbert estimated in 1956 that total gas resources were 850 trillion cubic feet (TCF). In 1978 he increased his estimate to 1,100 TCF. By the end of 2012 however, the nation had produced and marketed almost 1,200 TCF (Maley, 2013).

8.3. The U.S. presently produces and consumes about 25 TCF annually. Proved reserves typically stay about a dozen years ahead of current production. The Potential Gas Committee released its biennial assessment of the resource potential of the U.S. on April 9, 2013 and concluded that the nation has undiscovered, technically recoverable resources sufficient to replenish reserves at the current rate of production for approximately 100 years. If we assume that the combination of exports and domestic usage of natural gas were to double from present levels that would still be a half century.

8.4. For a rough calculation, let us assume that natural gas production might double from current levels - about 25 TCF annually - and that this larger output of some 50 TCF would cover current usage levels and leave another 25 TCF to replace imported oil. At a barrel of oil equivalent (BOE) of 5,430 cubic feet of natural gas per barrel of oil (What is a barrel of oil equivalent, 2011) this added natural gas produced would be the equivalent of and theoretically could replace 4,604,000,000 barrels of oil each year for transportation and other uses.

8.5. Figures cited above indicate that the U.S. has net imports of 7.4 million barrels per day. If we multiply this by 360 days in a year we come up with a figure of 2,664,000,000 barrels of oil imported per year. At 5,430 BOE, it would take only 57 percent of the leftover natural gas production postulated above (the extra 25 TCF beyond current domestic usage) to replace all oil currently imported, theoretically eliminating the need for any petroleum imports at all.

8.6. Assuming an approximate cost of $100 per barrel, reduction of imports from 2,664,000,000 MBD per year to zero would result in a foreign exchange saving that could reduce the U.S. trade deficit by approximately $266 billion dollars per year. The trade deficit, as of this writing, was running at an annual rate of approximately $500 billion per year (Crutsinger, 2013). The U/S. trade deficit could be cut by more than half.

8.7. These are very rough approximations – and it appears unlikely that all present uses of petroleum would be replaced by natural gas - but they illustrate the potential of increased production of natural gas to reduce reliance on oil imports and improve the foreign trade balance.

How Abundant Natural Gas Works in Favor of American Industrial Employment.

9. Projections for increased employment from development of the natural gas industry exist not only in the industry itself – concerned with extraction, transportation, storage, and processing - but for other industries as well. While cleaner air and energy self-reliance are worthy goals in themselves, one source predicts that expanding use of natural gas for power generation, transportation and industrial purposes means that over the next 25 years, shale gas development will create one million additional American jobs. Ripple effects will extend far beyond the natural gas industry to others ranging from steel pipes to plastic bags. (Hopper) (Sherman)

9.1. Cheaper natural gas works to the competitive advantage of a variety of industries – both those that use gas as a feedstock and energy-intensive industries that use it as an energy source. For example, in the area of feedstocks, plunging prices have turned the U.S. into one of the most profitable places in the world to make chemicals and fertilizer, Further, they have drastically reduced costs for makers of energy-intensive products such as aluminum, steel and glass. (Casselman)

9.2. It was reported in November 2013 that Asia's largest chemical producer, Formosa Plastics Group, was seeking permits to make a two billion dollar expansion of its existing Texas operations. Vice Chairman Susan Wang, said in an interview in Washington that "Because of shale gas, the cost of making petrochemical and plastic-related products is becoming very competitive here in the United States.. "It's probably as cost effective as in the Middle East." (Wingfield)

How Will These Developments Play Out? We Do Not Know.

10. Can we forecast a golden age of energy independence and industrial expansion? Of course not. Forecasts are almost always wrong. In Peter Drucker's words:

"Trying to predict the future is like trying to drive down a country road at night with no lights while looking out the back window."

Looking back only five years, can we tell ourselves that the conventional wisdom of that time pointed inexorably to the reality of now? Of course not. And what may look fairly obvious today, for five years hence, assuredly may not come to pass. Successful terrorist attacks on key Gulf Coast refineries could occur. Or optimistic projections for production of tight oil or natural gas might not materialize – although with new resources announced at a steady clip this seems unlikely. Or other non-linear events could impact the situation.

What is clear is this: A significant non-linear event is occurring at this moment in the energy arena. Its positive implications for energy independence, the U.S. balance of trade, and U.S. employment are staggering.

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