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Unconventional wisdom: an economic analysis of US shale gas and implications for the EU

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INTRODUCTION: CONTEXT, OBJECTIVES, LIMITATIONS AND FINDINGS OF THE STUDY

The recent rapid growth in the production of unconventional oil and gas (shale gas and tight oil) in the US has profoundly changed the US energy market. It has also had global implications, in particular a significant divergence of natural gas prices between the US and major economic trading partners, such as the EU, Japan and China.

In the EU, the US unconventional oil and gas revolution has created concerns about the competitiveness of European industry, and led to calls for a revision of EU climate and energy policy. The exploitation of shale gas in the EU is proposed as a way to rebalance climate and energy policy in order to favour economic competitiveness. Simultaneously, it is suggested that less emphasis should be given to carbon pricing, energy efficiency and renewable energy policies, as wider use of gas would be a cheaper avenue to deliver greenhouse gas emissions reductions.

This paper assesses the energy sector and economic impacts of the unconventional oil and gas revolution in the US. It then addresses the potential for the EU to replicate the US experience.

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KEY MESSAGES

- **Despite very low and ultimately unsustainable short-term prices of natural gas, the unconventional oil and gas revolution has had a minimal impact on the US macro-economy.** We provide an upper estimate of its long-term effect on the level of US GDP (not its long-term annual growth rate) at about 0.84% between 2012 and 2035. Compared to an annual growth rate of 1.4%, this long-term increase of 0.84% in the level of US GDP is small. We also provide an upper estimate of the short-term stimulus effects of the unconventional oil and gas revolution at 0.88% of GDP during the 2007-2008 to 2012 downturn. This is an "optimistic" estimate: we assume that all extra revenue from lower gas prices and increased activity in oil and gas production is spent and not saved, and we assume an optimistic multiplier of 1.5. Relaxing these assumptions would reduce this estimate.
- **The unconventional oil and gas revolution has had a minimal impact on US manufacturing.** Its impacts are confined to gas-intensive sectors, which we calculate as making up about 1.2% of US GDP. Net exports have increased in these gas-intensive sectors from 10.5 billion USD in 2006 to 27.2 billion USD in 2012. This compares to a US manufacturing trade deficit of 779.4 billion USD in 2012, up from 662.2 billion USD in 2006. There is thus no evidence that shale gas is driving an overall manufacturing renaissance in the US. Nonetheless, the shale gas revolution will likely lead to a competitive advantage for the US

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in basic petrochemicals, but not in the chemicals sector has a whole.

- **Absent further policies, the US shale revolution will not lead to a significant, sustained decarbonisation of the US energy mix nor will it assure US energy security.** A reference scenario based on current policies sees US emissions stagnant at current levels out to 2040, clearly insufficient for a reasonable US contribution to global climate change mitigation. Oil imports continue to rise in monetary terms. While it can promote some coal to gas switching in the short-term if additional policies are enacted, there is also the risk that the unconventional oil and gas revolution further locks the US into an energy- and emissions-intensive capital stock.
- **It is unlikely that the EU will repeat the US experience in terms of the scale of unconventional oil and gas production.** Uncertainty exists around the exact size of exploitable EU shale gas reserves. Nevertheless, a median scenario would see the EU producing several tens of billions of cubic meters (bcm) of shale gas by 2030-2035, or about 3-10% of EU gas demand. The EU's fossil fuel import dependency will therefore continue to increase and its fossil fuel prices will remain largely determined by international markets. Shale production would not have significant macroeconomic or competitiveness impacts for Europe in the period to 2030-2035. To solve its energy, climate and manufacturing competitiveness challenges, the EU thus needs a broad strategy of energy efficiency, innovation, low carbon energy sources, and a stronger internal market. Shale gas could potentially be a complement to this for some countries heavily dependent on coal or Russian gas, but it is certainly not a substitute for the current strategic orientations of EU energy policy.

ENERGY SECTOR IMPACTS OF UNCONVENTIONAL OIL AND GAS IN THE US

Between 2005 and 2013, US production of natural gas increased by 33% from 18.05 to 24.00 trillion cubic feet (tcf) per year. Most of this was due to production of shale gas, which increased by more than 1000%, from 0.75 to 8.5 tcf. Over the same period, US production of liquid fuels increased by 52%, and the contribution from tight oil increased by more than 1000% from 0.29 million barrels/day (mb/d) to 3.48 mb/d. By any standards, this is a dramatic change in US energy markets.

As a result, the US has been able to reduce its dependence on imported fuels. However, a fall in demand has made the largest contribution to narrowing the US energy trade deficit. This has been driven by the recession, improved energy efficiency standards and changed consumer behaviour in particular in response to higher global oil prices.

The unconventional oil and gas revolution has had an uneven impact on consumer prices. Gas prices for residential consumers have fallen somewhat from a peak pre-2008, while industrial and power sector gas prices fell by about 50% from 2008 peaks. Residential electricity prices have continued to rise, while industrial electricity prices have risen albeit at a lower rate. For households, the effects of the unconventional oil and gas revolution have been largely outweighed by continued rises in electricity and in particular gasoline prices (Table 1). Indeed, the inefficiency of transport and residential energy consumption is rather a drag on US consumer spending.

Table 1. Average household energy expenditure 2005-2012

	2012 expenditure (USD)	2012 expenditure vs 2005 (USD)	2012 expenditure as a share of 2012 post-tax income (%)	2005-2012 change as a share of 2012 post-tax income (%)
Natural gas	359	-150	0.57	-0.24
Electricity	1,388	122	2.19	0.19
Fuel oil and other fuels for heating	137	-1	0.22	0.00
Gasoline and motor oil	2,756	529	4.35	0.83

Source: US Census Bureau, 2012, Consumer Expenditure Survey.

The dramatic decline of US natural gas prices does not appear sustainable in the longer term. Prices fell to their lowest point of 1.95 USD/Mbtu at the beginning of 2012, before climbing to 4.69 USD/Mbtu in January 2014. This price collapse was due to a number of short-term factors: limits on export capacities, limited elasticity of natural gas consumption in the residential, industry and electricity sectors, and the production of highly valuable liquid fuels associated with natural gas production. Longer-term expectations of production costs for shale are situated closer to 6-10 USD/Mbtu.

OUTLOOK FOR THE US ENERGY SECTOR

The study examines a broad range of scenarios for US oil and gas production, energy demand and prices, policy and economic conditions. It is

likely that the US will become a net gas exporter around the end of this decade, subject to political approval of export infrastructure. This would lead to some price convergence over time between US and regional gas prices. The scenarios suggest that the US will remain a significant importer of crude oil well into the foreseeable future. Climate and energy policies to improve the efficiency of the transport sector will therefore be crucial for reducing US crude imports and costs to US motorists.

The scenarios examined do not suggest that the US shale revolution will lead to a significant decarbonisation of the US energy sector. Indeed, historical data shows that the recent decline in the share of US coal-fired electricity was due to the cyclical drop in natural gas prices. Absent further policy, the shale revolution will be insufficient on its own to drive coal out of the US power fleet or decarbonise the US energy sector.

MACROECONOMIC IMPACTS OF THE UNCONVENTIONAL OIL AND GAS REVOLUTION

The macroeconomic impacts of the unconventional oil and gas revolution can be divided into three channels.

Firstly, the impact on productivity and GDP of lower gas prices. Cheaper gas prices, particularly for household consumers, free up resources for spending on other goods and services and hence increase the level of GDP. We provide an upper estimate this long run effect on the *level* of US GDP to be in the order of 0.575% GDP over the period 2012-2035. Compared to an annual real growth *rate* of 1.4%, this impact on the long-run level of GDP is not large.

Secondly, the improvement in the US trade balance due to decreased oil imports. Increased production of oil and gas has lowered US imports, albeit not as significantly as demand reduction and to a lesser extent improved efficiency. Essentially this means that the oil producer profits have been transferred from non-US oil exporters to US oil producers and thereby into the US economy. Assuming a long run marginal production cost of around 70-80 USD/barrel for light tight oil and a long run oil price of 114 USD/barrel, we estimate that the maximum long run GDP effects of reduced oil imports would be equivalent to a about a 0.26% increase in the level of GDP in the period to 2035. This may be offset slightly, but not entirely, by a small increase in the exchange rate and other crowding out effects in US capital and labour markets. As with the point above, this is a long-term increase in the level of GDP, not the growth rate. As discussed further below, we do not see a significant positive impact on the US manufacturing deficit in aggregate.

Thirdly, a stimulus effect due to the recessionary circumstances in which the unconventional oil and gas revolution took place. The US economy was not and is not at full employment of labour and capital. Thus the extra income freed up thanks to lower gas prices and extra investment in the oil and gas sector will have a demand multiplier in the short-term. We estimate this short-term stimulus of lower gas bills and increased investment and employment in the oil and gas sector at 0.4% of GDP and 0.48% of GDP, respectively over the period 2008-2012.

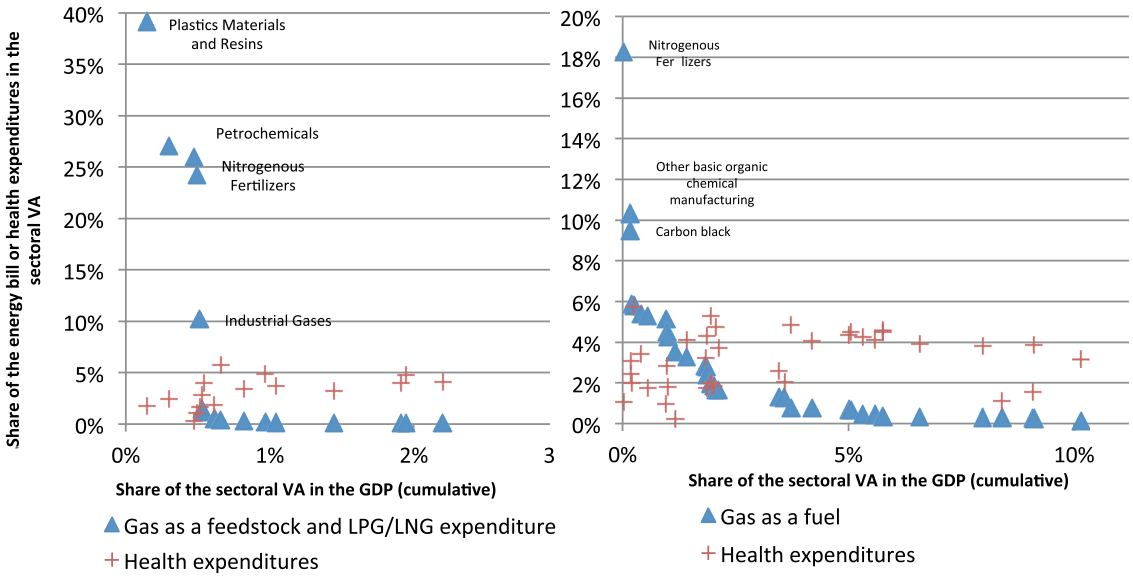
IMPACT ON MANUFACTURING COMPETITIVENESS

Figure 1 shows the share of gas as a feedstock and fuel in value added in gas consuming manufacturing subsectors. This is compared with the share of expenditure on employer-sponsored health insurance in order to give a point of comparison. Natural gas is an important input as a feedstock and fuel to a small number of manufacturing subsectors, particularly the petrochemical sector. However, these sectors make up a relatively small share of the US manufacturing sector, and only about 1.2% of US GDP. To the extent they are trade intensive, these sectors will enjoy a competitive advantage relative to competitors thanks to lower gas prices. However, there is no evidence that the shale gas revolution will contribute to a "reindustrialization" in the US at the level of the manufacturing sector as a whole. Net exports have increased in these gas-intensive sectors from 10.5 billion USD in 2006 to 27.2 billion USD in 2012. This compares to a US manufacturing trade deficit of 779.4 billion USD in 2012, up from 662.2 billion USD in 2006.

IMPLICATIONS FOR EU ENERGY AND CLIMATE POLICY

The above analysis suggests that even for the US, the unconventional oil and gas revolution has not been a panacea for the US economy, manufacturing competitiveness and household purchasing power, nor for its long term energy and climate policy aims. Nonetheless, many ask whether the EU could repeat the US experience in shale gas production, with a view to improving the competitiveness of EU manufacturing and reducing energy bills for households.

Figure 1. Gas and health care expenditures in the manufacturing sectors (2010)



Source: EIA, 2013a, Net Generation by Fuel Type, Natural Gas Electric Power Prices.

There are a number of reasons to suggest that the EU will not reproduce the scale of the US shale gas revolution. It is often overlooked, but the US shale revolution came after several decades of geological exploration which scaled up massively in the years preceding the boom. Between 2000 and 2010 the US drilled a total of 17,268 exploratory natural gas wells, at an average of 130 per month. Exploration in the EU is in its infancy, with about 50 wells drilled. The EU service industry is also significantly smaller, less experienced and less equipped than is the case in the US. The US natural gas drilling fleet an averaged 1087 active rigs between 2005-2012.[1] This compares to the December 2013 natural gas rig count for Europe of 32. Exploration and scaling up the EU service industry would take time, and in the meantime would pose a cost and scale constrain on production. Other factors, like more difficult conditions for land access, more stringent environmental regulations, and significant local opposition will also slow down EU shale development.

For these reasons and based on the literature review conducted for this paper, a median scenario would see the EU producing in the order of several tens of bcm of shale gas by 2030-2035. This would equate to about 3-10% of projected demand. The most optimistic scenarios would see EU gas import dependency roughly stabilised at current levels. The EU would remain a significant importer of gas and certainly of oil. EU prices would therefore depend on international prices.

Shale gas should therefore not be seen as a solution to the EU's energy, climate and competitiveness challenge. The EU needs a holistic strategy combining energy efficiency, eco-innovation, low-carbon energy sources, and a stronger, more integrated internal market. Shale gas could be a complement in this, in so far as it could contribute to the creation of a more liquid, resilient internal gas market, particularly in those Member States currently highly dependent on polluting coal or Russian gas.

1. EIA, Crude oil and natural gas drilling activity. European figure from JRC, pp. 76.