

Shale Gas and the Relationship between the US Natural Gas, Liquefied Petroleum Gases and Oil Markets

Executive summary

Liquefied petroleum gases (LPGs) together with other natural gas liquids (NGLs) have played an important role in the current US shale gas boom. Depressed gas prices in recent years have made pure natural gas operations less profitable. The result is that liquids components in gas production have become increasingly important in ensuring the profitability of shale gas operations.

Much focus in the literature on energy markets has been directed towards the relationship between oil and natural gas markets. Less attention has been paid to other important petroleum products, and their relationship with oil and natural gas markets. One such market segment is Liquefied Petroleum Gases (LPG). LPGs such as propane and butane are related to oil and natural gas both on the demand side (through its use for fuel and heating) and the supply side (production comes from both natural gas liquids processing and crude oil refining). It is reasonable to assume that the state of the liquids markets can affect the relative prices of oil and natural gas. High liquids prices, due to for example high oil prices, might increase gas production and hence depress gas prices (because of the associated gas from natural gas liquids fractionating). This implies that the relationship between oil and natural gas prices do not only depend on direct inter-fuel substitution or gas-to-gas competition but also the state of the liquids markets.

In this paper we investigate the relationship between LPG (as measured by propane and butane), oil and natural gas prices in the US. Our main research question is whether the shale gas expansion, which has affected the oil/natural gas relationship, has also affected the relationship between LPG and oil prices. Even though the oil price has historically been the main determinant for LPG prices, the new supply of LPG from shale gas operations might have been sufficient to move LPG prices away from oil prices. The shale gas boom provides a natural experiment to evaluate the effects of a significant and persistent supply shock on the historically stable LPG/oil price relationship. This question is of interest not only in terms of establishing the relationship between oil, natural gas and LPG markets, but also in terms of the future development of US energy markets. If the LPG markets have remained largely

unaffected by the shale gas boom, absorbing most of the supply without affecting long run prices, it is more likely that the low natural gas prices might persist for a significant period. If however the additional supply can affect the LPG/oil relationship it is more likely that natural gas production might decline as future shale gas operations are likely to become less profitable. For gas operations the liquids markets have ensured an exposure to world energy markets in a time where lack of natural gas exports have led to a segmented and depressed US natural gas market. The stability of the liquids markets is therefore important in terms of the need for natural gas exports. A liquids market largely unaffected by the domestic natural gas market will reduce the need for natural gas exports. However, if US liquids markets move in the direction natural gas price has moved this will make additional export capacity more important.

We find a structural break in 2009, after which both the propane and butane prices settle at a lower value relative to oil. We find that the relatively strong cointegration relationship between propane/butane and oil prior to January 2009 is significantly weakened in recent years. Whereas the oil price previously has been closely associated with LPG prices, the new supply of LPG from associated shale gas operations appears sufficient to move LPG prices away from the historical long run relationship with oil. Reduced income from these liquids may further reduce profitability from shale gas wells, thus pushing upwards pressure on domestic natural gas prices again. A further expansion of greenfield petrochemical plants with increased ethane and propane demand might ease this conversion.