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Airfares and oil prices: 'Feathers and Rockets' adjustments

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ABSTRACT

One reason that the US Department of Justice is examining collusion within the airline industry may be the small (12%) decline in airfares that follows a large (57%) drop in crude oil prices. This relatively small response could be caused by three mechanisms related to the oil market; (1) slow rates of adjustment, (2) airfares adjust asymmetrically to changes in the oil market, or (3) asymmetric adjustments within the oil market that are communicated symmetrically to airfares. I evaluate these hypotheses by estimating a cointegrating vector autoregression model from monthly data and testing the error correction mechanism for asymmetry. Although small, estimated rates of adjustment indicate that the large reduction in oil prices has been passed to airfares. Tests of the error correction model do not provide evidence for asymmetric adjustments between airfares and oil market. Contrary to the relation between crude oil and motor gasoline prices, prices for jet fuel adjust faster to reductions in crude oil prices and so cannot be responsible for the relatively small decline in airfares. Although the CVAR model does not identify an oil-related mechanism that can generate the small decline in airfares relative to the large decline in the price for crude oil, this absence does not imply the converse, that airlines collude to set airfares.

1. Introduction

The price of crude oil declines by about 57%, from $102.51 to $43.58 between June 2014 and May 2016. During that period, the CPI for airfare declines by about 12%. This small decline is somewhat surprising; jet fuel accounts for about 33% of average operating costs incurred by the airline industry (Berghofer and Lucey, 2014). Consistent with this large percentage, industry analysts estimate that the reduction in oil prices will save US airlines about $20 billion in 2015 (New York Times, January 20, 2015).

The juxtaposition of a large cost saving and a relatively small price reduction is a topic for both academic researchers and policy enforcement. From an academic perspective, airlines respond to changes in oil prices three ways; (1) changing the energy efficiency of their operations (i.e. changing the fleet), (2) passing the cost increases (decreases) to passengers, and (3) hedging fuel costs (Morrell and Swan, 2006). Of these, Berghofer and Lucey (2014) find that hedging behavior and changes in fleet diversity do not reduce exposure to the risk that is associated with changes in oil prices. Furthermore, hedging may increase the risk premium and increase costs (Aabo and Simkins, 2005), perhaps by 1% of fuel costs (Rao, 1999). Despite these costs, the accounting losses of hedging will be more than offset by lower fuel prices, such that US airlines will save $15 billion (New York Times, 2015).

Academic research suggests that the degree to which cost increases (decreases) are passed on to passengers may be influenced competition in the airline industry. High levels of competition make it difficult to raise ticket prices in response to rising prices for jet fuel (Carter and Simkins, 2004). Consistent with this hypothesis, the Portuguese airline industry could not recover the full cost of higher fuel prices (Button et al., 2011).

Recent research indicates that the intensity of competition among airlines is decreasing. Concentration in the US airline industry increases between 2007 and 2009 (Johnston and Ozment, 2011). The resultant reduction in competition may slow additions to capacity. Robert Mann, a former airline executive states; "The industry is full at these prices. You can't stimulate additional revenue by cutting prices." Based on these concerns, in June 1015, the US Department of Justice opened an inquiry into whether the airline industry is colluding to limit seating.

Beyond a reduction in competition, the small effect (to date) of lower oil prices on airfares could be caused by asymmetric rates of adjustments in the relation among the price of crude oil, the price of jet fuel, and airfares. If the price of jet fuel and/or airfares respond asymmetrically to changes in crude oil prices (or other components of the oil market), such that increases in crude oil prices are translated into higher prices for jet fuel and air travel faster than reductions in crude oil prices are translated into lower prices for jet fuel and air travel, the small decline in airfares as of June 2016 (the last month for which data are available) may be caused by an asymmetric rate of adjustment to lower prices for crude oil. This hypothesis echoes an extensive literature on the relation between prices for crude oil and motor gasoline, which suggests that increases in crude oil prices translate into higher

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motor gasoline prices faster than lower crude oil prices translate into lower motor gasoline prices (e.g. Perdiguero-Garcia, 2013; Frey and Manera, 2007). This pattern of asymmetric adjustment is termed a 'rockets and feathers' effect (Bacon, 1991).

To test for an asymmetric relation between the price of jet fuel and air travel, Wadud (2015) uses a method developed by Gately (1992), which decomposes jet fuel prices into three components; price rises to a new all-time high, price declines, and price rises back towards a previous high. Each of these price changes has a different effect on airfares such that a one dollar rise in the price of jet fuel to a new all-time high generates a larger increase in airfares than a one dollar rise in the price of jet fuel that leaves prices below the previous all-time high (Wadud, 2015). These results suggest that the price of jet fuel does not define a unique price level for airfares. That is, the relation between the price of jet fuel and air travel is 'path dependent.' Although path dependency could explain the small effect of large reductions in crude oil prices (if the equilibrium response to price reductions is smaller than the equilibrium response to price increases), path dependency or regime change (e.g. Holmes and Panagiotidis, 2009) are different from the asymmetric rates of adjustment that are described by the 'rockets and feathers' relation between the price for crude oil and motor gasoline.

Here, I test three hypotheses about how the oil market may cause airfares to fall by a small percentage relative to a large decline in the price for crude oil:

1) Airfares adjust very slowly to changes in airfares.
2) Airfares adjust asymmetrically to changes in the oil market.
3) The oil market adjusts asymmetrically to changes in the price of crude oil, and these asymmetric adjustments are communicated symmetrically to airfares.

These hypotheses are tested by estimating a cointegrated vector autoregression (CVAR) model from monthly data. The cointegrating relations identify long-run relations for wholesale and retail prices for jet fuel, inventories of jet fuel, and airfares. The results indicate that slow or asymmetric rates of adjustment cannot account for the small decline in airfares relative to the large drop in crude oil prices. Surprisingly, the retail price for jet fuel adjusts faster to reductions in the price for crude oil, which is opposite the asymmetric rate of adjustment between prices for crude oil and motor gasoline in many markets. I hypothesize that this 'feathers and rockets' effect is generated by the relative rigidity of refinery yields for jet fuel, which generates a trade-of between the rate at which price changes are passed through to jet fuel and the refiner's cost of holding inventories of jet fuel. Together these results indicate that the small decline in airfares cannot be attributed to relations within the oil market or the relation between the oil market and airfares. The failure to identify an oil-related mechanism for the relatively small decline in airfares does not imply the converse, that airlines collude to set airfares; nor does it rule out collusion.

These results and the methods used to obtain them are described in five sections. The second section describes the data and the statistical methodology. The statistical results are described in the third section. Section 4 describes the long-and short-run relations among components of the oil market and their relation with airfares. Section 5 concludes with a short discussion about what these results imply about possible causes for the small decline in airfares relative to crude oil prices.

2. Methodology

2.1. Data

I compile monthly data on airfares and six components of the oil market that may affect airfares. Monthly data likely would fail to detect asymmetries at a weekly or daily frequency, but high frequency asymmetries could not generate the longer adjustments that are discussed in the introduction. I include components of the oil market beyond the price of jet fuel because previous research suggests that omitted variables can bias statistical tests for symmetric rates of adjustment. Including time series for the inventories of crude oil, inventories of motor gasoline, and refinery utilization rates in the cointegrating relations and the error correction models for motor gasoline prices reduces the likelihood of rejecting the null hypothesis of symmetric rates of adjustment (Kaufmann and Laskowski, 2005).

Data on the U.S. city average for airline fares (CUSR0000SETG01) are obtained from the Bureau of Labor Statistics. These data are deflated by monthly values of the U.S. city average for all items (CUUR0000SA0) to generate real airfares (*Fare*).

Monthly data are compiled for six components of the US oil market; (1) the average price of crude oil purchased by refiners (*PCrude*), (2) inventories of crude oil (*CStock*), (3) refinery utilization rates (*Util*), (4) the wholesale price of jet fuel (*JetW*), (5) the retail price of jet fuel (*JetR*), and (6) inventories of jet fuel (*JStock*). Observations for the nominal monthly price of crude oil (dollars per barrel) purchased by refiners (R0000____3) are obtained from the Energy Information Administration. The same source is used to compile time series for the U.S. kerosene-type jet fuel nominal wholesale/resale price (EMA_EPJK_PWG_NUS_DPG) by refiners (dollars per gallon), U.S. kerosene-type jet fuel nominal retail sale prices by refiners (EMA_EPJK_PTG_NUS_DPG; dollars per gallon), U.S. ending stocks excluding SPR of crude oil (MCESTUS1 thousand barrels), U.S. Ending Stocks of Kerosene-Type Jet Fuel (MKJSTUS1 –thousand barrels), and the US percent utilization of refinery operable capacity (MOPUEUS2). Prices for crude oil and jet fuel are deflated using the U.S. city average for all items that is described above.[1]

The availability of observations differs among variables. Observations for some of the oil-related variables start in the 1970′s, but January 1989 is the first observation for airfares. Conversely, the data for airfares extend through June 2016, whereas May 2016 is the most recent observation for some of the oil market variables. As such, the sample period includes 329 monthly observations from January 1989 through May 2016.

To eliminate the effects on inverting matrices with elements that differ greatly in size (due to different units of measurement), the time series for each variable is standardized as follows:

$$x_t = \frac{(y_t - \bar{y})}{\sqrt{Var(y)}} \tag{1}$$

In which y_t is the value (in original units), $\bar{y}$ is the average value over the sample period, and $Var(y)$ is the variance over the sample period.

2.2. Statistical methodology

The statistical methodology consists of two general stages.[2] In the first stage, I estimate a CVAR model to quantify the long- and short-run relations among the six components of the oil market and their relation with airfares. In the second stage, the long-run relations are used to calculate the disequilibria in each cointegrating relation, these disequilibria are decomposed based on the change in the price of crude oil, and these decomposed disequilibria are used in an error correction model to test the null hypothesis that variables adjust symmetrically.

[1] As such, all prices refer to real prices.
[2] Two steps are needed because the CATS software used to estimate the CVAR does not allow for asymmetric rates of adjustment.