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Some pitfalls in testing the law of one price in commodity markets

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A B S T R A C T

Several articles find no support for the LOP in commodity markets. A few articles find some support. Rejecting the LOP would strike at the heart of economic theory. Rejection would suggest that firms do not maximize wealth and households do not maximize utility. Our objective is to show how four common pitfalls can cause tests of the LOP to fail when in fact the LOP holds. All tests that fail to support the LOP fall in to at least two pitfalls. All of these pitfalls are the result of ignoring important practical implications of arbitrage.

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1. Introduction

Many studies fail to find significant support for the law of one price (LOP) in commodity markets.¹ Starting with early studies by Isard (1977) and Richardson (1978), rejections include Ardeni (1989), Fraser et al. (1991), Ceglowski (1994), Asplund and Friberg (2001), Engel and Rogers (2001), Haskel and Wolf (2001), Parsley and Wei (2001), Lutz (2004) and Goldberg and Verboven (2005). A few studies such as Goodwin (1992), Michael et al. (1994), Obstfeld and Taylor (1997), Vataja (2000), Lo and Zivot (2001) and Sarno et al. (2004) find some support. This failure to find clear support for the LOP strikes at the heart of economic theory. A failure of the law of one price, as that law is generally understood, implies that individuals and firms ignore risk free opportunities to increase wealth. Such behavior raises serious questions about wealth and utility maximization, cornerstones of economic theory. Our objective is to show how four common pitfalls can cause tests of the LOP to fail when in fact the law holds.

Section 2 briefly discusses the law of one price. The major objective of that section is to demonstrate that the law of one price, as it is generally understood, involves arbitrage. All four pitfalls are the result

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¹ We ignore most of the earlier empirical work that excludes unit roots and cointegration.

of ignoring practical implications of arbitrage. The pitfalls are: (1) using retail prices, (2) omitting transportation costs, (3) ignoring time and (4) not using identical products. The last three pitfalls are widely recognized as problems for testing the LOP. The first pitfall is not.

Section 3 describes the data. Section 4 uses that data to show that the LOP worked in the wheat market between the United States and Japan. Section 5 describes and illustrates the pitfalls into which almost all tests of the LOP, particularly those that have failed to find support, have fallen. The final section summarizes the article and presents our conclusion. We conclude that, as a result of the prevalence of these pitfalls in the literature, we know of no evidence that would lead us to reject the law of one price in commodity markets.

2. Law of one price

The term “law of one price” does not mean the same thing to everyone. A few articles do not appeal or refer to arbitrage in discussing the law of one price. In those articles, apparently the law of one price is simply a tendency for prices of similar commodities to converge. See for example, Engel and Rogers (2001), McChesney et al. (2004) and Eckard (2004).

However, the vast majority of the literature on the LOP appeals or refers to arbitrage. For example, Officer (1986, p. 160) puts it this way: “For the law of one price of tradables to be valid, a sufficient condition is that the markets involved be purely and perfectly competitive (in the Chamberlinian sense). This would assure the existence of perfect arbitrage.”

Definitions of the law of one price in dictionaries and encyclopedias for economics also appeal or refer to arbitrage. For example, *The New Palgrave Dictionary of Money and Finance* (1992, p. 563) describes the law as follows:

This law is an immediate consequence of the absence of arbitrage and, like the absence of arbitrage, follows from individual rationality. Departures from the no arbitrage condition imply that there are profit opportunities. These arise because it would be profitable for arbitrageurs to buy good i in the country in which it is cheaper and transport it to the country in which it is more expensive and, in doing so, profit from trade.

In our perusals of dictionaries and encyclopedias, we did not find a single reference to the law of one price that did not appeal or refer to arbitrage. When we refer to the “law of one price”, we mean this dominant interpretation where arbitrage is the mechanism that produces the LOP.

Effective arbitrage imposes at least three conditions on the transactions used in a valid test of the law of one price: (1) products must be identical, (2) resale must be possible, and (3) there must be no risk. All tests of the LOP of which we are aware, particularly those that fail to support the LOP, violate at least one of these conditions and many violate all three. All of our pitfalls are the result of ignoring at least one of these conditions.

Our model of the law of one price begins with a standard statement of the LOP in Eq. (1). Let P_t^J be the price in dollars of a metric ton of a particular variety of wheat in Japan in month t . Let P_t^P (P_t^G) be the price of that same wheat in dollars at Pacific (Gulf) ports in month t . Let F_t represent the freight rates and C_t represent all the other relevant transaction costs.

$$P_t^J / (P_t^P + F_t + C_t) = 1.0 + u_t. \quad (1)$$

However our interpretation of Eq. (1) is not standard. Since commodity arbitrage takes time, prices and the relevant transaction costs should be from forward, not spot, contracts.² With this interpretation, the error term u_t should be relatively small and not highly correlated. Large and persistent errors in Eq. (1) would be inconsistent with effective arbitrage.

Like all previous tests of the LOP, we are forced to use spot prices. With spot prices, freight rates and other transaction costs, Eq. (1) becomes Eq. (2).

² Selling prices must be from forward contracts or the transaction involves risk. Normally buying prices and freight rates also will be from forward contracts because it normally is impossible to find a ship and load the cargo within the 2–4 business days that is standard for a spot contract.

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