ELECTRICITY DERIVATIVE MARKETS AND SAMUELSON HYPOTHESIS

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Overview

After having been considered as a public good during decades, electricity is now regarded as a tradable commodity in most developed countries. Since they were launched twenty years ago, electricity derivative markets exhibit sustained rises in their transaction volumes. Even if these markets are still recent, there is now enough information to understand precisely how they function and to compare them with other markets for traditional commodities. Moreover, it is common to assert, in the literature on commodity derivative markets, that the behavior of futures prices is characterized by the "Samuelson Hypothesis" (Samuelson, 1965), i.e. by the presence of a decreasing pattern of volatilities along the prices curve. A deeper knowledge of the Samuelson hypothesis is required for industrial and financial agents as well as for regulatory authorities. Traditional hedgers on commodity markets are producers, industrial processors and trading companies. They use the futures markets to hedge their physical exposure to the underlying asset. Taking into account the Samuelson effect might impact the choice of their hedging horizon. Moreover, volatility is one of the most important parameters in the pricing of options. Whenever the framework of a constant volatility, as in the Black-Scholes model, is relaxed, the Samuelson effect must be taken into account. Finally, the maturity impact concerns clearing houses and regulatory authorities when setting margin requirements and thinking about risk exposures. Margin requirements, which protect against counter-party credit default risk, are function of the risk of the underlying contract, for which a proxy could be the volatility. Despite some debates about statistical measurements, this hypothesis has found a large empirical support. Yet, to the best of our knowledge, one of its empirical implications has never been proposed nor tested: if Samuelson is right, then prices shocks emerging in the physical market should propagate in the direction of the paper market. The first contribution of this paper is to fill this gap. Second contribution: up to now, the validation of the Samuelson hypothesis has never been considered in the case of electricity futures markets. Yet the non storability of this commodity raises interesting questions.

Methods

In this article, we examine the prices behavior of the four most important electricity futures markets worldwide from 2009 to 2013: the German market, the NordPool, the Australian market and the PJM Western Hub in the USA. We also rely on the American crude oil market as a benchmark for a storable commodity negotiated on futures markets and as an example of a mature contract. Using different econometric tools (hereafter in brackets), we test the three following empirical implications of the Samuelson hypothesis on these markets: The first one is the most closely linked to the idea developed by Samuelson himself: if prices shocks arising from the physical market influence the futures contracts all the more that these contracts are close to their expiration date, then volatility is a decreasing function of the remaining maturity (linear regression between volatilities and time-to-maturities). A second implication is that there should be an ordering in the time series of volatilities across maturity: more precisely, a decreasing pattern should be observed (non-parametric test of Jonckheere-Terpstra). Finally, shocks propagating from the physical to the paper markets should lead to directional volatility spillovers (measure of volatility spillover developed by Diebold and Yilmaz, 2012, in a static and a dynamic framework).

Results

For each market, and each econometric procedure used, results are quite homogeneous. That is, in a static framework, we always find evidences of the existence of the Samuelson hypothesis for our four electricity derivative markets and for the WTI using a linear regression, the Jonckheere-Terpstra test or the directional volatility measures of Diebold and Yilmaz. However, an exception exists for the Australian market when we look at directional volatility spillover measures. This is probably due to the use of quarterly futures contracts, which introduced very long maturities in the analysis, compared to other markets. In a dynamic framework, for each market, volatility spillover measures imply most of the time the existence of the maturity impact. There exist some exceptional time period where this is not the case, but we have not investigated them yet.

Conclusions

This article provides insights for the literature on commodity derivative markets, in several directions. First, it proposes a new empirical implication of the Samuelson Hypothesis and suggests the proper methodology to use it. Second, this article enhances the knowledge about the dynamics of the futures prices in the four most important electricity futures markets, worldwide, and creates a link with other storable commodities. This is interesting, as most of the models of the Samuelson hypothesis emphasize the importance of inventories (see Bessembinder et al. (1996), or Routledge et al. (2000)).

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