Cross-listings and Time-Varying Arbitrage: A Trans-Niagra Tale

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Abstract  
This paper develops and tests a heterogeneous agents model for an asset that trades on multiple markets. To be more specific, we set up a model where boundedly rational investors optimize their portfolio by distributing wealth between a risk-free asset, and a risky asset that is listed on two exchanges. Investors use simple rules of thumb in order to determine their expectation for future prices for the risky asset: they are either arbitrageur or technical analyst. Since prices in both markets are on the same underlying asset, arbitrageurs can profit when prices get too far out of sync. Arbitrageurs, therefore, trade on the price-difference between the two markets. They take long-short positions offsetting the price difference between the two exchanges.

Technical analysts, on the other hand, take advantage of the patterns that exist in price (changes). Practically, technical analysts behave as momentum traders and use a simple AR(p) rule. As such, arbitrageurs serve as a stabilizing mean-reverting force, while technical analysts are destabilizing and introduce volatility in returns. Investors are able to change between strategies conditional on past performance. That is, investors compare the profits of the two rules ex-post and adjust their strategy for the next period accordingly.

The model reduces to a VECM with varying parameters with the two prices of the risky asset as endogenous variables, where the time variation is due to switching between strategies. In addition, since we know that the two strategies produce

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different levels of volatility in returns, the time-variation in volatility (i.e., volatility clustering) is also introduced by the switching between rules. Hence we can proceed with the estimation of the model in two ways, either by Nonlinear Least Squares (NLS), where we ignore the structure of the error term and make a correction when computing the standard error or we estimate the model by Generalized Least Squares (GLS) directly controlling for the (known) error structure in the estimation. We apply our model to a selection of Canadian firms traded on the Toronto Stock Exchange (TSX) that have cross-listings on the NYSE. We select these particular markets, because they are highly integrated and because Canadian firms list as ordinary shares in the US market as opposed to ADRs or Global Depository Receipts. We select our stocks with a long history of data, from January 1, 1995 to June 30, 2008, and end up with a sample of five firms that offer sufficient liquidity (i.e. trading volume) in both markets. The five selected stocks are Agnico, Barrick, Cott, Magna, and Potash.

For the results, we take a step-by-step approach. First of all, we show that the price series are non-stationary, while returns are stationary. In addition, the two markets are indeed cointegrated. The subsequent (standard) VECM analysis indicates that for two stocks, Cott and Magna, it is mainly the United States market that adjusts towards the Canadian market. In other words, the price discovery mainly takes place in Canada. For Barrick, the opposite is true, while there are no large differences between the markets in terms of informational contents of trade for Agnico and Potash. Estimation of the full heterogeneous agents model, finally, shows that both arbitrageurs and technical analysts are actively trading on both markets for all stocks. In addition, allowing investors to switch between strategies significantly improves the fit of the model. In other words, we find significant evidence of switching between strategies. The results of the GLS methodology indicate that the estimated technical analysts increase volatility, while arbitrageurs decrease volatility.