MERGERS AND ACQUISITIONS IN THE LITHIUM INDUSTRY. A FRACTIONAL INTEGRATION ANALYSIS

Manuel Monge, Department of Economics and Business, Francisco de Vitoria University, +34 913 510 303, manuel.monge@ufv.es
Luis Alberiko, Faculty of Economics, University of Navarra, +34 948 425 600, alana@unav.es
Enrique Cristóbal, Faculty of Economics, University of Navarra, +34 948 425 600, ecristobal@external.unav.es

Overview

Lithium has a strategic role as a natural resource as more and more clean technologies emerge. This paper aims to analyze the time-series properties of the mergers and acquisitions (M&A) activity in the behavior of the lithium sector, applying statistical methods based on long memory and fractional integration models. Our results indicate that the series has a long memory and fractionally integrated behavior with an order of integration strictly smaller than 1, thus we can conclude that the impacts will be transient and are expected to disappear on their own in the long term.

Methods

We use long memory and fractional integration models that is a time series technique that allows for a fractional degree of differentiation which is very appropriate to determine if a shock in a given series has a permanent or transitory effect, and at the same time is more flexible than other classical methods based on integer degrees of differentiation. Thus, if the order of integration is smaller than 1, the series is mean reverting, with the effect of the shock disappearing in the long run. On the contrary, if d is equal to or higher than 1, its effect will be permanent persisting forever. We estimate the differencing parameter by using both parametric and semiparametric approaches based on Robinson (1994) and Robinson (1995).

Results

From the results obtained, we estimates d using the Whittle parametric approach (Dahlhaus 1989) for the database of M&A in lithium industry. We observe that the results are very similar for the three cases of the deterministic components (i.e., with no regressors, with an intercept, and with an intercept and a time trend) and also across the different types of disturbances (white noise and autocorrelation). If u is white noise, we observe that the time trend is required, obtaining a significantly positive coefficient for it, and the estimated value of d is lower than 0.5 meaning that the time series is stationary. If we impose autocorrelation throughout the model of Bloomfield (1973)216, the time trend is now insignificant, and the estimated value of d is slightly higher (0.59), though the unit root null hypothesis (i.e. d = 1) is again rejected in favor of mean reversion (d < 1), implying transitory shocks though with long lasting effects.

Nevertheless, the results based on this parametric approach produce some confronting results. Thus, under no autocorrelation on the error term, the estimated value of d is 0.36 and the confidence interval fully ranges in the stationary area (d < 0.5). However, under autocorrelation, which apparently might be a more realistic approach, the estimated value of d is much larger and above 0.5 implying a nonstationary pattern. Because of this, we also implement a semiparametric approach where no functional form is imposed on the error term. For this purpose we use Robinson (1995) mainly because of its simplicity and that it relies simply on a single bandwidth parameter unlike other methods which might be very sensitive to their userchosen parameters. The results using this approach, and using a bandwidth number m from 10 to 30 (20 = T0.5) are displayed across Table 3. We observe that all them are once more in the interval (0, 1) supporting fractional integration and also above 0.5 implying nonstationarity though mean reverting behavior.

Conclusions

Our results suggest that the time series is fractionally integrated and mean reverting, as the estimated value of d is lower than 1 both for the white noise and imposing autocorrelation. Nevertheless, it seems to be stationary under the white noise specification for the error term while nonstationary under autocorrelated disturbances. Performing a semiparametric approach the latter specifications seems to be preferred since the estimated value of d ranges then in the interval (0.5, 1). Therefore, we observe mean reversion (d < 1), implying transitory shocks albeit with long lasting effects. Hence, we can conclude that the impacts for the lithium industry due to M&A will be transient and are expected to disappear on their own in the long term.

References

Andrade, G., M. L. Mitchell, and E. Stafford. 2001. New evidence and perspectives on mergers. Journal of Economic Perspectives 15 (2): 103-120.

Arouri, M. E. H., Hammoudeh, S., Lahiani, A., and Nguyen, D. K. 2012. Long memory and structural breaks in modeling the return and volatility dynamics of precious metals. The Quarterly Review of Economics and Finance, 52, 207-218.

Baillie, R.T. 1996. Long memory processes and fractional integration in econometrics. Journal of Econometrics 73, 5-59.

Bloomfield, P. (1973): "An exponential model in the spectrum of a scalar time series," Biometrika, 60, 217-226.

Bos et al. (2018). Please complete the reference

Brealey, R. A., and A. J. Marcus. 1995. In Fundamentals of Corporate finance. International Ed., eds. Myers, S. C. and A. J. Marcus. New York: McGraw-Hill.

Cherif, R., and F. Hasanov. 2017. Riding the energy transition: oil beyond 2040. IMF Working Paper. 10.5089/9781484301128.001

Coase, R. 2009. The nature of the firm. In The Economic Nature of the firm: A Reader, eds. Kroszner, R. S. and L. Putterman III, 79–95. Cambridge: Cambridge University Press.

Energy Outlook, B. P., 2017. <https://www.bp.com/content/dam/bp/pdf/energy-economics/energyoutlook2017/bpenergy-outlook-2017.pdf>.

Germeraad, P., Khan, R., Ravindranath, D. 2017. Shifts in Big Oil Patent Landscape: Capturing Value from Intellectual Property for National Transformation.

Gil-Alana, L.A. and P.M. Robinson. 1997. Testing of unit roots and other nonstationary hypotheses in macroeconomic time series. Journal of Econometrics, 80, 241-268.

Gil-Alana, L.A., Hualde, J. 2009. Fractional integration and cointegration. An overview with an empirical application. The Palgrave Handbook of Applied Econometrics, 2, 434-472.

Gil-Alana, L. A., Tripathy, T. 2014. Modelling volatility persistence and asymmetry: A Study on selected Indian non-ferrous metals markets. Resources Policy, 41, 31-39.

Gil-Alana, L. A., Chang, S., Balcilar, M., Aye, G. C., and Gupta, R. 2015. Persistence of precious metal prices: A fractional integration approach with structural breaks. Resources Policy, 44, 57-64.

Golbe, D. L. and L. J. White. 1988. A time-series analysis of mergers and acquisitions in the US economy. In Corporate takeovers: Causes and consequences. University of Chicago Press 265-310.

Golbe, D. L. and L. J. White. 1993. Please complete the reference

Gort, M. 1969. An economic disturbance theory of mergers. The Quarterly Journal of Economics 83 (4):624–42. doi:10.2307/1885453.

Granger, C.W. J. 1980. Long memory relationships and the aggregation of dynamic models. Journal of Econometrics, 14, 227-238.

Granger, C. W. J. 1981. Some properties of time series data and their use in econometric model specification. Journal of Econometrics,16, 121-130.

Granger, C. W. J. and R. Joyeux 1980. An introduction to long memory time series and fractionally differencing. Journal of Time Series Analysis, 1, 15-29.

Gregoriou, G. N., and L. Rennebook. 2007. International Mergers and Acquisitions Activity since 1990: Recent Research and Quantitative Analysis. North Holland: Elsevier.

Harford, J. 2005. What drives merger waves?. Journal of Financial Economics 77 (3): 529-560.

Holmstrom, B. and S. N. Kaplan. 2001. Corporate governance and merger activity in the U.S.: Making ense of the 1980s and 1990s. National Bureau of Economic Research Working Paper n.8220.

Hosking, J. R. M. 1981. Modelling persistence in hydrological time series using fractional differencing. Water Resources Research, 20, 1898-1908.

Martijn Bos; Riza Demirer; Rangan Gupta and Aviral Tiwari. 2018. Oil returns and volatility: The role of mergers and acquisitions, Energy Economics, 71, 62-69.

Maxwell, P. 2014. Analysing the lithium industry: Demand, supply, and emerging developments. Mineral Economics, 26, 97-106.

Mitchell, M. L. and J. H. Mulherin. 1996. The impact of industry shocks on takeover and restructuring activity. Journal of Financial Economics 41 (2): 193-229.

Monge, M. and L. A. Gil-Alana. 2016. Fractional integration and cointegration in merger and acquisitions in the US petroleum industry. Applied Economics Letters 23 (10): 701- 704.

Monge, M., L. A. Gil-Alana, F. Pérez de Gracia and I. Rodríguez Carreño. 2017. Are mergers and acquisitions in the petroleum industry affected by oil prices?. Energy Sources, Part B: Economics, Planning, and Policy 12 (5): 420-427.

Monge, M. and L. A. Gil-Alana. 2018. Lithium industry in the behavior of the mergers and acquisitions in the US oil and gas industry, Energy Sources, Part B: Economics, Planning, and Policy, 13:9-10, 392-403.

Nelson, R.L. 1959. Merger movements in American industry, 1895-1956. NBER Books.

Panas, E. 2001. Long memory and chaotic models of prices on the London Metal Exchange. Resources Policy, 27, 235-246.

Ravenscraft, D. J. 1987. The 1980s merger wave: An industrial organization perspective. The merger boom, 31: 17-51.

Resende, M. 1999. Wave behaviour of mergers and acquisitions in the UK: a sectoral study. Oxford Bulletin of Economics and Statistics 61 (1): 85-94.

Schurr, S. H., and B. C. Netschert. 1960. Energy in the American Economy, 1850-1975, Vol. 960. Baltimore: Johns Hopkins.

Shleifer, A. and R. Vishny. 1990. Equilibrium short horizons of investors and firms. American Economic Review 80 (2): 148-153.

Silverberg, G. and B. Verspagen. 1999. Long memory in time series of economic growth and convergence, Eindhoven Center for Innovation Studies, Working Paper 99.8.

Town, R. J. 1992. Merger waves and the structure of merger and acquisition time-series. Journal of Applied Econometrics 7 (1): 83-100.

United States Geological Survey, various years a, Minerals Yearbook, Lithium chapter, Washington (downloaded from www.usgs.gov).

United States Geological Survey, various years b, Mineral Commodity Summaries, Lithium section, Washington (downloaded from www.usgs.gov).