Referee Report on Dissertation Thesis

Author:	**Peter Štefko**
Title of the Thesis:	Essays on Information in Financial Markets
Reviewer**:**	Eduard Baumöhl

The thesis consists of three separate essays, which I will discuss separately as well. Overall, the dissertation thesis is on a very high level and it was a pleasure to read it. First and second essay are both conducted from a more practical point of view and I found them very interesting, as well as publishable in some respected finance journals. The third essay is the weakest one, however, still on a very good level.

1. Does the Profitability of Technical Analysis Depend on Trading Frequency? A Comparison of Developed and Emerging Markets.

The first essay is aimed to challenge the weak-form of market efficiency by analyzing the predictive power of three classes of technical indicators on a sample of stock market indices from five CEE markets, complemented with those from US and Germany. What is interesting here is the wide range of trading rules (more than 600) and very clean methodology. Accounting for data-snooping bias is essential in these types of studies on the efficiency of technical analysis. Also acknowledging that some potential profitable strategies might exist even at the efficient markets (although short lived) – in line with the Adaptive Markets Hypothesis – is indeed commendable.

My first impression was that this area of study is already closed, we know what to expect from technical trading rules and what not – essentially, accounting for data-snooping bias and transaction costs usually do not result in the profitable trading strategies (i.e. not consistently). What else is interesting in this area? I do not see a lot of papers on this topic in finance journals, at least not in the top-tier ones. However, I found the results for CEE stock markets interesting and worth of investigation. What I found particularly well conducted was the review of relevant literature, including the main studies, studies aimed at emerging markets, and studies that utilized high-frequency data.

From methodological point of view, I do not have any comments. The entire analysis is very clear and sound. Perhaps from practical point of view, I would like to see some other risk-return characteristics, not only the Sharpe ratio (e.g. average drawdown, expected shortfall, Burke, Sortino, Treynor, etc.). Also, from practical point of view, it would be more convincing to use data on tradable assets, which not all of those indices included in a sample are, as far as I know.

But these are only minor comments. The main point is that this essay is at a very high level and provide some new evidence into this stream of literature by exploring the CEE stock market high-frequency data and utilizing the state-of-the-art methodology. I also believe that the findings are publishable in some respected finance journal.

2. Order Flow Toxicity Around Oil Inventory Announcements: Evidence of the VPIN Metric.

The second essay is the most interesting one from my point of view. It analyzes the information adaptivity of price discovery processes on WTI crude oil futures, again, from a high-frequency market microstructure perspective. The choice of asset in this essay is very good, as it is essentially one of the most traded one security in the world. In combination with two distinct reports on oil inventories, which are published weekly but at different times, it provides an excellent framework for an event study.

Perhaps it is a lack of my knowledge, but unfortunately, I am not able to provide any significant suggestions to this essay. Formulated hypotheses are clear, methodology is appropriate, I really do not see anything wrong here.

3. Spillovers in the Eurozone Sovereign Bond Market: Causes and Dynamics.

The third essay is in my opinion the weakest one. Its aim is to contribute to the empirical stream of literature on financial contagion by focusing on the European sovereign bond market. However, the overall contribution to the existing literature is rather marginal. On the other hand, assessing the statistical significance of the estimated connectedness measures by applying the non-parametric bootstrap methodology is a very nice touch and indeed, I have never seen this in the vast amount of papers with Diebold-Yilmaz approach.

Here are my comments:

- My first concern is about the definition of contagion – I haven't seen any formal definition in this essay and I do not think that the existence of return and/or volatility spillovers is sufficient. Although existing studies in this area of research often differ in their specific use and definition of the term financial contagion, most definitions share two attributes: (1) contagion is a negative event and (2) is associated with increased co-movement between markets. As an example, see the top five papers cited in this area: Allen and Gale (2000), Kaminsky and Reinhart (2000), Forbes and Rigobon (2002), Bae et al. (2003), Bekaert et al. (2005). Within the framework of Diebold-Yilmaz methodology, I would say that in the case of significantly larger spillovers after some shock, we can attribute this increase to financial contagion. However, we should formally test this increase – to keep it simple let's say just run a regression with a time trend. By looking at your results, I would say spillovers are not always associated with their increase after the events under the study.
- The second concern is about the utilized data. I do not understand why it is more beneficial to use futures rather than directly bond yields (which as far as I know is more common in this stream of literature, even in the papers you are citing). In analyzing daily co-movements or spillovers it is quite crucial to align the data properly to avoid the non-synchronous trading effects. I would be very careful in handling the data and as I was reading your essay, there are few steps which raises some concerns (e.g. the paragraph on p. 113 about the data transformation). It would be beneficial for readers to at least address your choice of data in more detailed manner.
- The third comment is about the applied methodology. I believe this stream of literature (on co-movements, spillovers, connectedness, contagion, safe-haven assets, etc.) has already shifted to quantile-based measures, rather than analysing the average states, as in Diebold and Yilmaz (2012, 2014). First, moment conditions are not

required, and more importantly, heavy-tailed behaviour is accounted for. You could try to extend your analysis by applying, for example, the simple methodology of Han et al. (2016), the so called cross-quantilogram. The first advantage of this method is that it allows for the identification of the direction of the dependence – which variable predicts the other one based on past information – presented by lagged values (hence, the spillover effect is accounted for). The second advantage is that this directional predictability is calculated under various quantile levels of the distribution of the considered time series (by looking at extreme negative returns, let's say spillovers from 5^{th} to 5^{th} quantile, you will obtain a good perspective about the contagion effect). Or perhaps the quantile coherence measure proposed by Baruník and Kley (2019). The main advantage of this approach is that the measure was designed to detect any general type of dependence structure across different frequencies and quantiles – again, as opposed to methodologies that focus on the average states (e.g., Diebold and Yilmaz, 2009, 2012). In this respect, copulas are also a useful tool to address dependencies across different quantiles, but their applications usually do not primarily focus on the frequency domain. Or perhaps you will find useful the extension of the Diebold-Yilmaz methodology proposed by Baruník and Křehlík (2018) – the frequency-domain spillover index that focuses on frequencies, although it is still fitted to the mean-to-mean analysis of spillovers.

My point here is that there are a lot of other approaches (the codes are all available in R), which are able to shed much more light into the dependence structure than the standard Diebold-Yilmaz methodology. However, I am not saying that there is something wrong with the essay in its current from! I am just suggesting some further steps, which might provide larger contribution to this field of research.

- My final comment here is not that important, just please consider adding a note about this, perhaps on p. 105. In a standard Diebold-Yilmaz connectedness table, the row-wise and column-wise sum should be equal to the sum of a given elements (in rows or columns), which is not the case here. As far as I remember, this is not explained in their original paper from 2012 and there is some confusion about it, as some estimation procedures standardize these sums by the number of elements in the table (N), and some software applications do not. In your case, it appears that the *i-i* element is not counted.

References

[1] Allen, F., Gale, D. 2000. Financial contagion. Journal of Political Economy 108(1): 1-33.

[2] Bae, K.-H., G. A. Karolyi, R.M. Stulz. 2003. A New Approach to Measuring Financial Contagion. Review of Financial Studies 16 (3): 717–763.

[3] Baruník, J., Kley, T. 2019. Quantile coherency: A general measure for dependence between cyclical economic variables. Econometrics Journal 22 (2): 131–152.

[4] Baruník, J., Křehlík, T. 2018. Measuring the frequency dynamics of financial connectedness and systemic risk. Journal of Financial Econometrics 16 (2): 271–296.

[5] Bekaert,G., C. R. Harvey, A. Ng. 2005. Market Integration and Contagion. Journal of Business 78 (1): 39–69.

[6] Diebold, F., Yilmaz, K. 2014. On the network topology of variance decompositions: Measuring the connectedness of financial firms. Journal of Econometrics 182 (1): 119–134.

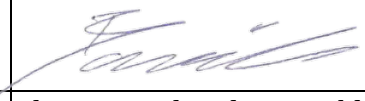
[7] Diebold, F.X., Yilmaz, K. 2012. Better to give than to receive: Predictive directional measurement of volatility spillovers. International Journal of Forecasting 28 (1): 57–66.
[8] Forbes, K. J., R. Rigobon. 2002. No Contagion, Only Interdependence: Measuring Stock Market Comovements. The Journal of Finance 57 (5): 2223–2261.
[9] Han, H., Linton, O., Oka, T., Whang, Y.J. 2016. The cross-quantilogram: Measuring quantile dependence and testing directional predictability between time series. Journal of Econometrics 193 (1): 251–270.
[10] Kaminsky, G.L., Reinhart, C.M. 2000. On crises, contagion, and confusion. Journal of International Economics 51 (1): 145–168.

All comments that I have raised at this stage were just in a form of the suggestions, perhaps suitable for a further discussion. It is not essential to implement all of them. There are still few typos, but it is perfectly understandable that in longer text, such mistakes may occur. Few examples I have noticed during the reading:

- p. 21: „be a statitical artifact, while“ or at the same page „data-snooping is the ?)“
- p. 70: “Uninformed buy and se;; traders arrive”
- p. 74 is as a whole hyperlinked to the literature
- p. 101: some references missing a space in front of them, e.g. “semi-variance ofBarndorff-Nielsen, Kinnebrock, and Shephard (2008)”, or later on p. 102: “carried out byFavero and Missale (2012) and”.

My overall assessment is:

“**I recommend the thesis for defense without substantial changes”.**

Date:	16.3.2022
Reviewer’s Signature:	
Reviewer’s Affiliation:	doc. Ing. Eduard Baumöhl, PhD. University of Economics in Bratislava