Economic Modelling 69 (2018) 301–312

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/econmod

Directional predictability and time-varying spillovers between stock markets and economic cycles☆

Stelios Bekiros[a,*], Syed Jawad Hussain Shahzad[b], Jose Arreola-Hernandez[c], Mobeen Ur Rehman[d]

[a] Department of Economics, European University Institute (EUI), Villa La Fonte, Via delle Fontanelle, 18, I-50014 Florence, Italy
[b] Energy and Sustainable Development (ESD), Montpellier Business School, 2300 Avenue des Moulins, 34080 Montpellier, France
[c] ESC Rennes School of Business, 2 rue Robert d'Arbrissel CS 76522, 35065 Rennes, Brittany, France
[d] Department of Management Sciences Shaheed Zulfiqar Ali Bhutto Institute of Science and Technology, Islamabad, Pakistan

ARTICLE INFO

JEL classifications:
B26
E32
G15

Keywords:
Business cycles
Stock markets
Quantile-on-quantile analysis
Cross-quantilogram
Spillover predictability

ABSTRACT

We examine the nonlinear dependence structure and causal nexus between business cycles, stock market returns and asset return volatility for the US economy. We implement two novel methodologies, namely quantile-on-quantile analysis and cross-quantilogram to account for tail dependence and spillovers across quantile ranges. We find evidence of statistically significant spillover effects from extreme equity market returns and their corresponding volatility to specific stages of business cycles. The sensitivity of returns and volatility to business cycle shocks is only evident for extreme quantiles. These findings indicate the importance of modeling the nonlinearity and tail behaviour when analyzing the relationships between equity markets and business cycles. Financial and monetary policy regulators may use the dynamics of spillover predictability and influence between the equity market returns, their volatility and business cycles to exert some degree of control upon business cycle formation and development.

1. Introduction

Business cycles are intriguing phenomena that continuously draw the attention of economic agents and financial market stakeholders. Some stakeholders look at them as opportunities for investment, rebalancing and divestment, depending on the stage and characteristics of the business cycles and the market sectors sourcing it. Other stakeholders (e.g. inflation and money supply regulators) see them as sources of multiple risks that need to be managed, mitigated, minimized and transferred across sectors of the economy to maneuver potential macroeconomic instability. Equity portfolio investors in the downside for instance look at business cycle downturns as opportunities to profit. Investors in the long side, on the other hand, optimistically look at new business cycle formation, which may bring slow but steady appreciation in security prices. Hence, the possibility of a spillover relationship of dependence between business cycles and equity markets appears to be present (also pointed out by Lucas, 1987, Fama and French, 1989,1999, Cochrane, 2005, 2009, 2017). This fact makes the quest of understanding the extent and ways in/to which particular sectors of the economy drive business cycles worth pursuing. Likewise, knowing what the network structure of the interdependence between business cycles and equity markets consists of and how business cycles influence specific sectors of the economy is of interest to researchers, investors, as well as policy makers and financial regulators. Specifically, important strategies for investment, portfolio allocation, risk management and business cycle control could be designed to reduce social costs in market downturns, and maximize economic spillover ramifications in times of economic prosperity.

Previous research has focused on the role various economic variables play in explaining stock market volatility, and on the importance of adequate volatility forecasting using macroeconomic fundamentals (Engle and Rangel, 2008; Diebold and Yilmaz, 2008; Corradi et al., 2013). Besides, although some studies have explored causal relationships between financial variables, yet the existing literature emphasizes on modeling innovations rather than on identifying and understanding the determinants of equity returns and business cycle fluctuations (Diebold and Yilmaz, 2008). Very few studies indeed involve predicting real economic activity and business cycles using stock market volatility as a risk factor for optimal investment decision making (Choudhry et al., 2014; Fornari and Mele, 2013). In this

☆ We are grateful to faculty members of the European University Institute (EUI) and Montpellier Business School (MBS) for helpful discussions. The usual disclaimer applies.
* Corresponding author.
E-mail addresses: stelios.bekiros@eui.eu (S. Bekiros), j.syed@montpellier-bs.com (S.J.H. Shahzad), jose.arreola-hernandez@rennes-sb.com (J. Arreola-Hernandez), mobeen.rehman@szabist-isb.edu.pk (M. Ur Rehman).

http://dx.doi.org/10.1016/j.econmod.2017.10.003
Received 13 August 2017; Received in revised form 1 October 2017; Accepted 3 October 2017
Available online 17 October 2017
0264-9993/

respect, we undertake an examination of the nonlinear dependence structure and causal nexuses between business cycles, stock market returns and the volatility of the returns, for the US economy. We implement two novel methodologies, namely quantile-on-quantile analysis and bivariate cross-quantilogram on a large monthly frequency dataset spanning from 1950 to 2017. The main objective of our research study is to investigate the presence or absence of bidirectional spillover cause-effect predictability between US equity market returns, their volatility, and business cycles caused by increases and decreases in overall industrial production. We also aim at providing more accurate estimations of spillover predictability between the considered variables' time series by targeting the nonlinearities in their dependence relationship. This feature of our modeling is important given that equity returns have for long being identified to display nonlinear relationships (see e.g., Keynes, 1936; Shiller, 1993; Peters, 1994; Hiemstra and Jones, 1994; Lux, 1995; Brock and LeBaron, 1996; Anderson, 1997, Shin et al., 2013; Choudhry et al.,2014). Besides, business cycles while generally showing well-defined trends for certain time periods, they do not respond linearly to changes in macroeconomic fundamentals, as well as to fluctuations in financial equity markets.

Our motivation for the selection of the S & P500 equity index in our analysis is that it accounts for five hundred of the largest capitalized listed firms of the entire US equity market. As a consequence, it suitably lends itself to be used as a representative of overall US equity market return and volatility. Besides, it enables us to measure and understand the extent to which equity market returns and their volatility influence business cycles (proxied by the Industrial Production Index - IPI) in the US economy, and vice versa. By providing aggregate values related to the entire US economy's industrial production the IPI can rightly be used to represent business cycles. We select the quantile-on-quantile (QQ) modeling technique because it can detect underlying nonlinear dependence in stock market return and volatility series, repeatedly reported to be nonlinear (Bekiros et al., 2016). Our selection and application of the cross-quantilogram methodology is motivated by its analytical and graphical design, which makes possible to draw detailed information about pairs of variables' strength of interdependence, directionality of spillover effects and spillover transmissions under bearish and bullish market scenarios (determined by low, medium and upper quantiles of the distribution). Altogether, the modeling frameworks we implement provide a robust approach to adequately account for nonlinearities in causal spillover predictability between equity returns, asset return volatility and business cycles.[1] In addition to that, although the informative role of macro-economic variables on future stock returns has previously been investigated (see e.g., Lustig and Nieuwerburgh, 2005; Santos and Veronesi, 2006), their causal interdependence relationship has rarely been explored using nonlinear models. It is in this respect where we try to fill a gap in the existing literature regarding the nonlinear interdependencies between business cycles, equity returns and their volatility. The quantile-based approaches have three main advantages: Firstly, they are robust to error misspecifications as they allow the underlying dependence structure to vary across distributions. Secondly, they are designed to not only account for the causality-in-mean but also for causality effects in the tails of the pairs of variables' joint distributions. This is an essential aspect of the model's design, particularly if the dependent variable is highly leptokurtic.[2]

We contribute to the existing literature in the following ways: firstly, we examine under normal, bearish and bullish market scenarios the dependence structure between US equity market returns, their volatility and business cycles, using a novel quantile-on-quantile (QQ) approach. This modeling approach of Sim and Zhou (2015) by combining quantile regression with non-parametric estimations makes possible the modeling of nonlinearities in the specific type of bilateral dependence relationship equity returns, their volatility and business cycles have. Secondly, our insights about directional spillover predictability across various quantile ranges by means of the Cross-Quantilogram (CQ) methodology of Han et al. (2016) further enrich the results on predictability obtained by previous studies (Narayan and Bannigidadmath, 2015; Devpura et al., 2017; Bannigidadmath and Narayan, 2016), and the existing body of knowledge on the subject by employing network structures that reliable provide estimates of interdependence and spillover influence. The CQ modeling technique implemented, in addition to that, is adequate as the interdependencies between two variables at different quantiles can be analyzed, rather than just considering the distribution mean or median. Thirdly, to our knowledge, this is the first time the aforementioned modeling approaches are implemented to examine the nonlinear interaction between business cycles, equity returns and the volatility of returns.

We find evidence of statistically significant spillover effects from equity market returns and their corresponding volatility to business cycles. The dependence and directional predictability from business cycles to equity returns and their volatility is marginal. The sensitivity of returns and volatility to business cycle shocks is higher only for extreme quantiles. Bearish equity markets are observed to drive the US business cycles, and the shock effect of volatility on business cycle is negative and gradually increases as volatility rises. A novel finding of our research is that although a bilateral feedback spillover relationship is observed between equity market returns, their volatility and business cycles, the directional effect equity market returns and their volatility have on business cycles is noticeably more significant than the converse case. Our research findings highlight the increasing importance of equity markets in driving industrial production, economic growth and business cycle formation. The equity market (e.g., its return and performance), being part of the overall security market sector that includes bond, swap and other derivative markets, is a good indicator of market confidence and future market prospects particularly. Hence, inferred and derived information from fluctuations in equity markets could be used for effective portfolio investment, allocation and risk management. Financial and monetary policy regulators such as the central bank and other government agencies may also find the unveiled dynamics of spillover predictability and influence between the equity market returns, their volatility and business cycles useful to design macroeconomic strategies oriented to exert some degree of control in business cycle formation and development.

The rest of the paper is organized as follows: Section 2 discusses thoroughly the relevant literature. Section 3 presents the dataset and provides a preliminary analysis of it. Section 4 introduces the methodological approaches considered, whilst Section 5 states and explains the empirical results. The Section 6 concludes our research study.

2. Literature review

The direction of the causal relationship, under varied market circumstances, between equity returns, their volatility and business cycles remains inconclusive in the finance literature. For instance, Errunza and Hogan (1998) for European markets, Davis and Kutan (2003) for 13 developing and developed markets, Kearney and Daly (1998) and Chowdhury and Rahman (2004) regarding frontier markets, have come up with mixed results. Studies such as those by Campbell et al. (2001), Fornari and Mele (2013) and Buch et al., (2004) have even considered the possibility of a reverse causality from equity market volatility towards measures of aggregate output and business

[1] Business cycles are strongly related to equity returns and liquidity as they can be used to predict information about future macro-economic conditions. Bloom (2009) and Bloom et al. (2012) moreover argue that uncertainty shocks are important drivers of business cycles.

[2] Nonlinearities in financial return series may arise from various factors including information frictions, transaction costs, investor risk profile, and investor heterogeneity and investor herd behaviour. Consequently, the modeling of nonlinearities and asymmetries in the marginal and joint distributions must be incorporated.