ARTICLE IN PRESS

Economic Modelling xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Economic Modelling

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

Do business cycles, investment-specific technology shocks matter for stock returns?

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ARTICLE INFO

JEL classification codes:
C22
E32
E44
F44
O33

Keywords:
Business cycles
Technological change
Stock market
Structural VAR

ABSTRACT

This paper empirically analyzes the dynamic relationship between business cycle, investment-specific technology shocks, and stock returns in the Indian context. Using Structural VAR technique the study finds: (1) business cycle shocks and stock market returns are more pronounced, especially during the financial market liberalization (2) the dominant role of global cycles over country cycles in explaining stock returns (3) interest rate plays an important role to interact the business cycle dynamics and stock returns (4) a relatively weak effect of investment-specific technology shocks on the business cycle and stock returns.

1. Introduction

There has been significant literature that supports macroeconomics factors determine the stock returns (see Fama, 1981; Rangvid, 2006; Chen et al., 1986; Campbell and Shiller, 1988). Yet, the underlying mechanism that connects macroeconomic factors, technology shocks and stock returns remain an unresolved theoretical debate. Indeed, most of the theoretical research has carried out individually on the linkage effects but not conclusive on the empirical front. For instance, there are studies that show business cycle affects stock returns (Balvers et al., 1990; Cooper and Priestley, 2009; Campbell and Diebold, 2009). Another set of papers find that the technology shocks affect stock prices through Research and Development (R & D), patents and changes in factor productivity (Blundell et al. 1999; Cockburn and Griliches, 1988; Madsen and Davis, 2006). Whilst these studies are silent on possible interlinkage between the 'trio'-technology shocks, business cycles, and stock returns. The dearth in empirical literature may be due to the lack of in-depth study carried out linking the trio, and the conflicting nature of the conclusion of individual studies on the trio. There is enormous scope for linking the trio and the role of technology shocks (investment-specific technology shocks) and business cycle in determining stock returns.

We hypothesize that linking the trio would reveal the dynamics embedded in business cycles in explaining the stock returns. In fact, business cycles affect the stock returns through the expected profitability of investment. For instance, an economic boom may lead to high aggregate demand which often ends up with the hike in interest rate. Further, a hike in interest rate reduces the investment and the expected profitability. Similarly, we further hypothesize that investment-specific technological (IST) shocks drive business cycle, as technological advancement makes a new capital equipment less expensive and it increases the investment demand and output fluctuations (Greenwood et al., 1997, 2000). Whereas, in recent times of high financial integration, the risk associated with the business cycle, especially global business cycles can also impact stock price movements. Based on these premises, our hypothesis is that business cycle is firmly explaining stock returns.

Our approach towards testing the above interlinkage is as follows. We analyze the dynamic relationship between IST shocks, business

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http://dx.doi.org/10.1016/j.econmod.2017.09.014
Received 15 August 2017; Accepted 15 September 2017

Please cite this article as: Prabheesh, K.P., Economic Modelling (2017), http://dx.doi.org/10.1016/j.econmod.2017.09.014

cycle, and stock returns, using Indian data [2] from 1983 to 2015 and structural vector autoregressive model. We also examined the relative importance of shocks (IST shocks and business cycle) in explaining the forecasted error variance and impulse response functions of stock returns. To explore the dynamic relationships among these variables we included domestic interest rate in the model. As a step further, we accounted the impact of global business cycle shocks into our model and tested the relative importance of global business cycles over the country business cycle in determining stock returns. Our empirical findings conclude as follows: 1) IST shocks have a weak power in explaining the stock returns in India. 2) global business cycle shocks dominate over domestic cycles in explaining the stock returns 3) domestic interest rate is more responsive to global business cycles as compared to domestic cycles.

The study is one of the first attempts to analyze the dynamics of interlinkage among the trio-technology shocks, business cycles, and stock returns. Our empirical finding mainly supports the role of global business cycles in determining the stock returns. These results are in line with the existing studies that found global risk factors play a significant role in determining stock returns (e.g. Cooper and Priestley, 2013; Guo, 2006; Nitschka, 2013; Nitschka, 2014). Moreover, our findings further provide a value addition by linking the role of central bank response to global cycle and possible divergence of business cycle between countries i.e. business de-synchronization. Further, our empirical findings shows a weak role of IST shocks in determining business cycle, unlike other studies that found IST shocks are the primary source of business cycles (Fisher, 2006 and Justiniano et al. 2010; Chen and Wemy, 2014) [3]. Moreover, our empirical approach is also different from the existing studies in Finance, that link the IST shocks to stock returns (Kogan and Papanikolaou, 2014; Li, 2013; Yang, 2013, Garlappi and Song 2016) [4].

We adopted three robustness test to verify the empirical results observed from structural vector autoregressive model. First, we use various proxies of stock returns such as excess returns and real returns. Second, we further extend our model by including more global variables such as global stock returns and global interest rates. And third, we employ an alternative empirical estimation approach, co-integration approach, to examine the role of IST shocks and business cycles on stock returns. The overall findings suggest that the results are not sensitive. The rest of the paper is organized as follows. Section 2 presents the econometric framework; Section 3 discusses data; Sections 4 and 5 present empirical results and robustness check, and Section 6 concludes.

2. Econometric framework

The study employs the structural vector autoregressive (VAR) model to analyze the dynamic relationship among IST shocks, business cycle, interest rate, and stock returns. SVAR model is originally proposed by Sims (1980), which is an alternative to simulations equation models. A standard SVAR model can be expressed in the following form

$$A_0 X_t = A_1(L)X_t + B\varepsilon_t \tag{1}$$

Where X_t represents is an $n \times 1$ vector of variables in time t, A_0 and B are $n \times n$ matrices of coefficients, $A_1(L) = \sum_{i=1}^{\rho} A_{1i}L^i$ indicates the matrices polynomial in the lag operator. Matrix B contains the structural form parameter of the model and ε_t is an $n\times 1$ vector of serially uncorrelated and zero mean structural shocks with an identity covariance matrix $\sum\varepsilon = (\varepsilon_t\varepsilon_t') = I$. The reduced from of the model can be expressed as

$$X_t = C(L)X_t + u_t \tag{2}$$

Where $C(L)X_t = A_0^{-1}A_1(L)$ with $A_0 u_t = B\varepsilon_t$

The residuals u_t from the reduced VAR model are also assumed to be white noise, but can be correlated with each other due to the contemporaneous effect of the variables across equations. Hence to identify the structural shocks, it is necessary to impose the restrictions in the equation. We employ the identification strategy by applying short-run restrictions on contemporaneous coefficients in A_0. More specifically, we need to impose $n(n-1)/2$ restrictions to exactly identify the structural shocks. In this paper, we estimate two separate SVAR models. Model 1 includes the endogenous variables such as IST shocks, cycle, interest rate and stock return, while in Model 2 we include global cycle along with other variables. The details of the definition and the construction of variables are reported in Appendix A.

The identification strategies for these models as follows.

Identification strategy for Model 1, X_t= (*IST shocks, cycle, interest rate, returns*)

$$\begin{bmatrix} a_{11} & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} u_t^{\text{IST shocks}} \\ u_t^{\text{Cycle}} \\ u_t^{\text{Interest rate}} \\ u_t^{\text{Returns}} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{21} & 0 & 0 \\ 0 & 0 & b_{31} & 0 \\ 0 & 0 & 0 & b_{41} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{\text{IST shocks}} \\ \varepsilon_t^{\text{Cycle}} \\ \varepsilon_t^{\text{Interest rate}} \\ \varepsilon_t^{\text{Returns}} \end{bmatrix} \tag{3}$$

Here we treat *IST shocks* as contemporaneously exogenous to the other variables in the system. Similarly, the variable *cycle* is also contemporaneously exogenous to interest rate and stock returns as the standard SVAR literature on monetary policy suggest that real variable, such as output, responds with a lag to financial and monetary variables' exogenous shocks (Abouwafia and Chambers, 2015; Sims, 2007). Whereas, we assume interest rate respond to all variables except to stock return (Dupor et al., 2009; Miyao, 2002). Finally, stock returns are contemporaneously endogenous to the other variables in the system.

Identification strategy for Model 2 X_t= (global cycle, IST shocks, country cycle, interest rate, returns)

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_t^{\text{Global cycle}} \\ u_t^{\text{IST shocks}} \\ u_t^{\text{Country cycle}} \\ u_t^{\text{Interest rate}} \\ u_t^{\text{Returns}} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{21} & 0 & 0 & 0 \\ 0 & 0 & b_{31} & 0 & 0 \\ 0 & 0 & 0 & b_{41} & 0 \\ 0 & 0 & 0 & 0 & b_{51} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{\text{Global cycle}} \\ \varepsilon_t^{\text{IST shocks}} \\ \varepsilon_t^{\text{Country cycle}} \\ \varepsilon_t^{\text{Interest rate}} \\ \varepsilon_t^{\text{Returns}} \end{bmatrix} \tag{4}$$

Here we assume the *global cycle* is contemporaneously exogenous

[2] Why India? India, the third-largest economy in the world in terms of purchasing power parity (PPP), has grown by an average of 7% during the last fifteen years. India's share of global GDP has increased from an average of 4.8% to 7% during 2000-2015 and its contribution to global growth in PPP terms has also increased from an average of 8.3% to 14.4% during the same period (Government of India, 2015). The higher growth is also associated with high investment rate in the economy, which increased from 24% to 34% during 2000-2014 (RBI, 2015). Similarly, the stock markets have also grown significantly during this period. For instance, National Stock Exchange (NSE) stock index CNX- Nifty increased from 1120 to 8600. The number of listed companies in the NSE has increased from 951 to 1733, and the market capitalization to GDP has also increased from 34% to 78% (SEBI, 2015).

[3] The standard Real Business Cycle theory that economic fluctuations are mainly driven by exogenous changes in real factors in the economy and emphasized a dominant role of neutral technological shocks in explaining economics fluctuations (Kydland and Prescott, 1982).

[4] The studies deal with how IST shocks relate the stock price is found to be very limited/ is rather scarce. In the finance literature, Gomes et al. (2006) discuss that the differences in the durability of a firm's output i.e. consumption good and capital good, lead to differences in expected returns. Using two-sector general equilibrium model Papanikolaou (2011) found that investment-specific shocks benefits producers of capital goods relative to producers of consumption goods and this increase in investment in the capital goods sector. Kogan and Papanikolaou (2014) also found that investment-specific shocks are a major source of systematic risk and therefore stock market returns. They found that the firms with high growth opportunities benefit more from positive IST shocks than firms with limited growth opportunities. Similarly, Li (2013) and Yang (2013) argue that IST shocks can explain the profitability of momentum strategies and the commodity basis spread, respectively. The recent study by Garlappi and Song (2016), found weak evidence that IST can explain value premium and momentum profit.