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

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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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cycle, and stock returns, using Indian data 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). 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).

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

\[
A_0X_t = A_1(L)X_t + Be_t
\]

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

\[
X_t = C(L)X_t + u_t
\]

Where \(C(L)X_t = A_0^{-1}A_1(L)\) with \(A_0u_t = Be_t\)

The residuals \(u_t\) from the 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, \(X_t = (IST\ shocks, cycle, interest rate, returns)\)

\[
\begin{bmatrix}
   a_{11} & 0 & 0 & 0 \\
   a_{21} & a_{22} & 0 & 0 \\
   a_{31} & a_{32} & a_{33} & 0 \\
   a_{41} & a_{42} & a_{43} & a_{44} \\
\end{bmatrix} X_t = \begin{bmatrix}
   h_{11} & 0 & 0 & 0 \\
   0 & h_{21} & 0 & 0 \\
   0 & 0 & h_{31} & 0 \\
   0 & 0 & 0 & h_{41} \\
\end{bmatrix} \begin{bmatrix}
   IST\ shocks \\
   Cycle \\
   Interest\ rate \\
   Returns \\
\end{bmatrix}
\]

(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 (Abouwafa 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 \(X_t = (global\ cycle, IST\ shocks, country\ cycle, interest\ rate, returns)\)

\[
\begin{bmatrix}
   0 & 0 & 0 & 0 \\
   a_{11} & 1 & 0 & 0 \\
   a_{21} & a_{22} & 1 & 0 \\
   a_{31} & a_{32} & a_{33} & 1 \\
   a_{41} & a_{42} & a_{43} & a_{44} \\
\end{bmatrix} \begin{bmatrix}
   u_{Global\ cycle} \\
   u_{IST\ shocks} \\
   u_{Country\ cycle} \\
   u_{Interest\ rate} \\
   u_{Returns} \\
\end{bmatrix} = \begin{bmatrix}
   b_{11} & 0 & 0 & 0 & 0 \\
   0 & b_{21} & 0 & 0 & 0 \\
   0 & 0 & b_{31} & 0 & 0 \\
   0 & 0 & 0 & b_{41} & 0 \\
   0 & 0 & 0 & 0 & b_{42} \\
\end{bmatrix} \begin{bmatrix}
   IST\ shocks \\
   Country\ cycle \\
   Interest\ rate \\
   Returns \\
\end{bmatrix}
\]

(4)

Here we assume the global cycle is contemporaneously exogenous.
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