INTERACTIONS BETWEEN BALANCE SHEET ACCOUNTS: APPLICATION OF PVAR MODELS FOR NASDAQ INDICES

Kaya TOKMAKCIOGLU[*], Oguzhan OZCELEBI[†]

Abstract

The importance of firm-based empirical evidence is crucial for the last decades for capturing the relationship between macroeconomic and financial data. In order to present the financial and economic relationship between US biotechnology, telecommunications and transportation sectors, this paper tests whether the liquidity, leverage and profitability preferences of the firms in the specific sectors have impact on the investment behavior. As a result of PVAR estimations, it can be revealed that there exists interdependence between liquidity and leverage effect whereas direct evidence supporting the profitability in biotechnology, telecommunications and transportation sectors can't be exposed.

Keywords: PVAR model, balance sheet accounts, firm-based empirical evidence

JEL Classification: M21, D21, D22, C50

[*] Corresponding author. Istanbul Technical University, Faculty of Management. tokmakcioglu@itu.edu.tr
[†] Istanbul University, Faculty of Economics. ogozc@istanbul.edu.tr

1. INTRODUCTION

In the era of economic globalization process, telecommunication and transportation sectors constitute a base for economic activity as well as the development of these sectors can promote economic growth and stability. Thus, application of new technologies and innovation in telecommunication and transportation sectors have become crucial in terms of well functioning of economic system both in micro and macro level. These sectors are also interrelated with the financial system and environment since the firms in those sectors are quoted to the stock market and they are debted to the banking system. The increase in financial efficiency of these sectors may well trigger technological efficiency and innovation, particularly in case of USA. On the other hand, the importance of biotechnology can not be underestimated in USA due to its interaction with other sectors and real economic activity. US biotechnology sector revenue is estimated to have grown on average >10% each year over the past decade—much faster than the rest of the economy (Carlson, 2016).

It has been generally recognized that financial variables can be highly interacted with other macroeconomic variables when the prevelant financial globalization process has been deepening (Bhargava 2014; Pradhan et. al. 2014; Kwon and Shin 1999; Kuosmanen et al. 2015; Fricke and Menkhoff 2015; Maio and Philip 2015). Accordingly, it is critically important to determine these interactions both in microeconomic and macroeconomic perspectives (Alifiah 2014; Bhattacharjee and Han 2014; Bottazzi and Secchi, 2003; Claessens et al. 2014; Goddard et al. 2005; Kero 2013; Memon et al. 2015; Nucci and Pozzolo, 2001; Poghosyan 2013; Resende and Lima, 2005). From the microeconomic point of view, researchers generally apply to firm-level data in order to analyze the consequences of sectorial developments on economic activity and vice versa. In this respect, we study the case of US firms in biotechnology, telecommunications and transportation sectors since these sectors are highly dependent in terms of liquidity, profitability and financial leverage and economic factors. Similar to Das (2008), we employ PVAR models to study these kind of relations not only with impulse response functions but also variance decomposition analysis. Within this context, we aim to show the relationship between

US biotechnology, telecommunications and transportation sectors and discuss the possible impacts of these variables on the financial and macroeconomic situation in the US for the following periods by estimating impulse response functions (IRFs) and variance decompositions (VDCs). The main hypothesis of this paper is to test whether the liquidity, leverage and profitability preferences of the firms in the specific sectors have impact on the investment behavior. Within biotechnology, telecommunications and transportation sectors; data of 10 firms with the highest assets are used in our empirical exercise, whereupon we examined the financial and economic consequences of the balance sheet items in a plausible econometric methodology.

2. LITERATURE REVIEW

Balance sheet of firms can be exposed to exchange rate risk due to their high level of debt in foreign currency for their investment financing. In this respect, the study by Nucci and Pozzolo (2001) can be recognized as a pioneering approach. In their study, they examined the effects of exchange rate variations of Italian manufacturing firms. They found that the depreciation/appreciation of the exchange rate has a positive/negative effect on investment; more precisely the validity of revenue channel and cost channel were emphasized. On the other hand, the net impact of exchange rate changes can vary over time according to the share of foreign sales over total sales and the reliance on imported inputs. Furthermore, the market share of the firm is another crucial factor influencing the consequences of exchange rate fluctuations on investment decisions.

The possible impacts of foreign trade flows on firms' balance sheets can be recognized as a crucial, external, macroeconomic risk factor. Hay (2001) investigated the effects of the 1990 Brazilian trade liberalization on the total factor productivity, market share and profits of a sample of 318 large manufacturing firms. Panel data techniques for production function analysis were employed and it was found that market share and profits decrease possibly due to the entrance of new foreign firms into the domestic market. However, this process triggered firms to implement measures to increase efficiency.

The role of market share on firms' financial structure was studied by Gallet and List (2001) who used ADF test with breaks to identify the nature of rivalry in U.S. cigarette industry. They showed that a majority of firm-level market shares were martingales, suggesting market shares have been unstable from 1934–94. Gallet and List (2001) exposed that rivalry in the cigarette industry has remained strong. Similarly, Resende and Lima (2005) examined the Brazilian industry for the 1986-1998 period. Using IPS panel data unit root tests both with and without a deterministic trend component, they revealed that market share deviations would indicate an important degree of market rivalry.

Along with market shares, firm size can also be accepted as a factor to be analyzed. Focusing on U.S. manufacturing firms in 15 sectors, Bottazzi and Secchi (2003) revealed that the presence of general statistical properties were valid across all the studied sectors. Additionally, the relation between the size of a firm and the variance of its growth rates was characterized, in different sectors, by very similar scaling relations. In detail, Bottazzi and Secchi (2003) found the presence of robust and sectoral invariant characteristics determining the dynamic of firms across the whole industry. Additionally, it can be asserted that sectoral and firm-specific properties can be evaluated by financial statement analysis since balance sheet accounts can reflect the dynamics of liquidity, profitability and leverage. Using panel data approach, Goddard et al. (2005) explored the factors of profitability for manufacturing and service sector firms in four countries. In contrast to Hay (2001), Goddard et al. (2005) revealed that trade liberalization and thus the increasing competitiveness level cannot always decrease profits. More specifically, they found that abnormal profit still appeared to persist significantly from year to year. Goddard et al. (2005) also found a negative size-profitability relationship which implies that the increase in firm size has a negative effect on firm's total productivity. On the other hand, they supported the importance of monopoly power by obtaining a positive market share-profitability relationship. According to Goddard et al. (2005), it can be inferred that liquidity is a key factor influencing the negative relationship between leverage and profitability. More precisely, increasing the liquidity could lead to a higher level of profitability due to its inverse effect on the level of debt.

Most recently, Alifiah (2014) studied the dynamics of balance sheet accounts of firms for the case of Malaysia using logit analysis. In his empirical approach, factors

influencing the financial distress were examined and it was indicated that debt ratio, total assets turnover ratio, working capital ratio, net income to total assets ratio and base lending rate were used to forecast the financial distress of companies in Malaysian trading and service sectors. More specifically, the results showed that the abovementioned independent variables in the logit model lead to a possible financial distress if they exceed 0.5. Another study investigating the financial distress was conducted by Bhattacharjee and Han (2014) who enhanced the microeconomic analysis by including the role of macroeconomic factors on Chinese listed companies. It was emphasized that macroeconomic factors improving macroeconomic stability such as low inflation with high growth rates and decreasing current account gap, that poses risks to financial stability, play an important role on the financial conditions of firms. According to Bhattacharjee and Han (2014), firm characteristics and institutional factors are other micro and macro conditions having impact on financial distress in China. Moreover, their results are robust to unobserved heterogeneity at the firm level with the same macroeconomic environment.

The macroeconomic developments can transmit through domestic and foreign sectors due to their commercial and financial relationship. Thus, quantitative models departing from microeconomic foundations can be used to identify the channels of macroeconomic transmission in open-economics framework. In this respect, DSGE models can be a useful tool to analyze the relationship between micro- and macroeconomics dynamics. On the other hand, the disadvantage of DSGE models can be recognized that firm-level data cannot be incorporated into the theoretical model. Therefore, times series and econometric techniques can be adapted to the analysis of firm-level data. In this study, we explored the interactions between U.S. telecommunication, transportation and biotechnology sectors employing balance sheet accounts with panel data techniques. Another contribution to the existing literature is that we conduct impulse response and variance decomposition analysis of Panel-VAR model which allow us to determine the impact direction and contribution of shocks in balance sheet accounts on each other in the following periods. Hereby, we intend to shed light on the policy makers by making implications about the economic dynamics between these sectors.

3. RESEARCH METHODOLOGY

3.1. Empirical Model

In this study, PVAR modeling is employed to explore the interactions between biotechnology, telecommunications and transportation sectors using firm-level data. More specifically, we employ the balance sheet accounts of some stocks in NASDAQ Biotechnology Telecommunications and Transportation Indices. The selection of firm-level data is based on the 10 firms with the highest assets included in the relevant indices, whereupon we include cash ($cash_t$), common equity ($cequ_t$), current liabilities (cl_t), number of employees (emp_t), property (pro_t), total assets (ta_t). Within this context, we aim to show the effects of shocks in firm-level data on each other, and discuss the possible outcomes of these interactions on financial and macroeconomic variables by estimating IRFs and VDCs. The analysis period covers years between 2000-2013. All series are taken from the database of Thomson and Reuters.

3.2. Identification of PVAR Model

Vector autoregression (VAR) is a useful time-series model for detecting the linear interdependencies among macroeconomic and financial variables. Moreover, the structure of VAR models can constitute a base for the specification of other time-series and panel data models. If it is assumed that all the variables are endogenous and interdependent, a cross-sectional dimension can be included in the representation of VAR models (Canova and Ciccarelli 2013: 6). Accordingly, PVAR models can be derived and thus they can be estimated with or without fixed effects after some transformation using Ordinary Least Squares (OLS).

$$Y_{i,t} = Y_{i,t-1}A_1 + Y_{i,t-2}A_2 + Y_{i,t-p+1}A_{p-1} + Y_{i,t-p}A_p + X_{i,t}B + u_{i,t} + e_{i,t} \quad (1)$$

In equation (1), the lag length of the PVAR model are represented by p. Y_{it} is the $(1\times k)$ vector of dependent variables and $X_{i,t}$ denotes a $(1\times l)$ vector of exogenous

covariates. Thus, the $(k \times k)$ matrices $A_1, A_2, ..., A_{p-1}, A_p$ and the $(l \times k)$ matrix B refer to the model parameters. Dependent variable-specific fixed effects and idiosyncratic errors are expressed by $(1 \times k)$ vectors $u_{i,t}$ and $e_{i,t}$, respectively (Abrigo and Love 2015: 2). Lags of all endogenous variables of all units are added in the model for cross-section i, while $e_{i,t}$ is assumed to be correlated across i, and the intercept, the slope, and the variance of the shocks $e_{1,i,t}$ may be cross-section specific (Canova and Ciccarelli 2013: 8).

In fixed N and T settings, PVAR model estimations can be inconsistent; thus, generalized method of moments (GMM) method can be employed as an estimation strategy to improve the efficiency of the PVAR. On the other hand, a longer set of lags can be adopted as instruments, and this strategy may also reduce observations, especially with unbalanced panels or with missing observations. In this case, Holtz-Eakin et al. (1988) assumes that the instrument list cannot be correlated with the errors; more precisely, instruments are generated using observed realizations, substituting missing observations with zero. In this respect, consistent estimates of the PVAR model can be obtained by equation-by-equation GMM estimation. When a number of $L \geq kp + l$ instruments are added in vector $Z_{i,t}$, the model in (1) can be specified as below;

$$Y_{i,t}^{*} = \overline{Y_{i,t}^{*}} A + e_{i,t}^{*} \tag{2}$$

where the transformations of relevant variables are notated by asterisk. Accordingly, it can be expressed that $Y_{i,t}^{*} = [y_{i,t}^{1*}, y_{i,t}^{2*}, ..., y_{i,t}^{k-1}, y_{i,t}^{k*}]$, $\overline{Y_{i,t}^{*}} = [Y_{i,t-1}^{*}, Y_{i,t-2}^{*}, ..., Y_{i,t-p+1}^{*}, Y_{i,t-p}^{*}, X_{i,t}^{*}]$, $e_{i,t}^{*} = [e_{i,t}^{1*}, e_{i,t}^{2*}, ..., e_{i,t}^{k-1*}, e_{i,t}^{k*}]$ and $A^{'} = [A_1^{'}, A_2^{'}, ..., A_{p-1}^{'}, A_p^{'}, B^{'}]$ (Abrigo and Love 2015: 2–3).

In VAR type of models, Cholesky decomposition, as proposed by Sims (1980), influences the structure of the PVAR model and its impulse response estimations. VAR models can also be written in the moving average representation, thus adopting an infinite order vector moving average (VMA) representation can be used to estimate the impulse response functions and forecast error variance decompositions. The impulse response function Φ_i can be derived as an infinite VMA as follows:

$$\Phi_i = \sum_{j=1}^{i} \Phi_{t-j} A_j \qquad i = 1, 2, \ldots \tag{3}$$

In equation (3), $I_k = \Phi_0$ and a shock to one variable are accompanied by shocks to other variables as the innovations $e_{i,t}$ in model (1) are correlated contemporaneously. Accordingly, a matrix denoted as S can be employed to orthogonalize the innovations as $e_{i,t}S^{-1}$ and to transform the VMA parameters into the orthogonalized impulse responses $S\Phi_i$ (Abrigo and Love 2015: 6). Additionally, variance decomposition (VDC) determines the proportion of the movements in the dependent variables that are due to their own shocks, versus shocks to the other variables. More specifically, VDC exposes how much of the h step-ahead forecast error variance of a given variable is accounted for the exogenous shocks related to the other variables of VAR-type of models (Brooks 2008: 299-300).

4. RESULTS AND DISCUSSION

4.1. Panel Unit Root Analysis

In order to specify the appropriate type of panel data model, unit root properties of the variables of the empirical exercise have to be determined. In this respect, we employ the Levin–Lin–Chu (LLC) panel unit root tests (Levine et al., 2002), assuming that the persistence parameters are common across cross-sections. We also applied the panel unit root tests of Im et al. (2003), Fisher-ADF and Fisher-PP based on the assumption that persistence parameters vary across cross-sections. Furthermore, Pesaran's (2007) panel unit root test is performed to take into account cross-sections. All variables included in the empirical model are in levels and derived using plausible techniques.[‡] In this case, it is not possible to explore potential cointegration relationships among the variables and thus we analyze the relationship between include cash, common equity, current liabilities, number of employee, property, total assets with PVAR modeling.

[‡] Unit root test results can be provided upon request.

4.2. Empirical Analysis

As for the empirical exercise, we use PVAR modeling following the methodology of Abrigo and Love (2015) to estimate our PVAR model and its IRFs and VDCs. However, Nickell (1981) states that fixed effects estimators may be correlated with the regressors due to lags in the dependent variable. Thus, we implement the Helmert procedure to remove the fixed effects, allowing us to use the lagged regressors as instruments and estimate the coefficients using the GMM procedure similar to Gnimassoun and Mignon (2016) and Abrigo and Love (2015). We use the moment and model selection criteria (MMSC) proposed by Andrews and Lu (2001) to determine the optimal lag order in the PVAR specification, whereupon VDC and impulse response analysis based on a PVAR(1) model are conducted.

4.2.1. Results of Variance Decomposition Analysis

According to our variance decomposition analysis, current liabilities account for approximately 40% of the variation in cash account up to the following 14th period. In this respect, it can be inferred that current liabilities, which is an important part of liquidity position of a firm, has an important aspect in explaining cash position of the firm. The net operating working capital implies this relationship as well due to the corporate finance theory. Furthermore, an increase in current liabilities affects the liquidity of the firm badly, thus creating a weak cash position. Moreover, property and total assets have minor importance in analyzing the variation in the cash account. The reason for this issue may be the dominance of any current account over other long-term accounts. It is expected that cash account's lagged values have a significant impact on itself which underlines the importance of cash management.

Table 1. FEVD Analysis for cash account

	Impulse variable					
Forecast horizon	emp	shr	cl	ta	pro	cash
0	0	0	0	0	0	0
1	0.013786	0.019875	0.088561	0.025325	0.138374	0.714079
2	0.014021	0.054746	0.124672	0.025174	0.145569	0.635818
3	0.015224	0.07856	0.175198	0.028887	0.157187	0.544944
4	0.017017	0.08945	0.232576	0.035727	0.171632	0.453598
5	0.019024	0.091045	0.287153	0.044608	0.186884	0.371286
6	0.020953	0.087771	0.331857	0.054324	0.201258	0.303837
7	0.022641	0.082966	0.364006	0.063898	0.213721	0.252768
8	0.024024	0.078514	0.384372	0.072717	0.223857	0.216517
9	0.025097	0.075182	0.395402	0.080475	0.231669	0.192177
10	0.025884	0.073087	0.399864	0.087069	0.237392	0.176704
11	0.026421	0.07205	0.400163	0.092518	0.241359	0.167489
12	0.026745	0.071795	0.39812	0.096909	0.243925	0.162506
13	0.026895	0.072059	0.394995	0.100358	0.245422	0.160271
14	0.026907	0.072623	0.391597	0.102998	0.246141	0.159734

Table 2 indicates that current liabilities account is a crucial variable in explaining the variation in property account which is also another part of total assets. Over 26% of the variation in property account up to the following 14th period originates from the variation in current liabilities. It could be said that the management of current liabilities has an important effect in creating new investments and the change in gross fixed capital formation in the relevant sectors. As it's theoretically assumed and expected, the cash position has a pivotal importance in describing the change in property account. More precisely, we can well assert that improvements in cash positions of firms in various sectors can increase gross fixed capital formation which in turn triggers economic growth in the long-run. In the managerial respect, the variation in cash is an underlining factor representing the change in fixed asset investments.

Table 2. FEVD Analysis for property account

	Impulse variable					
Forecast horizon	emp	shr	cl	ta	pro	cash
0	0	0	0	0	0	0
1	0.029589	0.089144	0.076494	0.294935	0.509838	0
2	0.042738	0.102876	0.045104	0.349639	0.430722	0.028921
3	0.047996	0.120768	0.025405	0.364573	0.359503	0.081755
4	0.047604	0.138905	0.01391	0.354964	0.301796	0.142821
5	0.043985	0.154878	0.009067	0.332477	0.257116	0.202479
6	0.038859	0.167449	0.010552	0.304309	0.223366	0.255466
7	0.033283	0.176063	0.01873	0.274479	0.198401	0.299043
8	0.027864	0.180514	0.034252	0.245105	0.180476	0.331788
9	0.022925	0.180803	0.057689	0.217279	0.168294	0.353011
10	0.018628	0.177111	0.08915	0.191594	0.160927	0.36259
11	0.01504	0.169845	0.12793	0.168436	0.157703	0.361046
12	0.012176	0.159673	0.172286	0.148118	0.158083	0.349665
13	0.010026	0.147512	0.219488	0.130906	0.161544	0.330524
14	0.008565	0.134434	0.266218	0.116982	0.167509	0.306294

Our variance decomposition analysis reflects that the change in cash, property and current liabilities constitute nearly 75% of the variation in total assets. More specifically, our findings stress the importance of asset and debt management at the same time since growth of the firms is highly dependent on the increasing cash and current liabilities. In telecommunications, transportation and biotechnology sectors, where the managerial operations take place in short-term horizons, any kind of current accounts reflects the change of the one side of the balance sheet effectively.

Table 3. FEVD Analysis for total assets account

	Impulse variable					
Forecast horizon	emp	shr	cl	ta	pro	cash
0	0	0	0	0	0	0
1	0.002304	0.104024	0.272487	0.621185	0	0
2	0.00311	0.102427	0.355771	0.503967	0.010239	0.024486
3	0.015141	0.092368	0.436702	0.362246	0.043596	0.049947
4	0.038454	0.071841	0.499865	0.231296	0.103093	0.055451
5	0.066962	0.046445	0.529448	0.13766	0.178222	0.041263
6	0.090958	0.026243	0.520331	0.091172	0.247906	0.023391
7	0.103874	0.017748	0.484006	0.081819	0.295145	0.017408
8	0.105756	0.020193	0.438855	0.090962	0.317098	0.027137
9	0.100422	0.028994	0.398031	0.104344	0.32067	0.047539
10	0.091723	0.039908	0.366794	0.115367	0.314187	0.072022
11	0.082153	0.050397	0.345505	0.122396	0.303569	0.095979
12	0.072992	0.059333	0.332611	0.125872	0.292152	0.11704
13	0.064777	0.066404	0.326176	0.126768	0.281536	0.134339
14	0.057659	0.071696	0.324447	0.126002	0.272358	0.147839

Variance decomposition results of current liabilities reveal that the variation in property accounts for 27% of the change in current liabilities. Accordingly, it can be implied that increased investments and thus property can be debt-financed which increases current liabilities. Moreover, the variation in current liabilities constitutes of approximately 39% of the variance of itself, indicating high level of interactions between these two accounts since Table 1 shows that over 55% of the variation in cash account originates from change in both cash and current liabilities. This interdependence implies that cash and short-term debt management are two important, mutually complementary aspects of business management. Additionally, these factors can well have consequences on the dynamics of sectorial growth.

Table 4. FEVD Analysis for current liabilities account

	Impulse variable					
Forecast horizon	emp	shr	cl	ta	pro	cash
0	0	0	0	0	0	0
1	0.031501	0.001453	0.967046	0	0	0
2	0.024897	0.000947	0.963944	0.001169	0.008629	0.000414
3	0.021631	0.0011	0.945769	0.001304	0.029434	0.000762
4	0.021257	0.000777	0.913519	0.00077	0.062285	0.001391
5	0.023436	0.000564	0.865731	0.002511	0.10462	0.003138
6	0.027537	0.001732	0.803001	0.009482	0.150896	0.007352
7	0.0325	0.005358	0.730147	0.022442	0.194171	0.015383
8	0.037151	0.011676	0.65497	0.039567	0.228922	0.027714
9	0.040646	0.020047	0.58499	0.057812	0.252878	0.043627
10	0.042667	0.029402	0.525015	0.074533	0.266778	0.061605
11	0.043316	0.038733	0.476757	0.088255	0.272932	0.080008
12	0.042896	0.047331	0.439762	0.098586	0.273903	0.097522
13	0.041754	0.054813	0.412514	0.105798	0.27182	0.113301
14	0.040185	0.061045	0.393197	0.110449	0.268204	0.126919

Total shares outstanding are a part of owner's equity and thus changes in this account can have considerable impacts on the financial investor. Table 5 shows that the variation in total shares originates from the variation in cash, property and current liabilities, as 15%, 27% and 23%, respectively. Generally, it can be inferred that both changes in cash and property accounts underline the importance of asset management in terms of raising new capital. On the other hand, the change in current liabilities gives an opinion about how to analyze the leverage effect in terms of issuing new equity. Using the opportunities of raising external debt, firms in those sectors could issue new common stock and thus improve their capital structure. Since we found that the financial position of the enterprise is influenced by cash, property and current liabilities, we can infer that the tendency of making new investments is also influenced.

Table 5. FEVD Analysis for total shares outstanding account

	Impulse variable					
Forecast horizon	emp	shr	cl	ta	pro	cash
0	0	0	0	0	0	0
1	0.260735	0.739265	0	0	0	0
2	0.314063	0.640977	0.014875	0.016712	0.003396	0.009977
3	0.363533	0.540018	0.031221	0.034811	0.004659	0.02576
4	0.421652	0.453237	0.039311	0.043122	0.003654	0.039025
5	0.493531	0.377367	0.037797	0.040736	0.006313	0.044256
6	0.571045	0.303734	0.030328	0.032529	0.022677	0.039688
7	0.626904	0.227869	0.025641	0.027418	0.062412	0.029756
8	0.624846	0.156644	0.035041	0.034123	0.123709	0.025636
9	0.556027	0.104049	0.062684	0.052951	0.187784	0.036505
10	0.452178	0.075825	0.101146	0.075515	0.235209	0.060127
11	0.350297	0.06585	0.14049	0.09421	0.261437	0.087717
12	0.267524	0.065277	0.175581	0.10673	0.272124	0.112764
13	0.2055	0.068202	0.205446	0.113955	0.274049	0.132848
14	0.160302	0.071766	0.230733	0.117497	0.271814	0.147889

4.2.2. Results of Impulse Response Analysis

As a result of a positive shock in cash, all accounts except the property continue to increase up to 14th period. This pattern indicates that long-term investments are decreasing due to the cash inflow arising from selling fixed assets. Positive shocks in property, indicating additional new fixed assets, yield in a decrease in other related accounts. In order to make new investments any investor should rely on excessive cash, total assets and current liabilities. The cash position will decrease if there are new fixed asset investments. Moreover, in case of an increase in property short-term debt should increase due to leverage effect. Additionally, the increase in property affects the total assets negatively. Accordingly, we can infer that this change cannot be compensated with the increase in other assets. As theoretically expected, a positive shock in total assets results in increases of total shares outstanding, current liabilities, property and cash, respectively. This pattern indicates that an effective asset management could promote the sectorial growth. Our impulse response analysis also reveals that a positive shock in current liabilities yields in a rise in all

accounts except the property. In detail, short-term leverage effect has a diminishing impact on new fixed asset investment. This may be due to the fact that the external debt is balanced either by other current accounts or by owner's equity. The effect of total shares outstanding does not have a significant impact direction. More precisely, an increase in owner's equity positively affects total assets and property over the following period. Capital contribution is financed by long-term fixed asset investments and thus by total assets. On the other hand, the negative effect of total shares on the cash account could be explained with the help of property investments by means of cash. According to our results, we cannot detect any significant impact of total shares on current liabilities. This may be due to the fact that the current liabilities are more closely related to current assets, namely cash.

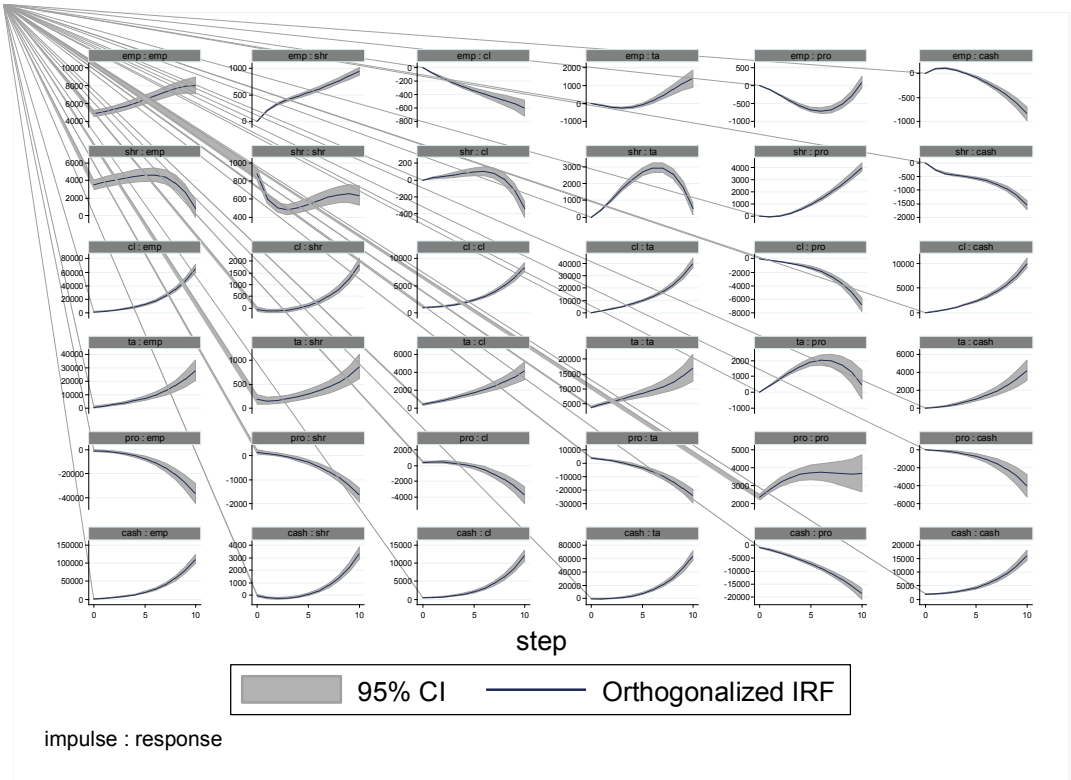

Figure 1. Impulse response results

According to impulse response analysis, we can generally infer that an increase in the number of employees may influence the financial strength of the firms in these sectors positively in the long-run. More precisely, it can also be implied that addition of new employees to these firms may have a rising effect on total factor productivity which in turn may trigger market value of firms. As a result of a positive shock in number of employees, total number of shares outstanding will grow ascending.

Moreover, current liabilities of these firms are descending while their total assets are positively affected. Increase in the total productivity due to additional employees may lead to an increase in new investments and total assets. However, the possible reason may be the increase in current assets such as accounts receivables and inventory.

5. CONCLUSION

In this study, a PVAR model is implemented in order to analyze the interactions between the balance sheet accounts of firms in biotechnology, telecommunications and transportation sectors quoted in NASDAQ stock exchange. Within this framework, we test the validity of liquidity, leverage and profitability effects whereas our impulse response and variance decomposition results both underline the existence of leverage effect in these sectors. More specifically, the impulse response analysis reveals that a positive shock in current liabilities yields in a rise in all accounts except the property. This reflects the short-term leverage effect which has a diminishing impact on new fixed asset investment. Moreover, it can be asserted that the external debt is balanced either by other current accounts or by owner's equity. FEVD results are also in line with IRF results. For instance, the variation in fixed asset investment plays an important role in explaining the variation in property account nearly to 30% up to the 14^{th} period. It can be emphasized that increased investments and thus property can be debt-financed which increases current liabilities.

We also intended to test the existence of liquidity by using the tools of PVAR model. According to our impulse response results, a positive shock in cash yields all accounts except the property account to increase up to 14^{th} period. Thus, it can be indicated that the decrease in long-term investments is due to the cash inflow arising from selling fixed assets. More precisely, generating excess cash by selling fixed assets may be due to a change in the operating sector and thus investing into new fixed assets. According to our FVED results, current liabilities explain approximately 40% of the variation in cash account up to the following 14^{th} period. As it can be inferred that liabilities are under the influence of credit policies of the banks, financial and macroeconomic conditions of US economy, the change in liquidity is not affected by firm-specific factors. Moreover, the positive difference between cash and current

liabilities accounts can be recognized as a major source of the financing new investments reflected in replacing old fixed assets.

As a result of PVAR estimations, it can be revealed that there may exist interdependence between liquidity and leverage effect. This interdependency is related directly to cash and current liabilities account. Thus, we can emphasize that a positive/negative change in net operating working capital of firms in these sectors may be due to a higher/lower increase in cash account than that of current liabilities account. On the other hand, we could not expose direct evidence supporting the profitability in biotechnology, telecommunications and transportation sectors. Impulse response results show that addition of new employees to these firms may have a rising effect on total factor productivity which in turn may positively affect the profitability.

When the microeconomic dynamics of US economy are considered, it can be recognized that biotechnology, telecommunications and transportation sectors are closely related to each other. Accordingly, inclusion of possible sectors into this interaction between these sectors is a crucial issue to be examined for further studies by researchers. Additionally, the role of quantitative models incorporating asymmetries, time-varying impacts and regime changes can be useful to determine the macroeconomics dynamics of US economy on biotechnology, telecommunications and transportation sectors.

6. REFERENCES

Abrigo, M.R.M., Love, I. (2016). “Estimation of Panel Vector Autoregression in Stata” *Stata Journal*, 16(3), 778–804.

Alifiah, M.N. (2014). “Prediction of Financial Distress Companies in the Trading and Services Sector in Malaysia Using Macroeconomic Variables” *Procedia - Social and Behavioral Sciences*, 129, 90–98. doi:10.1016/j.sbspro.2014.03.652.

Andrews, D.W.K., Lu, B. (2001). “Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models” *Journal of Econometrics*, 101(1), 123–164. http://doi.org/10.1016/S0304-4076(00)00077-4.

Bhargava, A. (2014). “Dividend payments and share repurchases of U.S. firms: an econometric approach” in: Lee, C.-F., Lee, J.C. (Eds.), Handbook of Financial Econometrics and Statistics. Springer.

Bhattacharjee, A., Han, J. (2014). "Financial distress of Chinese firms: Microeconomic, macroeconomic and institutional influences" *China Economic Review*, 30, 244–262. doi:10.1016/j.chieco.2014.07.007.

Bottazzi, G., Secchi, A. (2003). "Common Properties and Sectoral Specificities in the Dynamics of U.S. Manufacturing Companies" *Review of Industrial Organization*, 23, 217–232.

Brooks, C. (2008). "Introductory Econometrics for Finance", New York: Cambridge University Press.

Canova, F., Ciccarelli, M. (2013). "Panel Vector Autoregressive Models: A Survey" *ECB Working Paper Series*, (15), 1–53. doi:10.1108/S0731- 9053(2013)0000031006.

Carlson, R. (2016). "Estimating the biotech sector's contribution to the US economy" *Nature Biotechnology*, 34(3), 247–255.

Claessens, S., Ueda, K., Yafeh, Y. (2014). "Institutions and financial frictions: Estimating with structural restrictions on firm value and investment" *Journal of Development Economics*, 110, 107–122. doi:10.1016/j.jdeveco.2014.05.004.

Das, P.K. (2008). "Fundamentals, financial factors and firm investment in India: A Panel VAR Approach" *The Indian Economic Journal*, 55(4), 1–18.

Fricke, C., Menkhoff, L. (2015). "Financial conditions, macroeconomic factors and disaggregated bond excess returns" *Journal of Banking & Finance*, 58, 80–94. doi:10.1016/j.jbankfin.2015.03.015.

Gallet, C.A., List, J.A. (2001). "Market share instability: an application of unit root tests to the cigarette industry" *Applied Financial Economics*, 53, 473–480.

Gnimassoun, B., Mignon, V. (2016). "How do macroeconomic imbalances interact? Evidence from a panel VAR analysis" *Macroeconomic Dynamics*, 20(7), 1717–1741.

Goddard, J., Tavakoli, M., Wilson, J. (2005). "Determinants of profitability in European manufacturing and services: evidence from a dynamic panel model" *Applied Financial Economics*, 15, 1269–1282.

Hay, D. (2001) "The Post-1990 Brazilian Trade Liberalisation and the Performance of Manufacturing Firms: Productivity, Market Share and Profits" *The Economic Journal*, 111, 620–641.

Holtz-Eakin, D., Newey, W., Rosen, H.S. (1988). "Estimating Vector Autoregressions with Panel Data" *Econometrica*, 56(6), 1371–1395.

Im, K.S., Pesaran, M.H., Shin, Y. (2003). "Testing for unit roots in heterogeneous panels" *Journal of Econometrics*, 115(1), 53–74. http://doi.org/10.1016/S0304-4076(03)00092-7.

Kero, A. (2013) "Banks' risk taking, financial innovation and macroeconomic risk" *Quarterly Review of Economics and Finance*, 53(2), 112–124. doi:10.1016/j.qref.2013.01.001.

Kuosmanen, P., Nabulsi, N., Vataja, J. (2015). “Financial variables and economic activity in the Nordic countries” *International Review of Economics & Finance*, 37, 368–379. doi:10.1016/j.iref.2014.12.008.

Kwon, C.S., Shin, T.S. (1999). “Cointegration and causality between macroeconomic variables and stock market returns” *Global Finance Journal*, 10(1), 71–81. doi:10.1016/S1044-0283(99)00006-X.

Levine, R., Zervos, S. (1993). “What We Have Learnt About Policy and Growth from Cross- Country Regressions” *American Economic Review*, 83(2), 426–430.

Maio, P., Philip D. (2015). “Macro variables and the components of stock returns” *Journal of Empirical Finance*, 33, 287–308.

Memon, P.A., Rus, R.B.M., Ghazali, Z.B. (2015). “Firm and Macroeconomic Determinants of Debt: Pakistan Evidence” *Procedia - Social and Behavioral Sciences*, 172, 200–207. doi:10.1016/j.sbspro.2015.01.355.

Nickell, S.J. (1981). “Biases in dynamic models with fixed effects” *Econometrica*, 49(6), 1417–1426. http://doi.org/10.2307/1911408.

Nucci, F., Pozzolo, A.F. (2001). “Investment and the exchange rate: An analysis with firm-level panel data” *European Economic Review*, 45, 259–283.

Pesaran, M.H. (2007). “A simple panel unit root test in the presence of cross–section dependence” *Journal of Applied Econometrics*, 22(2), 265–312. http://doi.org/10.1002/jae.951

Poghosyan, T. (2013). “Financial intermediation costs in low income countries: The role of regulatory, institutional, and macroeconomic factors” *Economic Systems*, 37(1), 92–110. doi:10.1016/j.ecosys.2012.07.003.

Pradhan, R.P., Arvin, M.B., Hall, J.H., Bahmani, S. (2014). “Causal nexus between economic growth, banking sector development, stock market development, and other macroeconomic variables: The case of ASEAN countries” *Review of Financial Economics*, 23(4), 155–173. doi:10.1016/j.rfe.2014.07.002.

Resende, M., Lima, M.A.M. (2005). “Market share instability in Brazilian industry: a dynamic panel data analysis” *Applied Economics*, 37(6), 713–718.