Macroeconomic factors dynamics and firm performance in the United Kingdom

Kevin Pacini[#1], David Berg[*2], Thomas Tischer[#3], Peter Mayer, Jean Azam, and Joe Johnson

#*Research Department, Bank of England, London, United Kingdom*
[1]`kevin.j.pacini@gmail.com`

*Department of Economics, University of Bristol, Bristol, United Kingdom

[2]`david.berg@bristol.ac.uk`

Abstract - **How firms perform during the business cycle and what macroeconomic factors have the greatest influence on industrial firm performance? The purpose of this study is to study the impact of chosen macroeconomic factors on firm performance in the United Kingdom. To study effects of macroeconomic factors, panel data with instrumental variables were used between the period of 2000 and 2014 for top 100 firms in UK. As a result of the analysis, gross domestic product, inflation rate, and the rate of domestic debt interest payments to total income tax have a direct impact on firm performance. On the other hand, exchange rate, interest rate and the rate of short term foreign debts to central bank international reserves have an inverse relationship.**

Keywords - *Firm profitability; Macroeconomic factors; Panel data; Instrumental variables; Business cycle*

1. Introduction

Although there is a consensus that business cycles indicated by a variety of macroeconomic factors have material impact on microeconomic behaviours, there are not many studies to compare the importance of these macroeconomic factors. In this paper, we examine the impact of macroeconomic factors on performance of the top 100 firms in United Kingdom. The firm performance was measured by the profitability, which is the rate of the net value added to its total assets. It is also known as asset productivity. The top 100 largest firms play a major role in the United Kingdom. The performance of top 100 largest firms determines to the performance of British economy. The total exports of United Kingdom were £272.6 billion even as the top 100 largest firms exported £74.3 billion in 2015. The rate of created value added in industry by top 100 largest firms was 25.6% in 2014; 24.3% in 2015 with basic prices. The rate of created gross value added with production cost and GDP in industry by top 100 largest firms was 7.6% in 2014; 6.9% in 2015.

Therefore, this study represents the British economy and is essential for the analysis of United Kingdom.

The rest of the study is classified as follows. Section 2 is a brief review of recent studies that are related to this research. Section 3 discusses the data and Section 4 discusses the methodology. Empirical findings are presented in section 5 and section 6 concludes.

2. Literature

In existing studies, the effects of macroeconomic factors were mainly analysed for the banking system, stocks market, and profitability of companies. The following macroeconomic factors were selected: exchange rates, interest rate, inflation rate, money supply, cacao-oil-gold prices, economic activity level, default premium, maturity premium, slope of the yield curve, gross domestic product, unemployment, foreign direct investment, state debt, harmonized consumer price index, industrial production index, volume of trade, bank loans.

(i) The relation between the banking system and macroeconomic factors

Drake, Hall and Simper (2006) assess the relative technical efficiency of institutions operating in the market being affected by environmental and market factors in the Hong Kong banking system. The results indicate higher levels of technical inefficiency have higher impact on the financial sector in Hong Kong. Castro (2013) analyzes the link between the macroeconomic developments and the banking credit risk in a particular group of countries – Greece, Ireland, Portugal, Spain and Italy (GIPSI) – recently affected by unfavourable economic and financial conditions. The findings of the paper indicate that all macroeconomic factors, such as growth, employment, productivity and competitiveness and to reduce external and public

debt are fundamental to the credit risk in the banking system.

(ii) The relation between stock market and macroeconomic factors

There is a positive correlation between exchange rates and stock returns for multinational firms in the US, South Africa and Egypt (Jorion 1990); negative correlation in Tunisia, Ghana, Kenya, Mauritius and Nigeria (Adjasi, Biekpe, and Osei 2011). Also, there is a positive correlation between lagged changes in the dollar and current abnormal returns of US. firms (Bartov and Bodnar 1994). Conversely, it was found that macroeconomic variables, such as maturity premium, slope of the yield curve, change in monthly expected inflation, had no effect on stock returns in the Japanese and U.K. markets (Chan, Karceski, and Lakonishok 1998). The effects of macroeconomic factors were compared German stock returns to British stock returns (Altay 2003). Accordingly, the unexpected interest rate factor and the unexpected inflation factor affected asset returns of the German Stock Market, but it did not find any evidence for the British stock market.

(iii) The relation between profitability and macroeconomic factors

The relation between macroeconomic factors and profitability was studied since 1970s (Shapiro 1975). Shapiro (1975) described the components which affect the profitability as long-run and short-run components. Shapiro (1975) determined a negative correlation between permanent components and exchange rate, but a positive correlation between the transitory component and exchange rate. Furthermore, Pasiouras and Kosmidou (2007) analysed the profitability of banks which were evaluated in terms of the return on average assets and the macroeconomic conditions in the 15 EU countries over the period 1995-2001. Gao (2000) studied changes of unexpected exchange rate that affected the profitability of US multinational firms in the period 1988-1993. Firms' profitability was very sensitive to consumer price index (CPI) and Producer Price Index (PPI) in sectors of beverages and food in Borsa İstanbul from the period 1998 – 2007. On the other hand, it was found no relation between macroeconomic variables (inflation and growth rates) and profitability of companies in the Tunisian banking industry for the 1980-2000 period (Naceur 2003).

Profitability was evaluated by using several macroeconomic factors. Other studies used sector impacts, product differentiation and stage of product cycle (Caloghirou et al. 2004); differences of government, trade policies, technology efficiency, internal competition and culture (Ketelhöhn and Quintanilla 2012); firm strategy and the industry structure (Karabag and Berggren 2014, and Guo 2017); market power and more advanced operation (Canarella, Miller, and Nourayi 2013); economic growth, productivity, firm age and industry affiliation (Yazdanfar 2013) as indicator to explain the relationship with firms' profitability.

3.   Data

Economic profitability was evaluated by the rate of the net value added created by firms to its total assets. Profitability ratios of the 100 largest firms of the United Kingdom which represent the British economy have been used in the analysis. These firms are listed in the annual reports by Bank of England. The ranking of the top 100 firms is based on annual sales. The sectoral profitability ratios were compiled from annual reports each year regularly to the public. Ratios of the period of 2000-2014 are considered.

Estimating the effects of macroeconomic factors on profitability was used exchange rate, interest rate, inflation, gross domestic product (GDP), the rate of short term foreign debts to central bank international reserves, the rate of domestic debt interest payments to the net new borrowing and, the rate of domestic debt interest payments to total income tax. The definitions of these macroeconomic factors that affect the economic profitability are shown in Table 1.

Table 1- Macroeconomic Indicator in the Analysis

Independent Variables		Definition
EX	Exchange rate	In this study the exchange rate was based on the US dollar announced by the Central Bank of the United Kingdom at the end of the year.
INT	Interest rate	Annual interest rates, announced by the Central Bank of the United Kingdom, are used in the study.
INF	Inflation rate	Domestic producer price index is used as the inflation rate.
GDP	Gross Domestic Product	Market value of goods and services produced by labor and property in the United Kingdom.

FD	Rate of short term foreign debts to central bank international reserves (%)	Short term foreign debts /Central bank international reserves. The increase in this rate indicates an increasing amount of debt in the economy. This may result in a liquidity crisis.	
NB	Rate of domestic debt interest payments to the net new borrowing	Domestic debt interest payments / The net new borrowing This rate shows how much of the borrowing amount is used for debt interest payments.	
IT	Rate of domestic debt interest payments to total income tax	Domestic debt interest payments / Total income tax This rate shows how much of the tax income is used for debt interest payments.	

4.   Data

The data covers repeated observations on the same cross section of the sectors for the period of 2000-2014. Panel data was used to estimate the effects of macroeconomic factors that are dynamic in models containing lagged values of profitability. The estimation method was adopted from Shintani and Guo (2017). Shintani and Guo's dynamic factor estimators optimally exploit all the linear moment restrictions that follow from the assumption of no serial correlation in the errors, in an equation which contains individual effects, lagged dependent variables and no strictly exogenous variables. The main hypothesis and the regression model are shown below.

H1: Firm profitability is affected by macro-economic factors and lagged values of profitability. $(\sigma \neq 0)(B \neq 0)$

$$\Delta Y_{it} = Y_{it} - Y_{it-1} = \Delta\sigma Y_{it-1} + \Delta\beta_1 X_{1it} + \Delta\beta_2 X_{2it} + \Delta\beta_3 X_{3it} + \Delta\beta_4 X_{4it} + \Delta\beta_5 X_{5it} + \Delta\beta_6 X_{6it} + \Delta\beta_7 X_{7it} + \Delta u_{it,}$$

where

$X_{1,2,...7}$=EX, INT, INF, GDP, STFD/CBIR, DDIP/TNNB, DDIP/TIT, t= 1,2,....11 and i = 1,2,...,8.

Shintani and Guo (2017) proposed an estimator for serial correlation in the dynamic factors. This test calculates the first-order and second-order autocorrelation in the first-differenced errors. If the errors are serially independent, those in first-differences will exhibit first- but not second-order serial correlation. Because the first difference of

independently and identically distributed idiosyncratic errors will be serially correlated, rejecting the null hypothesis of no serial correlation in the first-differenced errors at order one does not imply that the model is mis-specified. Rejecting the null hypothesis at higher orders implies that the moment conditions are not valid.

The validity of instrumental variables is tested considering the Sargan test of over-identifying restrictions. All variables other than the lagged dependent variables are assumed to be strictly exogenous, although none of the over-identifying restrictions that follow from this assumption are exploited.

5.   Empirical Findings

The lagged dependent variable is statistically significant in explaining economic profitability and it has a positive sign as expected. Similarly, all independent variables are statistically significant for economic profitability. The rate of domestic debt interest payments to the net new borrowing, the rate of domestic debt interest payments to total income tax, GDP, inflation rate affect positively; the rate of short term foreign debts to central bank international reserves, exchange rate, interest rate affect negatively. Wald test was used to test overall significance of the statistical model. The model is statistically significant (p=0.0000<0.05) (Table 2).

Table 2 - Estimation and test results

	Coefficient	Standard Error	Z	P>IzI
Economic Profitability L1	0.308	0.109	2.84	0.005
EX	-3.553	0.754	-4.71	0.000
INT	-0.513	0.139	-3.7	0.000
INF	0.222	0.093	2.39	0.017
GDP	0.316	0.113	2.79	0.005
FD	-0.106	0.042	-2.50	0.012
NB	0.106	0.037	2.83	0.005
IT	0.193	0.069	2.79	0.005
Wald-test	$\chi^2(8) = 41.48$			
	p-value = 0.0000			
AR(1)	z = -6.2659			
	p-value = 0.0000			
AR(2)	z = 0.75455			

As expected, the output (Table 2) presents strong evidence (p=0.0000<0.05) against the null hypothesis of zero autocorrelation in the first-differenced errors at order 1 (AR1). However, the output above presents no significant evidence (p=0.4505>0.05) of serial correlation in the first differenced errors at order 2 (AR2) as expected.

The validity of instrumental variables was tested the Sargan test of over identifying restriction. The output presents evidence the null hypothesis is not rejecting, thereby over-identifying restrictions are valid as follows.

$$\chi^2 (44) = 49.22645$$

$$Prob > \chi^2 = 0.2719$$

The number of instruments in the model (p)=52

The number of parameters (k)=8

6.   Conclusion

The top 100 largest firms' profitability was affected by macroeconomic factors which were defined as independent variable. The performance of these firms plays a major role in the British economy. The performance evaluated economic profitability that is the rate of the net value added created by firms to its total assets. The sectoral profitability ratios were compiled from annual reports each year regularly declared to the public according to sectors for the period of 2000-2014. Macroeconomic factors are exchange rate, interest rate, inflation rate, gross domestic product, the rate of short term foreign debts to central bank international reserves, the rate of domestic debt interest payments to the net new borrowing and, rate of domestic debt interest payments to total income tax in the analysis. Lagged values of profitability, the rate of domestic debt interest payments to the net new borrowing, the rate of domestic debt interest payments to total income tax, GDP, inflation rate have a positive effect; the rate of short term foreign debts to central bank international reserves, exchange rate, interest rate have negative effects.

The rate of short term foreign debts to central bank international reserves shows the share of the short term foreign debt payments with respect to the reserves of the central bank and the increase in this rate can be interpreted as an increase in the debt of the economy and liquidity trouble. There is a

negative relationship between this rate and profitability. The increase in this rate leads to the economic crisis of liquidity. While foreign debt payments are increasing, international reserves are expected to decline. By increasing the central bank international reserves through the increase in foreign exchange inflows to the country (e.g. increase in exports and decrease in imports), this rate can be lowered. For this reason, it is expected that there is a negative relationship between profitability and this rate.

The rate of domestic debt interest payments to the net new borrowing shows how much of the borrowing amount is used for debt interest payments. The rate of domestic debt interest payments to the net new borrowing represents the share of the government's domestic debt payments in the new borrowing. The high rate indicates that the government hasn't paid its debts with new debt. This low rate indicates that the debt is paid by borrowing new debt. The government owes to invest in or to pay interest. In the study, there is a positive relationship between profitability and this rate. Because government uses tax revenues, other revenues or owes to make domestic debt interest payments on Treasury bonds and bills. Accordingly, if tax revenues are increased instead of borrowing, this rate will increase. An increase in tax revenues can be related to profitability. Therefore, when the tax revenues increase, the government will charge more taxes to pay the domestic debt interest payments. Therefore, tax incomes should be considered when assessing this rate.

The rate of domestic debt interest payments to total income tax shows how much of the tax income is used for debt interest payments. There is a positive relationship between this rate and profitability. If the government pays interest on domestic debt from collecting taxes and uses the savings rather than tax only in the payment, it can be said that there is a positive relationship between this rate and profitability. It was stated that one of the main reasons for the positive relationship between the rate of domestic debt interest payments to the net new borrowing, the rate of domestic debt interest payments to total income tax, GDP, inflation rate, and profitability could be increase in tax revenues due to the increase in the profitability and used for domestic debt interest payments. The positive relationship between the rate of domestic debt interest payments to total income tax and profitability

confirms this expression. The tax burden will increase as the incomes of the enterprises increase. In addition to real investment, businesses can invest in bonds and treasury bills. Therefore, there is a negative relationship between domestic debt interest payments and profitability due to the increase in tax revenues.

Gross domestic product is the currency value of goods and services produced in a country in a given period. Therefore, as the goods and services produced in the country increase, the profitability is expected to increase. There is a negative relationship between the interest rate and the inflation rate. The increase in the general level of prices is inflation. Inflation occurs if the demand for goods and services produced in a country exceeds production. In addition, the increase in the payments made to the production factors and the payments made to the inputs used in the production are reflected in the prices, which causes the inflation. Therefore, it is expected that inflation will increase as the production amount will increase as the profitability of the enterprises increases. On the other hand, if interest rates increase, this investment will be directed and will have an effect on reducing inflation.

It is seen that the increase in the exchange rate will decrease the profitability because the enterprises using input from abroad will increase their costs. However, when the number of exporting enterprises increases, the cost increase for input will create a greater added value in the sale of goods, so this time will have a positive effect. Since the majority of manufacturing enterprises in The United Kingdom use imported inputs, the increase in the exchange rate also reflects the costs in the short term. However, since sales prices can't be increased in the short term, this situation will result in a decrease in the profitability of the enterprises.

References

[1] Adjasi, C., N. Biekpe, and K. Osei (2011). Stock prices and exchange rate dynamics in selected African countries: a bivariate analysis. *African Journal of Economic and Management Studies* 2(2): 143-164.

[2] Altay, E. (2003). The effect of macroeconomic factors on asset returns: a comparative analysis of the German and the British stock markets in an APT framework. Working paper.

[3] Bartov, E., and G. Bodnar (1994). Firm valuation, earnings expectations, and the exchange-rate exposure effect. *Journal of finance*: 1755-1785.

[4] Caloghirou, Y., A. Protogerou, Y. Spanos, and L. Papagiannakis (2004). Industry-versus firm-specific effects on performance: contrasting SMEs and large-sized firms. *European Management Journal* 22(2): 231-243.

[5] Canarella, G., S. Miller, and M. Nourayi (2013). Firm profitability: mean-reverting or random-walk behaviour? *Journal of Economics and Business* 66: 76-97.

[6] Castro, V. (2013). Macroeconomic determinants of the credit risk in the banking system: the case of the GIPSI. *Economic Modelling* 31: 672-693.

[7] Chan, L., J. Karceski, and J. Lakonishok (1998). The risk and return from factors. *Journal of Financial and Quantitative Analysis* 33(2): 159-188.

[8] Drake, L., M. Hall and R. Simper (2006). The impact of macroeconomic and regulatory factors on bank efficiency: A non-parametric analysis of Hong Kong's banking system. *Journal of Banking & Finance* 30(5): 1443-1466.

[9] Gao, T. (2000). Exchange rate movements and the profitability of US multinationals. *Journal of International Money and Finance* 19 (1): 117-134.

[10] Guo, Z. (2017). Health Insurance and the Demand for Medical Care: a Case Study from China. *Asian Journal of Economics and Empirical Research* 4(1) 8-13.

[11] Jorion, P. (1990). The exchange-rate exposure of US multinationals. *Journal of business*: 331-345.

[12] Karabag, S. and C. Berggren (2014). Antecedents of firm performance in emerging economies: business groups, strategy, industry structure, and state support. *Journal of Business Research* 67(10): 2212-2223.

[13] Ketelhöhn, N. and C. Quintanilla (2012). Country effects on profitability: a multilevel approach using a sample of Central American firms. *Journal of Business Research* 65(12): 1767-1772.

[14] Naceur, S. (2003). The determinants of the Tunisian banking industry profitability: Panel Evidence. Universite Libre de Tunis working papers.

[15] Pasiouras, F. and K. Kosmidou (2007). Factors influencing the profitability of domestic and foreign commercial banks in the European Union. *Research in International Business and Finance* 21(2): 222-237.

[16] Shapiro, A. (1975). Exchange rate changes, inflation, and the value of the multinational corporation. *Journal of Finance* 30(2): 485-502.

[17] Shintani, M. and Z. Guo (2017). Improving the finite sample performance of autoregression estimators in dynamic factor models: a bootstrap approach. *Econometric Reviews*, forthcoming.

[18] Yazdanfar, D. (2013). Profitability determinants among micro firms: evidence from Swedish data. *International Journal of Managerial Finance* 9(2): 151-160.