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Monetary Policy Shocks, Financial Constraints and Firm-Level Equity Return: Panel Evidence

(Kejutan Dasar Monetari, Kekangan Kewangan, dan Pulangan Ekuiti Firma: Bukti Panel)

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ABSTRACT

The present paper investigates the effect of monetary policy shocks upon the equity returns of financially constrained and less-constrained firms in Malaysia for the 1990-2008 period using firm-level data. Monetary policy shocks are generated via a recursive structural VAR (SVAR) identification scheme that allows the monetary authority to set the overnight interbank rate after observing the current value of world oil price, foreign income, foreign monetary policy, domestic output and inflation. The Malaysian firms examined are divided into two categories based upon the cash flow to income ratio, namely financially constrained and financially less-constrained. After augmenting the Fama and French (1992, 1996) multifactor model using a dynamic panel data approach, the results reveal that equity returns of financially constrained firms are more affected by domestic monetary policy than the returns of less constrained firms. Meanwhile, international monetary policy shocks significantly influence the equity returns of financially less-constrained firms, but not those of financially constrained firms.

Keywords: Monetary policy; financial constraints; augmented Fama-French; dynamic panel data

ABSTRAK

Kertas ini mengkaji kesan kejutan dasar monetari ke atas pulangan ekuiti firma yang mempunyai kekangan kewangan dan kurang kekangan kewangan di Malaysia untuk tempoh 1990-2008 dengan menggunakan data pada peringkat firma. Kejutan dasar monetari dijana melalui skema pengenalpastian model rekursif VAR berstruktur yang mana membenarkan pihak berkuasa kewangan menentukan kadar bunga semalaman antara bank selepas membuat pemerhatian terhadap nilai semasa harga minyak dunia, pendapatan asing, dasar kewangan asing, output domestik dan inflasi. Firma juga telah diasingkan kepada dua kategori iaitu firma yang mengalami kekangan kewangan, dan firma yang kurang kekangan berasaskan kepada nisbah aliran tunai kepada pendapatan. Dengan menggunakan imbuhan terhadap model multi faktor Fama-French (1992, 1996) yang dianggar dengan kaedah data panel dinamik, keputusan kajian menunjukkan pulangan ekuiti firma yang mempunyai kekangan kewangan lebih dipengaruhi oleh dasar kewangan domestik berbanding firma yang kurang kekangan. Walau bagaimanapun, kejutan dasar kewangan antarabangsa secara signifikan mempengaruhi pulangan ekuiti firma yang mengalami kurang kekangan kewangan, tetapi tidak mempengaruhi firma yang mengalami kekangan kewangan.

Kata kunci: Dasar monetari; kekangan kewangan; imbuhan Fama-French; data panel dinamik

INTRODUCTION

The present study examines the effects of monetary policy shocks (domestic and international monetary policy) on the equity returns of financially constrained and less-constrained firms in Malaysia, which is an emerging market economy. First, an identified monetary policy change series is generated via an open economy recursive structural VAR (SVAR) identification scheme. Second, firm stock returns are assumed to follow an augmented Fama and French (1992, 1996) multifactor model, which is estimated using a dynamic panel technique within a generalized method of moment (GMM) framework. Finally, the firm-level data set is divided into two categories following the methodology proposed by Kaplan and Zingales (1997): financially constrained firms and less constrained firms.

Theoretically, the negative response of stock market returns to monetary policy changes can be explained by two theories, namely the 'financial propagation' mechanism proposed by Bernanke and Gertler (1989); and the 'credit channel' mechanism discussed by Bernanke and Gertler (1995). First, according to the 'financial propagation' mechanism, an adverse monetary policy shock raises the information and agency costs associated with external finance, which generally reduces access to bank loans and external finance. The resulting situation forces firms to decrease investment levels and eventually reduces the cash flow and stock returns. Second, under the 'credit channel' mechanism, the effect of monetary policy on equity return works through the 'balance sheet channel' and the 'bank lending channel.' The mechanism under the balance sheet channel is similar to the 'financial propagation' mechanism. In contrast, under the bank lending channel, a contraction of monetary policy is expected to cause banks to decrease the supply of loans and charge higher interest rates for new loan contracts, subsequently causing a decline in the cash flow, real earnings and stock returns of affected firms.

The present study is of particular interest for two reasons. First, a good understanding of why an individual stock return reacts so differently to monetary policy is crucial for both monetary authorities and financial market participants. For example, a monetary authority needs to know which categories of firms are more severely affected during monetary policy tightening. Thus, the most affected firms/sector may require financial assistance during a period of tight monetary policy. In contrast, for financial market participants, the heterogeneous effects of monetary policy on equity return is crucial for their investment plan, particularly for formulating effective investments and risk management decisions. Second, the effects of monetary policy on financial constraints are also related to the credit channel theory. Thus, the effect of monetary policy on firms (e.g., equity return) tends to be asymmetric. In particular, firms that are financially constrained are likely to be more strongly affected by changes in interest rates than firms that are less constrained. For example, Lamont et al. (2001) find that financially constrained firms react more strongly to changes in monetary policy or to business cycle conditions than less constrained firms.

The contributions of the present study stem from the fact that it differs from extant studies in four ways. First, the present paper is the first attempt (as far as can be established) to estimate how Malaysian monetary policy shocks affect the firm-level stock returns in settings that are subject to financial constraints and less-constraints. Second, the present study identifies monetary policy changes using a recursive structural VAR (SVAR) identification scheme. A few extant studies examine the link between a monetary policy measure and aggregate stock returns (e.g., Habibullah & Baharumshah 1996; Ibrahim 1999; Ibrahim & Aziz 2003), but none of these studies use identified monetary policy changes. Third, while several extant studies examine the determinants of firm-level stock returns in Malaysia, such studies ignore the effects of domestic and international monetary policy shocks in modeling the firm-level equity return (e.g., see Allen & Cleary 1998; Clare & Priestley 1998; Lau et al. 2002; Shaharudin & Fung 2009]. Finally, the present study uses the generalized method of moment (GMM), which is a panel data technique, proposed by Arellano and Bond (1991), Arellano and Bover (1995) and recently extended by Blundell and Bond (1998). The advantage of utilizing the technique is that it addresses the Nickell (1981) bias associated with fixed effects in short panels (i.e., bias due to the presence of the lagged dependent variable and bias due to the endogeneity of other explanatory variables).

The results of the present study indicate that differential effects of monetary policy shocks (domestic and international) upon firm-level equity return exist in an emerging market economy (i.e., Malaysia). The equity returns of financially constrained firms are more significantly affected by domestic monetary policy shocks than less constrained firms. In addition, the equity return of financial constraints firms are significantly affected by international monetary policy shocks.

The remainder of the paper is organized as follows. Section 2 briefly reviews the previous literature and Section 3 discusses the research methodology. Section 4 presents the main empirical results and a variety of robustness tests utilized in the present study. Finally, section 5 summarizes and concludes the present study.

REVIEW OF LITERATURE

It is generally believed that individual stock returns react differently to monetary policy according to their size (small and large firms); sub-sector economic activity; and financially constrained and less-constrained firms. Therefore, understanding why individual stock returns react so differently to monetary policy is an interesting issue to investigate. For example, Bernanke and Blinder (1992) and Kashyap et al. (1993) argue that a contraction of monetary policy predominantly affects firms that are heavily dependent on bank loans, since banks respond to a monetary contraction by shrinking their overall supply of credit.[1] Therefore, under imperfect capital markets with information asymmetries, the stock prices of firms listed on stock exchanges respond to monetary policy in different ways (Ehrmann & Fratzscher 2004). Specifically, small firms that have less information are more affected by monetary policy contraction than large firms because banks tend to reduce their credit lines. Small firms have difficulty finding alternative sources of financing during such periods, which can lead to a constraint of the supply of their goods.

Literature concerning the credit channel states that the effects of monetary policy upon firm-equity returns also differ according to whether firms are financially constrained or less-constrained. In particular, firms that are financially constrained are likely to be more strongly affected by changes in interest rates than firms that are less constrained. The equity returns of financially constrained firms respond more to monetary policy tightening because of their inability to fund investment due to credit constraints or an inability to borrow; an inability to issue equity; and dependence upon bank loans or the illiquidity of assets. In contrast, the equity returns of unconstrained firms are less responsive to monetary policy shock because such firms are enabled to access external financing due to the good credit condition. For example, a study by Perez-Quiros and Timmermann (2000), which uses the size of firms as a proxy for the degree of credit constraints, finds that the returns of smaller firms are more affected by monetary policy tightening than the returns of larger firms.

Ehrmann and Fratzscher (2004) use more direct measures of financial constraints: the cash flow to income ratio; the ratio of debt to total capital; and Moody's investment and bank loan rating. The study finds that the response of financially constrained firms with low cash flow, poor credit ratings, low debt to capital ratios, high price-earning ratios, and high Tobin's q to changes in monetary policies is more significant than the response of less constrained firms. In theory, firms with large cash flows should be immune to changes in interest rates because they can rely more heavily upon internal financing of investment. Firms with a lower debt to capital ratio are more affected by changes in monetary policies because they are more bank-dependant. The findings are supported by Basistha and Kurov (2008), who show that the size of the response of stock returns to monetary policy shocks in the US is more than twice as large during periods of recession and tight credit conditions than during periods of good economic conditions. The response of a firm stock returns to monetary news depends on the individual credit characteristics of the firm. For example, the equity returns of companies that are likely to be credit constrained react more strongly to monetary news during recessions and in tight credit market conditions than companies that are relatively unconstrained.

Most extant literature concerning the stock market channel focuses upon the effect of domestic monetary policy. Little interest has existed in investigating the effect of international monetary policy shocks on domestic market stock returns. For example, Conover et al. (1999) find that the equity markets in several countries react more strongly to US monetary policy than to local monetary policy. The response of stock markets is generally higher in expansive than in restrictive US monetary policy periods. Ehrmann et al. (2005) estimate the effect of US monetary policy on stock markets for the Euro area and find that a 100 basis point increase in US monetary policy drops Euro area stock markets by nearly 2 percent. In comparison, the effect of Euro monetary policy on the US stock market is relatively smaller at 0.5 percent. Ehrmann and Fratzsche (2006) analyze 50 equity markets worldwide and find that, on average, global equity market returns fall by 3.8 percent in response to a 100 basis point tightening of US monetary policy. Some countries have experienced stock return declines of more than 10 percent in response to the US monetary policy shocks, including Indonesia, Korea and Turkey.

A few studies (e.g., see Habibullah & Baharumshah 1996; Ibrahim 1999; Ibrahim & Aziz 2003) examine the link between monetary policy and aggregate stock returns in the Malaysian context, but none of these studies use identified monetary policy changes. All of the aforementioned studies find that monetary policy plays a significance role in influencing the Malaysian stock returns. Similarly, Allen and Cleary (1998), Clare and Priestley (1998), Lau et al. (2002) and Shaharudin and Fung (2009) examine the determinants of firm-level stock returns in Malaysia. However, these studies ignore the role of monetary policy variables in modeling the equity return. A recent study by Karim et al. (2011) examines the effects of international and domestic monetary policies upon firm-level equity return according to firm size and sub-sector economy. However, the study does not consider how the equity returns of financially constrained firms and less-constrained firms respond to monetary policy shocks.

Therefore, against this background, the present study makes a novel contribution to the literature by examining the effects of monetary policy shocks (domestic and international monetary policy) on equity returns using a disaggregated firm-level data set in an emerging market economy (i.e., Malaysia). The focus of the present study is to examine the effects of monetary policy on the firm-level stock returns of financially constrained firms and less-constrained firms.

RESEARCH METHODOLOGY

BASELINE MODEL

When investigating the effects of monetary policy on the stock returns of firms, the present study adds two monetary policy variables to the Fama and French (1992, 1996) three factor model[2]: domestic monetary policy and international monetary policy In addition to the monetary policy variables, other variables are also been considered in the model employed in the present study, including international market returns and four firm specific financial variables. Therefore, the baseline augmented Fama and French (1992, 1996) multifactor model can be represented as follows:

$$\begin{aligned} R_{it} - RF_t = {} & \alpha_0 + \beta_1[(RM_t) - RF_t] + \beta_2(SMB_t) + \\ & \beta_3(HML_t) + \beta_4[(IR_t) - USTB_t] \\ & + \beta_5 DMPS_t + \beta_6 IMPS_t + \beta_7 RSALEG_{i,t-1} \\ & + \beta_8 \text{In}\left(\frac{BV_{i,t-1}}{MV_{i,t-1}}\right) + \beta_9 \text{In}\left(\frac{LIQ_{i,t-1}}{TA_{i,t-1}}\right) \\ & + \beta_{10} \text{In}\left(\frac{DEBT_{i,t-1}}{EQUITY_{i,t-1}}\right) + \varepsilon_{it} \end{aligned} \quad (1)$$

In Equation (1), there are two types of risk-free interest rates: the Malaysian twelve months Treasury Bill rate (*RF*) and the US twelve month Treasury Bill rate (*USTB*). Therefore, Equation (1) can be re-expressed in term of excess returns[3] as follows:

$$\begin{aligned} r_{it} = {} & \alpha_0 + \beta_1 rm_t + \beta_2(SMB_t) + \beta_3(HML_t) + \beta_4 ir_t \\ & + \beta_5 DMPS_t + \beta_6 IMPS_t + \beta_7 RSALEG_{i,t-1} \\ & + \beta_8 \text{In}\left(\frac{BV_{i,t-1}}{MV_{i,t-1}}\right) + \beta_9 \text{In}\left(\frac{LIQ_{i,t-1}}{TA_{i,t-1}}\right) \\ & + \beta_{10} \text{In}\left(\frac{DEBT_{i,t-1}}{EQUITY_{i,t-1}}\right) + \varepsilon_{it} \end{aligned} \quad (2)$$

DEFINITIONS AND EXPLANATIONS OF THE VARIABLES

The dependent variable in the present study (i.e., the i^{th} firm's stock returns) is measured in terms of excess returns (r_{it}) as follows:

$$r_{it} = \left[\frac{SP_{it} - SP_{i,t-1}}{SP_{i,t-1}} + DY_{it} \right] - RF_t \quad (3)$$

Where SP_{it} is the closing stock price at year-end for firm i at time t; DY_{it} is the dividend yield for firm i at year-end at time t; and RF_t is a risk-free asset proxy (i.e., the Malaysian twelve months Treasury bill rate).

The independent variables of the present study may be categorized into (i) market return variables; (ii) firm specific characteristics; and (iii) monetary policy shocks.

Market Return Variablesrm Two market return variables are included in Equation (2), namely domestic (*RM*) and international market (*IR*) returns. The domestic market return (*RM*) is proxied by the return of the Kuala Lumpur Composite Index (KLCI). The domestic market return is also expressed in term of excess returns as follows:

$$rm_t = \left(\frac{KLCI_t - KLCI_{t-1}}{KLCI_{t-1}} \right) - RF_t \quad (4)$$

As international financial market integration increases, international market returns (*IR*) become more important in influencing the stock returns of domestic returns. Therefore, the return of Standard & Poor 500 Index (SP500) is used as a measurement of an international market return. The selection of this variable is reasonable given that the Malaysian stock market is an emerging and relatively small market that is exposed to international financial conditions, particularly to stock market developments in large countries such as the US. Therefore, the international market return, in terms of excess return, can be expressed as follows:

$$ir_t = \left(\frac{SP500_t - SP500_{t-1}}{SP500_{t-1}} \right) - USTB_t \quad (5)$$

where, *USTB* is the 12 months US Treasury Bill rate as a proxy for a risk-free asset.

Firm Financial Characteristics In Equation (2), four firm specific financial variables are considered in the multifactor model. The variables include the ratio of book value to market value (BVMV); leverage (debt-equity ratio); real sales growth; and liquidity ratio. These variables capture the role of company-specific, idiosyncratic risk factors in explaining the returns. All firm specific variables are expressed with a lagged effect in the augmented multifactor model. All variables, except real sales growth, are been transformed into logarithms.

BVMV is the ratio between the book value (BV) of common equity and the market equity (MV) at the fiscal year-end in the previous period. Stocks with high BVMV tend to exhibit higher average returns, while stocks with low BVMV ratios tend to exhibit lower returns. This is because a financially strong and established company will have a relatively high book value (strong balance sheet position), which results in a high BVMV as well.

Firm financial leverage (debt-equity ratio) also plays an important role as a risk factor in explaining the equity returns. For example, firms with higher leverage (higher debt-equity ratio) are likely to experience a greater price decline because of concerns regarding the possible inability of such firms to make interest and loan payments, which may lead to bankruptcy (Wang et al. 2009). Therefore, the relationship between financial leverage and returns should be negative.

The liquidity ratio is measured as liquid assets (LIQ) divided by total assets (TA). Liquid assets are comprised of the total cash plus the marketable securities of a firm. Liquidity is found to be an important factor in explaining stock returns. As argued by Wang et al. (2009), investors favor the stocks of firms with larger cash holdings than cash-constrained firms because a high liquidity level indicates that the firm is better able to meet its maturing obligations. Firms with higher liquid assets are safer against bankruptcy risks because higher cash holdings reduce the probabilities that a cash shortage will force the firms into default. Therefore, a positive sign is predicted for the effect of liquidity ratio upon firm equity returns.

The important role of sales growth in explaining stock returns is examined by Lakonishok et al. (1993), Davis (1994) and Lau et al. (2002). All of these studies find that stock returns are negatively related to past sales growth. Lakonishok et al. (1993) argue that stocks with high past sales growth are typically glamour stocks and stocks with low past sales growth are out-of-favor or value stocks. Lakonishok et al. (1993) find that stocks with low growth in sales (value stocks) earn an abnormal return of 2.2 percent, whereas stocks with high growth in sales (glamour stocks) earn an abnormal return of -2.4 percent. The finding indicates that the value stock outperforms the glamour stock.

In order to control for inflation, firm sales are expressed in real terms (*rsales*) by dividing the year-end nominal sales in period *t* by the consumer price index (*CPI*) in period *t*. Therefore, the firm real sales growth (*RSALESG*) is calculated as follows:

$$RSALESG_{it} = \left[\frac{rsales_{i,t} - rsales_{i,t-1}}{rsales_{i,t-1}} \right] \quad (6)$$

Monetary Policy Shocks An important issue in any evaluation of the effects of a monetary policy is the appropriate identification of a monetary policy. Two monetary policy variables are included in Equation (2): domestic monetary policy shocks (*DMPS*) and international monetary policy shocks (*IMPS*). In order to deal with the endogeneity problem associated with monetary policy variables, monetary policy is measured by a recursively identified structural VAR (SVAR). The SVAR model is estimated with six variables in level form. The data are at a monthly frequency, spanning January 1990 until December 2008, and are collected from the International Monetary Fund (IMF) database. According to the Akaike information criteria (AIC), the optimal lag length is six months. The SVAR-A model proposed by Amisano and Giannini (1996) can be expressed as follows:

$$A_0Y_t = \Gamma_0 D_0 + A(L)Y_t + \varepsilon_t \quad (7)$$

where A_0 is an invertible square matrix of coefficients relating to the structural contemporaneous interaction between the variables in the system. Y_t is a (6×1) matrix or $[LOIL\ LYUS\ FFR\ LYM\ INF\ IBOR]'$ that is the vector of system variables, where *LOIL* is log of world oil price (in US$ per barrel); *LYUS* is log of US income proxy by Industrial Production Index; *FFR* is the US Federal Fund Rate as a proxy for an international monetary policy stance; *LYM* is log of Malaysian income proxy by Industrial Production Index; *INF* is the inflation rate which is computed from the Consumer Price Index (CPI); and *IBOR* is the inter-bank overnight rate as a proxy for domestic monetary policy. D_0 is a vector of deterministic variables, which may include constant, trend and dummy variables; $A(L)$ is a k^{th} order matrix polynomial in the lag operator L; and $\varepsilon_t = [\varepsilon_{loil}\ \varepsilon_{lyus}\ \varepsilon_{ffr}\ \varepsilon_{lym}\ \varepsilon_{inf}\ \varepsilon_{ibor}]$ is the vector of structural shocks which satisfies the conditions that $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_s) = \Omega_\varepsilon = I$ (identity matrix] for all $t = s$.

International monetary policy (FFR), which is based upon US monetary policy, is assumed to respond contemporaneously to world oil prices and v income. In contrast, domestic monetary policy variables, which is based upon the interbank overnight rate (IBOR), is ordered last in the VAR system by assuming the Malaysian monetary policy contemporaneously responds to all variables in the VAR. However, Equation (7) cannot be directly observed or directly estimated to derive the true value of A_0, $A(L)$ and ε_t. Hence, Equation (7) is estimated by transforming it into the following reduced form representation:

$$Y_t = A_0^{-1}\Gamma_0 D_0 + A_0^{-1}A(L)Y_t + A_0^{-1}\varepsilon_t \quad (8)$$

or

$$Y_t = \Pi_0 D_0 + \Pi_1(L)Y_t + \mu_t \quad (9)$$

where, $\Pi_0 = A_0^{-1}\Gamma_0$, $\Pi_1 = A_0^{-1}A(L)$, $\mu_t = A_0^{-1}\varepsilon_t$ and $E(\mu_t\mu_t') = A_0^{-1}\Omega A_0^{-1'} = \Sigma$.

Monetary policy structural shocks are generated from $\mu_t = A_0^{-1}\varepsilon_t$. Monthly monetary policy shocks are computed by mapping the residual from the reduced form VAR, ε_t with contemporaneous matrix A_0. Then, monthly structural shocks of a given year are cumulated in order to compute the annual monetary policy shock.

DYNAMIC PANEL DATA

The firm-level equity returns in the current year can also be explained by its past returns.[4] Some studies, such as Jegadeesh (1990), Jegadeesh and Titman (1993), Grinblatt and Moskowitz (2004) and Wang et al. (2009), conclude that past returns contain information about current expected returns. Therefore, the dynamic version of the augmented Fama and French (1992, 1996) multifactor model in Equation (2) can be rewritten as follows:

$$r_{it} = \sum_{j=1}^{p} \alpha_j r_{i,t-j} + \beta_1' X_t + \beta_2' X_{it} + \delta_1' W_t + \eta_i + v_{it} \quad (10)$$

for $i = 1,...., N$ and $t = 1,...., T$

where, r_{it} is the firm stock return (excess return) as the dependent variable; $r_{i,t-j}$ is the lagged dependent variable (past excess returns); X_t and X_{it} are weakly exogenous (endogenous) or predetermined variables; and W_t is the strictly exogenous variable. In addition, the error term ($\varepsilon_{it} = \eta_i + v_{it}$) is assumed to follow a one-way error component model, where η_i is an unobserved firm-specific time-invariant effect that allows for heterogeneity in the means of the r_{it} series across individuals where $\eta_i \sim IID(0, \sigma_\eta^2)$; and v_{it} is the stochastic disturbance term that is assumed independent across individuals, where $v_{it} \sim IID(0, \sigma_v^2)$.

The inclusion of the lagged dependent variables in Equation (10) implies that a correlation exists between the regressors and the error term since the lag of firm excess returns $r_{i,t-1}$ depends on $\varepsilon_{i,t-1}$. The presence of lagged dependent variables show that OLS, fixed effects and random effects are biased and inconsistent for fixed T as N gets large. Due to this correlation, the dynamic panel data estimation in Equation (10) suffers from Nickell (1981) bias, which disappears only if T is large or approaches to infinity. In order to deal with the endogeneity issue, the present study employs the generalized method of moments (GMM) estimators developed by Anderson and Hsiao (1982), Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). This estimator is designed for a dataset with a large number of individual observations (N) over a limited number of time periods (T).

INSTRUMENT CHOICE

In the present study, the lagged dependent variable ($r_{i,t-j}$); X_t variables (i.e., domestic market return (rm_t), small minus big (SMB_t) and high minus low (HML_t)); and X_{it} variables (i.e., the ratio of book value to market value (*BVMV*), real sales growth (*RSALESG*), debt-equity ratio and liquidity ratio) are all assumed to be endogenous variables. Therefore, the set of moment conditions can be written as follows:

$$E[r_{i,t-s}(\varepsilon_{it}^*)] = 0 \quad for\ t = 3,\dots T;\ s \geq 2 \quad (11)$$

$$E[X_{t-s}(\varepsilon_{it}^*)] = 0 \quad for\ t = 3,\dots T;\ s \geq 2 \quad (12)$$

$$E[X_{i,t-s}(\varepsilon_{it}^*)] = 0 \quad for\ t = 3,\dots T;\ s \geq 2 \quad (13)$$

Monetary policy shocks (domestic and international) are assumed to be strictly exogenous. In addition, since the Malaysian stock market is an emerging market and a relatively small market that is vulnerable to the international stock market, international stock return (ir_t) is also considered a strictly exogenous variable. Therefore, the additional set of moment condition is:

$$E[W_{t-s}(\varepsilon^*_{it})] = 0 \quad for \;\; t = 1,2,3,4,\ldots T; s \geq 0 \qquad (14)$$

where W_t is a strictly exogenous variable (monetary policy shocks and international market return). Equation (14) indicates that the complete series of $W_t^{'} = (W_{t1}, W_{t2},\ldots, W_T)$ become valid instruments in each of the transformed equations. Equation (11)-(14) shows that the endogenous variables in the transformed equation will be instrumented with the lagged level of the regressors. The GMM estimator based upon moment conditions in (11)-(14) is known as the difference GMM.

However, Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) show that if the lagged dependent and the explanatory variables are persistent over time or nearly a random walk, then lagged levels of these variables are weak instruments for the regression equation in differences. This happens either as the autoregressive parameter (α) approaches unity or as the variance of the individual effects (η_i) increases relative to the variance of the idiosyncratic error (v_{it}). Hence, to decrease the potential bias and imprecision associated with the difference estimator, Blundell and Bond (1998) propose a system GMM approach by combining regressions in differences and in levels. In addition to the regression in differences, the instruments for the regression in levels are the lagged differences (transformed) of the corresponding instruments. Consequently, the extra moment conditions for the second part of the system, that is the regression in levels, can be written as follows:

$$E[r^*_{i,t-s}(\eta_i + v_{i,t})] = 0 \;\; for \;\; s = 1; t = 3,4,\ldots T \qquad (15)$$

$$E[X^*_{t-s}(\eta_i + v_{i,t})] = 0 \;\; for \;\; s = 1; t = 3,4,\ldots T \qquad (16)$$

$$E[X^*_{i,t-s}(\eta_i + v_{i,t})] = 0 \;\; for \;\; s = 1; t = 3,4,\ldots T \qquad (17)$$

$$E[W^*_{t-s}(\eta_i + v_{i,t})] = 0 \;\; for \;\; s = 0; t = 2,3,4,\ldots T \qquad (18)$$

By combining the set of moment conditions in the transformed Equations (11)-(14) and in the levels Equations (15)-(18), the system GMM can be constructed by stacking a system of $(T-2)$ transformed equations and $(T-2)$ untransformed equations, corresponding to periods $3,\ldots,T$ for which instruments are observed.

However, as noted by Roodman (2009), the system GMM can generate moment conditions prolifically. Too many instruments in a system GMM overfits endogenous variables even as it weakens the Hansen test of the instruments' joint validity. Therefore, the present study uses two main techniques to limit the number of instruments: (i) use only certain lags instead of all available lags for instruments; and (ii) combine instruments through addition into smaller sets by collapsing the block of the instrument matrix. These two techniques are proposed by Beck and Levine (2004), Calderon et al. (2002), Cardovic and Levine (2005) and Roodman (2009).

In addition, the present study uses a one-step and two-step system GMM in the baseline multifactor model. Baltagi (2008) argues that the parameters are asymptotically similar if the ε_{it} is *i.i.d*. However, Bond (2002) states that a one-step result is preferred over two-step results because the simulation studies performed by Bond (2002) demonstrate that a two-step estimator is less efficient when the asymptotic standard error tends to be too small or the asymptotic *t*-ratio tends to be too big. Windmeijer (2005) provides a bias correction for the standard errors in the two-step estimators. As noted by Windmeijer (2005), the two-step GMM performs somewhat better than the one-step GMM in estimating the coefficients with lower bias and standard errors. The reported two-step standard errors with the correction work well. Therefore, the two-step estimation with corrected standard errors seems modestly superior to cluster robust one-step estimation.

The success of the GMM estimator in producing unbiased, consistent and efficient results is highly dependent upon the adoption of appropriate instruments. Three specifications test are suggested by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). First, the Sargan or Hansen tests can be used to check for over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analogue of the moments conditions used in the estimation process. If the moment condition holds, then the instrument is valid and the model has been correctly specified. Second, serial correlation tests can be used to ensure no serial correlation exists in the transformed error term. Finally, the Hansen test can be used to test the validity of extra moment conditions on the system GMM. This test measures the difference between the Hansen statistic generated from the system GMM and the difference GMM. A failure to reject the three null hypotheses provides support for the estimated model.

DATA SPECIFICATION AND DETECTING OUTLIERS

The data set is observed at a yearly frequency collected from various sources. The year-end stock prices of firms, KLCI and S&P500 Index are collected from the Bloomberg database. Data concerning the year-end financial characteristics of firms, including book-value-market-value, sales, liquidity and financial leverage, are collected from Thompson Financial DataStream. All data sets span from 1990 to 2008.

The present study focuses on publicly listed companies in the Main Board of Bursa Malaysia. Currently, 650 companies are listed on the Main Board which covers various sub-sectors of economy activity, such as plantations (agriculture), property, consumer products, industrial products, services, technology and financial services. However, not all of the firms are considered in the present study. The firm-level data are refined by deleting certain firms, such as the financial firms and firms that have a data set covering less than 5 years. After refining the data, 449 firms are included in the sample.

In order to deal with the influential data points, Belsey et al. (1980) and Belsey (1991) propose using DFITS statistics. The DFITS measure is a scaled difference between the in-sample and out-of-sample predicted value for the j_{th} observations (Baum 2006). The measure also evaluates the result of fitting the regression model including and excluding that observation. The DFITS statistics is computed as follows:

$$DFITS_j = r_j\sqrt{\frac{h_j}{1-h_j}}$$

where h_j is the value of leverage and r_j is a studentized (standardized) residual, which is computed as follows:

$$r_j = \frac{e_j}{s_{(j)}\sqrt{1-h_j}},$$

where $s_{(j)}$ refers to the root mean squared error of the regression equation with the j_{th} observation removed; e_j is the residual; and h_j is the value of leverage.[5] Belsley et al. (1980) suggest that a cut-off value of $|DFITS_j| > 2\sqrt{\frac{k}{N}}$ indicates highly influential observations, therefore such firms must be removed from the regression model. By using DFITS statistics, 88 firms of the 449 firms, or 19 percent of the firm observations, are removed from the sample. The final sample examined in the present study consists of 361 firms (see Appendix 1 for the detailed firms by sub-sector category).

SPLITTING THE SAMPLE SIZE: FINANCIAL CONSTRAINTS AND LESS-CONSTRAINTS FIRMS

As noted earlier, significant differences may exist in the manner in which monetary policy shocks affect the equity returns of financially constrained firms and less-constrained firms. Kaplan and Zingales (1997) define the term 'financial constraint' as a wedge between the internal and external financing of a firm investment. Firms with greater financial constraints face more difficulty raising funds to finance investment.

In order to disaggregate the firms according to their constraints, the methodology proposed by Kaplan and Zingales (1997), Lamont et al. (2001) and Ehrman and Fratzscher (2004) is followed, which uses a direct measure of financial constraints based upon the cash flow to income ratio. Cash flow is measured as the sum of earnings before income tax (EBIT) and depreciation. In order to segment the constrained and less constrained firms, the average value of the cash flow to income ratio is first calculated for each firm over all years. Then, the median values of the ratio are computed to generate the threshold level. A firm is considered constrained if the mean value of cash flow to income ratio is less than the median value and considered less-constrained otherwise. According to this criterion, the sample consists of 181 financially constrained firms and 180 financially less-constrained firms. The hypothesis tested is that firms with a lower ratio of cash flow to income are more affected by monetary policy because they are more bank-dependent and bank-dependent borrowers are more strongly affected by a change in the supply of credit. In contrast, firms with large cash flows should be more immune to changes in interest rates as such firms can more greatly rely upon internal financing of investment.

EMPIRICAL RESULTS

Tables 1 and 2 report the estimation results of the dynamic augmented Fama and French (1992, 1996) multifactor model by using one-step and two-step system GMM estimations for the sub-sample of financially constrained and less-constrained firms.

As can be seen in Table 1 (one-step estimation), the stock returns of financially constrained firms are likely to be more affected by changes in interest rates than less-constrained firms. As argued earlier, this is because financially constrained firms have limited internal funds due to the credit constraints or an inability to borrow; an inability to issue equity; dependence on bank loan; or illiquidity of assets. Therefore, during periods of monetary tightening, such firms must reduce their activities (for example, investment). A decrease in investment will also reduce the firms' sales, cash flow and equity returns.

A 100 basis point increase in domestic interest rates leads to a decrease in the stock returns of financially constrained firms by 13.5 percent, while stock returns for less-constrained firms decrease by 4.1 percent. Since financially constrained firms have no access to international money markets, their equity returns are not significantly affected by international monetary policy. In contrast, less-constrained firms can access the international money market and their equity return will therefore be affected by international monetary policy. In response to a one percent increase in international monetary policy, the stock returns for less-financially constrained firms decrease by 3.2 percent.

Table 2 reports the estimation results using the two-step system GMM estimation. In general, the results are consistent with the baseline results (one-step system GMM estimation). As can be seen in Table 2, financially constrained firms respond significantly to domestic monetary policy shocks, but not to international monetary policy shocks. Two reasons exist concerning why financially constrained firms respond significantly to domestic monetary policy shocks, but not to international monetary policy shocks. First, the equity returns of financially constrained firms are more responsive to domestic monetary policy tightening because of the inability to fund investments due to credit constraints or an inability to borrow; an inability to issue equity; dependence on bank loans or illiquidity of assets. In contrast, the equity return of unconstrained firms are less responsive to domestic monetary policy shocks because they are able to access external financing due to the good credit condition. Second, the equity returns of financially constrained firms are not affected by international monetary policy because

TABLE 1. Augmented Fama-French multifactor model by financially constrained and less-constrained firms; system GMM estimation (one step estimation)

Explanatory variable	Financial constraint firm			Financial less-constraint firm		
	coeff.	Robust std. error	p-value	coeff.	Robust std. error	p-value
Lagged Dependent Variable						
$r_{i,t-1}$	0.040	0.112	0.725	0.056	0.035	0.112
$r_{i,t-2}$	0.178	0.046	0.000***	0.051	0.039	0.195
Domestic Market Return	1.730	0.266	0.000***	1.554	0.180	0.000***
Small Minus Big (SMB)	2.573	0.645	0.000***	1.669	0.280	0.000***
High Minus Low (HML)	-0.171	0.283	0.547	0.026	0.254	0.919
International Market Return	0.168	0.149	0.260	0.147	0.089	0.099*
Domestic Monetary Policy Shocks	*-0.135*	*0.062*	*0.031***	*-0.041*	*0.013*	*0.002****
International Monetary Policy Shocks	*-0.009*	*0.077*	*0.221*	*-0.032*	*0.016*	*0.051**
Book-Value-Market Value	-0.019	0.044	0.664	-0.021	0.028	0.444
Lagged of Real sales growth	0.086	0.131	0.509	-0.021	0.104	0.837
Financial leverage	0.060	0.048	0.212	0.016	0.025	0.517
Liquidity	0.125	0.096	0.195	0.092	0.043	0.032**
Number of observations		1001			1169	
Observations per group		5.82			6.96	
Number of firms		172			168	
Number of instrument		28			28	
AR(2) –p-value		0.945			0.176	
Hansen test-p-value		0.672			0.500	

Note: ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively. Constants are not included in order to save space. The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-values* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at the 10 percent significance level, but not reported here. The full results are available upon request.

Instrument for orthogonal deviation equation:

Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variables for financially constrained firms and less-constrained firms. The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009).

TABLE 2. Augmented Fama-French multifactor model by financially constrained and less-constrained firms: system GMM estimation (two step estimation)

Explanatory variable	Financial constraint firm			Financial less-constraint firm		
	coeff.	corrected std. error	p-value	coeff.	corrected std. error	p-value
Lagged Dependent Variable						
$r_{i,t-1}$	0.151	0.053	0.004***	0.043	0.037	0.248
$r_{i,t-2}$	0.211	0.044	0.000***	0.039	0.039	0.303
Domestic Market Return	1.654	0.249	0.000***	1.479	0.161	0.000***
Small Minus Big (SMB)	2.679	0.597	0.000***	1.552	0.268	0.000***
High Minus Low (HML)	-0.181	0.272	0.507	0.004	0.229	0.984
International Market Return	0.146	0.131	0.265	0.160	0.080	0.045**
Domestic Monetary Policy Shocks	*-0.118*	*0.060*	*0.049***	*-0.039*	*0.012*	*0.001****
International Monetary Policy Shocks	*-0.007*	*0.007*	*0.315*	*-0.038*	*0.015*	*0.013***
Book-Value-Market Value	-0.012	0.042	0.775	-0.014	0.028	0.620
Lagged of Real sales growth	0.084	0.124	0.498	-0.107	0.119	0.370
Financial leverage	0.008	0.024	0.746	0.013	0.018	0.484
Liquidity	0.045	0.043	0.294	0.109	0.042	0.009***
Number of observations		1001			1169	
Observations per group		5.82			6.96	
Number of firms		172			168	
Number of instrument		28			28	
AR(2) –p-value		0.786			0.280	
Hansen test-p-value		0.672			0.500	

Note: ***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively. Constants are not included in order to save space. The dependent variable is firm-level equity return (r_{it}) in terms of excess returns. All *p-values* of the difference in Hansen tests of exogeneity of instruments subsets are also rejected at least at the 10 percent significance level, but not reported here. The full results are available upon request.
Instrument for orthogonal deviation equation:
Lags 2 to 3 for all endogenous variables and all lags for strictly exogenous variables for financially constrained firms and less-constrained firms.
The estimation also collapses the instruments matrix as proposed by Calderon et al. (2002) and Roodman (2009).The two-step estimations are based on Windmeijer (2005).

they have no access to international financing due to the higher credit risk and, therefore, their equity returns will not be affected during periods of international monetary policy tightening.

In contrast, financially less-constrained firms respond significantly to domestic and international monetary policy shocks. However, the effect of domestic monetary policy shocks upon the equity return of less-constrained firms is smaller than financially constrained firms. Two possible reasons exist concerning why financially less-constrained firms respond significantly to international monetary policy shocks. First, the equity returns of financially less-constrained firms are affected by the financing costs incurred from international financing. For instance, financially less-constrained firms are more reliant on obtaining a portion of their funds from foreign markets (e.g., from the US money market) and are exposed to two sources of risks: foreign interest rates and exchange rate risks. Therefore, an increase in US interest rates due to the tightening of monetary policy will increase the financing costs and diminish the cash flows of financially less-constrained firms, which will subsequently decrease the investment levels, firm sales and stock returns of such firms. Second, the stock price evaluation of firms with business links with the US is affected indirectly through the impact of US monetary policy on real economic activity in the US.

All of the specification tests (i.e., AR(2) and Hansen tests in Tables 1 and 2) are also insignificant at least at the 10 percent significance level, which implies that no serial correlation exists among the residuals and that the instruments used in the one-step and two-step system GMM estimations are valid.

The findings of the present study are consistent with some previous studies in the US. For example, Perez-Quiros and Timmermann (2000) use the size of firms as a proxy for the degree of credit constraints and find that the returns of smaller firms are more affected by monetary policy tightening than large firms. Ehrmann and Fratzscher (2004) use various measures of financial constraints[6] and also find that financially constrained firms with low cash flow, poor credit ratings, low debt to capital ratios, high price-earning ratios, and high Tobin's q respond more significantly to changes in monetary policies than financially less-constrained firms. Basistha and Kurov (2008) also find that the equity return of companies that are likely to be credit constrained react more strongly to monetary news during recessions and in tight credit market conditions than companies that are relatively unconstrained.

ROBUSTNESS CHECKING[7]

For robustness, the baseline model in Equation (10) is re-estimated using various strategies, including using difference GMM (one-step and two-step estimation); various instrumental strategies (e.g., using different assumptions about endogenous and pre-determined variables); and the combination of instruments with levels and differences equations. In general, the main results are robust, in which the effects of monetary policy shocks also vary according to financially constrained and less-constrained firms.

SUMMARY AND CONCLUSIONS

The present study provides new empirical evidence concerning the effects of monetary policy shocks (domestic and international monetary policy) on firm-level equity returns in an emerging market economy (i.e., Malaysia). A dynamic model of an augmented Fama and French (1992, 1996) multifactor model is used to estimate the determinants of firm-level stock returns by focusing upon the effects of monetary policy shocks on financially constrained and less-constrained firms.

In general, the findings of the present study support economic theory in that firm-level equity returns respond negatively to the monetary policy shocks (domestic and international monetary policy). This finding gives three new directions concerning the importance of stock market effects in monetary policy analysis. First, the negative response of firm-level equity returns indicates that a monetary authority has a greater chance to influence economic activity through stock market effects. Second, the significant effect of international monetary policy shock on firm-level equity return indicates the relevance of international risk factors (in particular international monetary policy) in influencing the firm-level stock returns. Third, the equity returns of financially constrained firms are also more significantly affected by domestic monetary policy than less-constrained firms. This finding suggests that the asymmetric response of individual firms to monetary policy shocks is influenced by the differing degree of financial constraints. Therefore, financial assistance (or capital injection) from the monetary authority may be necessary to helping firms during periods of monetary contraction.

ENDNOTES

1. Agency costs are typically assumed to be smaller for large firms because of the economies of scale in collecting and processing information about their respective situations. As a result, large firms can more easily obtain financing directly from financial markets and less dependent upon loans from banks.
2. The three factor model proposed by Fama and French (1992, 1996) can be represented as follows:

$$R_{it} - RF_t = \alpha_i + \beta_i[RM_t - RF_t] + s_i\,(SMB_t) + h_i\,(HML_t) + \varepsilon_{it}$$

where, R_{it} is the return on asset i in period t; RF_t is the risk-free rate; β_i is the coefficient loading for the excess return of the market portfolio; s_i is the coefficient loading for the excess average return of portfolio with small equity class over portfolios of big equity class; h_i is the coefficient loading for the excess average returns of portfolio with high book-to-market equity class over those with low book-to-market equity class; and ε_{it} is the error term for asset *i* at time *t*.

3 In capital market theory, excess return or risk premium measures the difference between the expected market rate of return and the risk-free rate of return.

4 According to the weak form efficient market hypothesis (EMH), all past prices of stocks are reflected in today's stock price. Therefore, the past return of the stock is also connected to the current stock return.

5 The value of leverage (h_j) is computed from the diagonal elements of the 'hat matrix' as follows:

$$(h_j) = x_j\,(X'X)^{-1}x'_j,$$

where x_j is the *j*th row of the regressor matrix.

6 Ehrmann and Fratzscher (2004) use more direct measures of financial constraints: the cash flow to income ratio; the ratio of debt to total capital; and Moody's investment and bank loan rating. In theory, firms with large cash flows should be immune to changes in interest rates as they can rely more heavily upon internal financing methods of investment. Firms with a lower debt to capital ratio are more affected by monetary policy because they are more bank-dependent.

7 The full results of robustness checking are available upon request.

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APPENDIX

Number of Firm by Sector

Sector	Before detecting outliers	After detecting outliers
Construction	33	24
Consumer Product	66	57
Hotel	04	03
Industrial Product	114	88
Infrastructure	06	06
Mining	01	01
Plantation	30	22
Property	76	61
REITS	01	01
Services	106	88
Technology	12	10
Total Firms	449	361