The impact of macroeconomic variables on SMEs in Malaysia

F A Halim, M R Malim, Z Derasit, R M Rani and S S Rashid
Faculty of Computer & Mathematical Sciences, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia
E-mail: faridahh@tmsk.uitm.edu.my

Abstract. Small and Medium Enterprises (SMEs) in Malaysia have gained a prominent role as the significant contributor to the economic growth. However, the world nowadays is heading towards economic downturn. The stability of macroeconomic variables promotes profitability of SMEs which propels them to a stage where they can access financing for sustaining growth. Therefore, it is apparent that the behaviour of the macroeconomic variables plays a major part in determining the nation’s backbone in surviving the economic downturn. The objective of this study is to evaluate the impact of macroeconomic variables on the profitability of SMEs in Malaysia using multiple regression analysis. The findings revealed that the exchange rate has a small positive impact on SME GDP growth rate (10.81%), the interest rate has a strong positive impact (60.74%), while the inflation rate has a strong negative impact (-53.89%). Therefore, it can be concluded that the interest rate and inflation rate have significant impacts on the profitability of SMEs in Malaysia.

1. Introduction
Small and Medium Enterprises (SMEs) in Malaysia are regarded as an important contributor to economic growth. According to SME Annual Report 2015/2016 [1], the growth rate for SME Gross Domestic Product (GDP) is 6.1%, employment 5.6%, and productivity 0.4%. SME GDP in 2015 contributed at 36.3% as compared to 35.9% in 2014. In 2015, SME GDP rose to RM385.6 billion from RM363.4 billion in 2014. SME GDP is supported by domestic demand, particularly consumption and investment activities. Services and Manufacturing sectors are the anchor of SMEs economic structure, contributed 80.6% to SME GDP. Agriculture is the third largest contributor with 12.0%. According to Census Report on SMEs [2], there are 545,136 SMEs in Malaysia, representing 97.3% of the total business establishments. Globally, SMEs have a very significant contribution to the provision of goods and services to the society; without SMEs, large companies may not be able to meet the demand.

In a study on the real exchange rate and growth, Berg and Miao [3] verified that the exchange rate impacts the economic growth. Agalega and Antwi [4] studied the impact of macroeconomic variables on GDP in Ghana and concluded that the behavioural patterns of interest rate and inflation rate influenced GDP growth. Khan and Sattar [5] examined the impact of interest rate on the profitability of commercial banks in Pakistan and found a strong positive correlation. Fisher [6] found that inflation reduces growth by reducing investment and productivity. The medium and high inflation hampers economic growth due to the adverse impact on efficient distribution of resources by changing relative prices. However, low inflation levels promote growth by making prices and wages more flexible.

Although there was a global economic slowdown in the last five years (2010-2015), Malaysian economy has done extremely well with the GDP growth and ranked among the fastest in the region. Malaysian SMEs are significant component of the country’s economic development. SME businesses
might embrace a far challenging year in 2017 due to the constant downturn in the global economy and high degree of uncertainty. Conducive macroeconomic variables (such as exchange rate, interest rate, and inflation rate) promote the profitability of SMEs which propels them to a stage where they can access financing for sustained growth. Therefore, the factors and the impacts pertaining towards the profitability of SMEs must be explored thoroughly.

The main objective of this study is to evaluate the impact of macroeconomic variables (exchange rate, interest rate, and inflation rate) on the profitability of SMEs in Malaysia, and hence to determine the most important variable. The findings would create awareness on the macroeconomic environment to the entrepreneurs and prepare them physically and mentally to run the business efficiently.

2. Methodology

2.1 Data and variables
The data (SME GDP growth rate, exchange rate, interest rate, and inflation rate) are the time series datasets gathered from Department of Statistic Malaysia (DOSM), Bank Negara Malaysia (BNM) and SME Corporation Malaysia for the period 2002 to 2015. The variables are illustrated in figure 1.

![Figure 1. Dependent and independent variables.](image)

2.2 Multiple regression analysis
The dependent variable \( Y \) represents SME GDP growth rate in Malaysia while the independent variables represent the exchange rate \( X_1 \), interest rate \( X_2 \) and inflation rate \( X_3 \). The Multiple Regression model for this study can be stated as follows:

\[
Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i
\]

where \( Y_i \) is the \( i \)th value of SME GDP, \( \beta_0 \) is a constant, \( \beta_j \) is the coefficient of variable \( X_j \) for \( j = 1, 2, 3 \), \( X_{ji} \) is the \( i \)th value of variable \( X_j \) where \( i = 1, 2, ..., n \), and \( u_i \) is the error of the \( i \)th observation.

The model explains the variables that impact the profitability of SMEs in Malaysia. There are four phases in Multiple Regression model building; identify all possible models, obtain the models, select the best model using eight selection criteria (8SC), and conduct goodness-of-fit test.

2.2.1 Identify possible models. The number of possible models is determined by

\[
N = \sum_{k=0}^{j} \binom{k}{j}
\]

where \( k \) is the number of independent variables, and \( j \) is number of observation 1, 2, ...

2.2.2 Obtain possible models. Global Test, Multicollinearity Test, Coefficient Test and Wald Test are carried out to obtain all possible models. The main purpose is to remove all insignificant variables. All tests use \( \alpha = 0.05 \).

Global Test: To test whether it is possible for all independent variables to have zero coefficients; the ANOVA table in table 1 is considered [7]. This test is carried out on all possible models. The hypothesis statement; reject \( H_0 \) (all coefficients are zero) if \( F_{\text{calculated}} = \frac{\text{MSR}}{\text{MSE}} \) is greater than \( F_{\text{critical}} = F_{\alpha,k,(n-k-1)} \) (F-table). This is to prove that the independent variables in the models are significant.
Multicollinearity Test: Multicollinearity is a problem that occurs when correlation coefficient between two or more independent variables have strong positive or negative correlation [8]. It will cause an estimation value for a parameter to fall far from the real value. The easiest way to detect this problem is by using SPSS that generates a correlation matrix for each variable. This test is carried out to remove all multicollinearity source variables from each model. A model is considered free from multicollinearity when all independent variables are significant.

Coefficient Test: For each possible model, this test is carried out to ensure that the coefficient of each independent variable is significant. The variable with the smallest statistical value and nearest to zero is eliminated from the model. The elimination process is repeated until all variables are significant. The step-by-step procedure described by Zainodin and Khuneswari [7] is applied. The decision is to accept $H_0$ (all coefficients are significant) when $t_{calculated}$ is less than $t_{critical}$. If the $p$-value of a variable is greater than 5%, the variable is insignificant. This test can be conducted using SPSS.

Wald Test: To justify the eliminated variables from each possible model. There are two types of models to be tested; restricted and unrestricted models. A restricted model is the possible model after elimination process (coefficients of eliminated variables are assumed to be zero) whereas an unrestricted model is the initial model. Table 2 shows the ANOVA for Wald Test. The hypothesis to be tested: $H_0$: coefficients are all zeros, $H_1$: at least one of the coefficients is nonzero. Given $F_{critical} = F(df(R) - df(U), df(U), \alpha)$. $H_0$ is rejected if $F_{calculated}$ is greater than $F_{critical}$.

### Table 2. ANOVA table (Wald test).

| Source of Variations | Sum of squares (SS) | Degrees of freedom (df) | Mean Sum of Square (MS) | $F$ |
|----------------------|---------------------|-------------------------|-------------------------|-----|
| Differences (R-U)    | $SSE(R)-SSE(U)$     | $k-m$                   | $SSE(R)-SSE(U)$         | $[SSE(R)-SSE(U)]/(k-m)$ |
| Unrestricted Model (U)| $SSE(U)$           | $n-(k+1)$               | $SSE(U)/(n-(k+1))$      |     |
| Restricted Model (R) | $SSE(R)$           | $n-(m+1)$               |                         |     |

2.2.3 The Best Model. To select the best model, all possible models are considered. The best model can be identified based on the Eight Selection Criteria (8SC) [8], as shown in table 3. Every minimum value of each criterion is highlighted and a model with the lowest value is judged to be preferable.
3.1 Identify possible models

Regression models are 12 models. Below is the calculation of possible model:

Since there are three independent variables in this study, therefore the total of possible Multiple Regression models are 12 models. Below is the calculation of possible model:

\[ N = \sum_{j=1}^{3} \left( \begin{array}{c} 3 \left( \begin{array}{c} j \end{array} \right) \right) = (1)\left( \begin{array}{c} 3 \end{array} \right) + (2)\left( \begin{array}{c} 3 \end{array} \right)^2 + (3)\left( \begin{array}{c} 3 \end{array} \right)^3 = 3 + 6 + 3 = 12 \]

The possible models were developed based on one dependent variable (SME GDP) and three independent variables (exchange rate, interest rate and inflation rate), as listed in Table 4. There are seven single models, four first-order interaction models and one second-order interaction model.

### Table 3. Eight selection criteria (8SC).

| AIC (Akaike Information Criterion) | Rice Criterion: |
|-----------------------------------|-----------------|
| \[ \text{AIC} = \left( \frac{\text{SSE}}{n-k-1} \right) e^{\frac{2(k+1)}{n}} \] | \[ \text{Rice} = \left( \frac{\text{SSE}}{n-k-1} \right) \left[ 1 - \frac{2(k+1)}{n} \right]^{-1} \] |

| FPE (Finite Prediction Error) | SCHWARZ |
|-------------------------------|---------|
| \[ \text{FPE} = \left( \frac{\text{SSE}}{n-k-1} \right) \frac{n+(k+1)}{n-(k+1)} \] | \[ \text{SCHWARZ} = \left( \frac{\text{SSE}}{n-k-1} \right) n(k+1)/n \] |

| GCV (Generalized Cross Validation) | SGMASQ |
|-----------------------------------|--------|
| \[ \text{GCV} = \left( \frac{\text{SSE}}{n-k-1} \right) \left[ 1 - \frac{(k+1)}{n} \right]^{-2} \] | \[ \text{SGMASQ} = \left( \frac{\text{SSE}}{n-k-1} \right) \left[ 1 - \frac{(k+1)}{n} \right]^{-1} \] |

| HQ Crition (Hannan & Quinn) | SHIBATA |
|-----------------------------|--------|
| \[ \text{HQ} = \left( \frac{\text{SSE}}{n-k-1} \right) (\ln n)^2(k+1)/n \] | \[ \text{SHIBATA} = \left( \frac{\text{SSE}}{n-k-1} \right) \frac{n+2(k+1)}{n} \] |

2.2.4 Goodness-of-fit test. After the best model has been determined, the Goodness-of-fit Test is carried out on the residuals to investigate whether the residuals are randomly and normally distributed.

**Randomness Test:** The randomness of residuals \( u; (t = 1, 2, \ldots, n) \) can be tested using Run Test in SPSS by referring to the \( |Z| \) and Asymp. Sig. (2-tailed) value.

**Normality Test:** One of the Multiple Regression assumptions is the normality of residuals. Kolmogorov–Smirnov test and Shapiro-Wilk test can be used to test the normality of the residuals. Kolmogorov–Smirnov is used when the number of observations is large (> 50) while Shapiro-Wilk test is used when the number of observation is small. Both tests can be carried out using SPSS.

3. Analysis and results

3.1 Identify possible models

Since there are three independent variables in this study, therefore the total of possible Multiple Regression models are 12 models. Below is the calculation of possible model:

\[ N = \sum_{j=1}^{3} \left( \begin{array}{c} 3 \left( \begin{array}{c} j \end{array} \right) \right) = (1)\left( \begin{array}{c} 3 \end{array} \right) + (2)\left( \begin{array}{c} 3 \end{array} \right)^2 + (3)\left( \begin{array}{c} 3 \end{array} \right)^3 = 3 + 6 + 3 = 12 \]

The possible models were developed based on one dependent variable (SME GDP) and three independent variables (exchange rate, interest rate and inflation rate), as listed in Table 4. There are seven single models, four first-order interaction models and one second-order interaction model.

### Table 4. List of possible models.

| Individual | First-Order Interaction |
|-----------|-------------------------|
| M1: \( Y = \beta_0 + \beta_1 X_1 + u \) | M8: \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_2 X_1 + u \) |
| M2: \( Y = \beta_0 + \beta_2 X_2 + u \) | M9: \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + u \) |
| M3: \( Y = \beta_0 + \beta_3 X_3 + u \) | M10: \( Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_3 X_2 + u \) |
| M4: \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + u \) | M11: \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_2 X_3 + \beta_5 X_3 X_1 + u \) |
| M5: \( Y = \beta_0 + \beta_1 X_1 + \beta_3 X_3 + u \) | Second-Order Interaction: |
| M6: \( Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + u \) | M12: \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_2 X_1 + \beta_5 X_3 X_2 + \beta_6 X_2 X_1 + \beta_7 X_3 X_2 + \beta_8 X_2 X_3 + \beta_9 X_3 X_2 X_1 + u \) |
| M7: \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + u \) | |

The variables \( X_1, X_2 \) and \( X_3 \) are single variables representing the exchange rate, interest rate and inflation rate, respectively. There are first-order interaction variables such as \( X_{12}, X_{13}, \) and \( X_{23}. \) Variable \( X_{12} \) shows the interaction between exchange rate and interest rate which are \( X_1 \) and \( X_2; \) \( X_{13} \) is the interaction between exchange rate and inflation rate variables which are \( X_1 \) and \( X_3; \) and \( X_{23} \) indicates the
interaction between interest rate and inflation rate variables which are \( X_2 \) and \( X_3 \). The second-order interaction variables stated as \( X_{123} \) describe the interaction among three variables, which are exchange rate, interest rate and inflation rate.

3.2 Obtain possible models

SPSS software and Microsoft Office Excel were used to obtain all possible models by conducting the Global Test, Multicollinearity Test, Coefficient Test and Wald Test. The results of all possible models are summarized in table 5. Hence, from the results, only four models are selected.

3.3 The best model

The Eight Selection Criteria (8SC) were applied on the four selected models. The values for the eight selection criteria were calculated according to table 3, and the results are summarized in table 6. Based on the eight selection criteria (8SC), the model \( Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + u \) is selected as the best model based on the majority of smallest values of 8SC.

| Model | Results |
|-------|---------|
| M1 \( Y = \beta_0 + \beta_1 X_1 + u \) | Not selected, \( X_1 \) was removed due to insignificant (\( p > .05 \)) |
| M2 \( Y = \beta_0 + \beta_2 X_2 + u \) | \( Y = \beta_0 + \beta_2 X_2 + u \) |
| M3 \( Y = \beta_0 + \beta_3 X_3 + u \) | \( Y = \beta_0 + \beta_3 X_3 + u \) |
| M4 \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + u \) | \( Y = \beta_0 + \beta_2 X_2 + u \) |
| M5 \( Y = \beta_0 + \beta_1 X_1 + \beta_3 X_3 + u \) | \( Y = \beta_0 + \beta_3 X_3 + u \) |
| M6 \( Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + u \) | \( Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + u \) |
| M7 \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + u \) | \( Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + u \) |
| M8 \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_13 X_{12} + u \) | \( Y = \beta_0 + \beta_2 X_2 + \beta_13 X_{12} + u \) |
| M9 \( Y = \beta_0 + \beta_1 X_1 + \beta_3 X_3 + \beta_13 X_{13} + u \) | \( Y = \beta_0 + \beta_3 X_3 + \beta_13 X_{13} + u \) |
| M10 \( Y = \beta_0 + \beta_2 X_2 + \beta_3 X_3 + \beta_23 X_{23} + u \) | \( Y = \beta_0 + \beta_2 X_2 + \beta_23 X_{23} + u \) |
| M11 \( Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_13 X_{13} + \beta_23 X_{23} + u \) | \( Y = \beta_0 + \beta_2 X_2 + \beta_23 X_{23} + u \) |
| M12 \( Y = \beta_0 + \beta_1 X_1 + \beta_3 X_3 + \beta_13 X_{13} + \beta_23 X_{23} + \beta_123 X_{123} + u \) | \( Y = \beta_0 + \beta_2 X_2 + \beta_23 X_{23} + \beta_123 X_{123} + u \) |

| Selected Model | AIC | FPE | GCV | HQ | RICE | SCHWARZ | SGMASQ | SHIBATA |
|----------------|-----|-----|-----|-----|------|----------|---------|---------|
| \( Y = \beta_0 + \beta_2 X_2 + u \) | 3.9090 | 3.9355 | 4.1249 | 3.6378 | 4.4827 | 3.2410 | 3.6378 |
| \( Y = \beta_0 + \beta_3 X_3 + u \) | 4.0787 | 4.4563 | 4.6497 | 4.6772 | 4.7849 | 3.3816 | 3.7957 |

3.4 Goodness-of-fit test

Two tests were carried out under the goodness-of-fit which; Randomness Test and Normality Test. The results of randomness test (SPSS output) are shown in table 7. The decision is to accept the null hypothesis since \( |Z| = 0.278 \) is less than Asymp. Sig. (2-tailed) = 0.781. Thus, there is enough evidence that the residuals \( u \) are random.
Table 7. Randomness test.

| Test Value | Standardized Residual |
|------------|-----------------------|
| Test Value | -0.15396              |
| Cases < Test Value | 7                   |
| Cases ≥ Test Value | 7                   |
| Total Cases | 14                  |
| Number of Runs | 9                   |
| Z           | 0.278                |
| Asymp. Sig. (2-tailed) | 0.781              |

Normality Test: Since the sample size is small \((n = 14)\), the Shapiro-Wilk test was used. The results (SPSS output) are shown in Table 8. The decision is to accept \(H_0\) since \(p\)-value \((0.111)\) is greater than 0.05. Thus, there is enough evidence that the residuals are normally distributed.

Table 8. Normality test.

| Standardised Residual | Shapiro-Wilk |
|-----------------------|--------------|
| Statistic             | .900         |
| df                    | 14           |
| Sig.                  | .111         |

The possibility to obtain the lower order interaction as the best model is high because the high-order interaction variables were removed from the models. In this study, the best model is from single models, can be stated as \(Y = \beta_0 + \beta_2X_2 + \beta_3X_3 + u\). The coefficients of the model are shown in Table 9.

Table 9. Regression coefficients of the best model.

| Coefficients | Standard Error | \(t\) Stat | \(P\)-value |
|--------------|----------------|-----------|-------------|
| Intercept    | -13.1204       | -1.6516   | 0.1268      |
| \(X_2\)      | 3.3633         | 2.7620    | 0.0185      |
| \(X_3\)      | -0.8420        | -2.3593   | 0.0379      |

Hence, the best model is:

\[
SME GDP growth rate = -13.1204 + 3.3633 \text{ interest rate} – 0.8420 \text{ inflation rate}.
\] (2)

4. Conclusion

The objective of this study is to evaluate the impact of macroeconomic variables on the profitability of SMEs in Malaysia. Three variables (factors) were considered; exchange rate, interest rate and inflation rate. Multiple Regression analysis was conducted on the variables. A single model was chosen as the best model. The interest rate and inflation rate were justified as significant and contribute to the dependent variable SME GDP growth rate.

The intercept value of \(-13.1204\) represents the profitability of SMEs in Malaysia in term of its GDP growth rate given that interest rate \((X_2)\) and inflation rate \((X_3)\) are zero while all others are constant. The coefficient of \(X_2\) (interest rate) of 3.3633 implies the contribution of interest rate to SME GDP growth rate. This shows that there is a positive relationship between interest rate and SME GDP growth rate. In order words, if the value of interest rate is increased, the value of SME GDP growth rate will also increase (SME GDP growth rate and interest rate move in the same direction). This finding is similar with a previous study by Khan and Sattar [5].

Furthermore, the coefficient of \(X_3\) (-0.8420) suggests how much SME GDP growth rate would change if there is a unit increased in the inflation rate. This shows that there is a negative or inverse relationship between inflation rate and SME GDP growth rate (i.e., they move in opposite direction). Finally, we can conclude that the most affecting factors on the profitability of SMEs in Malaysia are interest rate and inflation rate.
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