THE RATIONALITY OF ECONOMIC FORECASTS: THE CASES OF RUBBER, OIL PALM, FORESTRY AND MINING SECTORS

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ABTRACT

INTRODUCTION

Forecasts of economic variables is very important for planning and policy making purposes. Forecasts is an important input in decision making processes because obtaining reliable forecasts of some relevant macroeconomic variables is necessary for efficient management of funds, time and resources.

Business has always recognised the need for a view of the future and has used explicit forecasts in the design and execution of their economic and/or business policies. For example, a firm trying to decide upon its investment programme will have to take into account not only the current known set of circumstances but also the unknown economic and business conditions in the future. The firm has to form a view about the future, such as the likely sales, costs, prices, competitors' reactions, labour requirements, government regulations and so on. These views about the future values of economic variables are frequently referred to as 'expectations', that is, what the firm expects to happen in the future.

In recent years the performances of many microeconomics and macroeconomics series have been erratic. For example, rate of inflation, price of crude oil, prices of primary commodities, rate of interest and other pertinent economic variables have been fluctuating widely and have caused concern among the public, politicians, economists and also the businessmen. According to Mayes (1981), with such non-uniformity of economic variables observed in the last two decades, the role of expectations has become more relevant in the economic agents' decision making process. Mayes (1981) further states that under the present conditions it has become more important to consider what expectations actually are and how they are formed.

The value of economic forecasts of certain macroeconomic variables can be derived from several methods. The three main methods for deriving economic forecasts are (i) time series, (ii) econometric models, and (iii) survey of intentions of concerned agents and organizations. Time series

analysis and econometric modeling are the two most widely used methods in economic forecasting, but Holden and Peel (1983) had noted their drawbacks. Recently, economists have turned their direction of interest in evaluating the rationality of economic forecasts from surveys of market participants. The empirical literature on the direct tests of the rational expectations hypothesis is vast and growing. Holden *et al.* (1985), Lovell (1986), Wallis (1989), Maddala (1991) and Pesaran (1991) had reviewed some of these studies. The aim was to determine whether survey data on economic forecasts are accurate in the Muth's (1961) sense, that is, whether participating economic agents used all available information at the time forecasts are made. In other words, the rational expectations hypothesis of the economic forecast was put to test. In general, the empirical studies do not support the rational expectations hypothesis.

Most of the studies carried out to evaluate the rationality of business firms' forecasts of economic variables were conducted on developed nations. Madsen (1993) studies the formation of output expectations in manufacturing industry in Japan, Denmark, Finland, France, Germany, Netherlands, Norway, Sweden and the United Kingdom. He found that the rational expectations hypothesis was weakly rejected. Williams (1988) and Chazelas (1988) found investment forecasts biased predictors of the actual investment value for firms in the United Kingdom and France. Meganck *et al.* (1988) have concluded that investment forecasts of the manufacturing firm in Belgium were unbiased predictors of the actual values. However, Daub (1982) failed to find any rationality of the Canadian capital investment intention survey data. On the other hand, a study by Leonard (1982) on employment forecasts by the United States services sectors found that the forecasts were biased and the rationality of these employment forecasts rejected.

The purpose of this paper is to present some empirical evidence on the rationality of agricultural firm managers' expectations using survey data. This study is important because it adds to the current literature on the testing of rationality of survey data, in particular, it provides empirical evidence from the perspective of a developing country. As for the country under study, the finding of the study could establish whether the forecasts documented by such survey are accurate or not; and if not, ways to produce more accurate forecasts must be found. 'Rationality' in this paper means that managers in agricultural firms have unbiased expectations and efficiently utilised available information at the time the forecasts are made.

METHODOLOGY

Following Muth (1961), expectations are said to be rational if the subjective probability distribution of expected outcomes coincides with the

objective probability distribution of actual outcomes. Such expectations must posses several properties. Let A_t denotes the realisation of output in period t, and ${}_{t-1}F_t$ denotes the forecast made on output for period t made in period t-1. If the forecast is based on rational expectations then

$$A_t = E({}_{t-1}F_t|I_t) \quad (1)$$

where E_t is an operator that denotes a mathematical expectation and I_t is the set of information available to agents at the end of period t. It follows that

$$E[(A_t - {}_{t-1}F_t)|\Omega_t] = 0 \quad (2)$$

where Ω_t is a subset of the full information set I_t. Letting η_t to represent the forecast error $(A_t - {}_{t-1}F_t)$, equation (2) can then be written as

$$E[\eta_t|\Omega_t] = 0 \quad (3)$$

which implies that the forecast error in equation (3) is uncorrelated with each variable in the information set Ω_t.

Defining the sampling interval of the forecasts as one period, equations (1)-(3) suggest two testable tests for rationality found in the literature. First, is the test whether the forecasts are unbiased estimates of the actual series. Second, whether forecasts incorporated available information.

The Unbiasedness Test

To test for the absence of biasedness, the following equation proposed by Theil (1966) is usually estimated

$$A_t = \alpha + \beta_{t-1}F_t + \varepsilon_t \quad (4)$$

where α and β are the parameters to be estimated, and ε_t is a random term with zero mean and constant variance. The output forecasts are unbiased predictors of actual output if the joint hypothesis that $\alpha=0$ and $\beta=1$ cannot be rejected. The *F*-test used to test the joint hypothesis on both the intercept (α) and the slope (β) coefficients of equation (4) is given by $F(r,n-k-1) = \{[(RSSR-USSR)/r]/[USSR/(n-k)]\}$, where RSSR is the restricted sum of squares residual (that is, the residual sum of squares of the regression in which the coefficient are restricted to their hypothesized values), USSR is the unrestricted residual sum of squares, r is the number of restrictions, k is the number of independent variables and n is the number of observations (Maddala, 1977). The likely sign and magnitude of the slope coefficient give

us the following interpretations: (1) If $\beta=1$, then on the average forecast values are actually equal to the observed realised output values; (2) If $\beta=0$, then on the average forecast values are unrelated to actual values; (3) If $\beta<1$, then on the average forecast values tend to over predict the actual output values; (4) If $\beta>1$, then on the average the forecast values under estimate the actual values; and (5) If $\beta<0$, then on the average the direction of forecast tends to be opposite of the actual value.

The Efficiency Test: Test For Non-Serial Correlation

Under rational expectations hypothesis, past forecast errors are part of the information set. Thus, it follows that forecast errors are serially uncorrelated. A direct test of non-serial correlation between the forecast errors and its past values is to regress η_t on lagged values of itself. That is, we estimate the following equation

$$\eta_t = \gamma_0 + \Sigma_{N,i=1}\gamma_i\eta_{t-i} + \nu_t \qquad (5)$$

and test the null hypothesis that γ_0 and γ_i (i=1,2,....N) equal to zero. If the null hypothesis is rejected, this will imply that information available at time t-1 is systematically excluded from the forecast. The forecast is therefore not optimal and consequently, the forecast is also not rational.

The Efficiency Test: Weak-Form Test

Managers with rational expectations will use information about past realisation of output produced efficiently in making predictions about the future course of the output variable. This concept of efficiency requires that the process generating observed realisation in output will be identical to the process generating the forecasts. Since past history of output values has been included as the only information set, the test is usually noted as a 'weak-form' of efficiency test. The following equation can be used to conduct the test for 'weak-form' efficiency test

$$\eta_t = \theta_0 + \Sigma_{N,i=1}\theta_i A_{t-i} + \omega_t \qquad (6)$$

The null hypothesis to be tested is that the estimated $\theta_0=\theta_i=0$ are not statistically significantly different from zero for all i (i=1,2,...,N) as a group.

Sources of Data

In Malaysia, explicit forecasts of economic variables from surveys of expectations have been conducted both by the government and the private sector. These include 'Business Expectations Survey of Limited Companies' by the Department of Statistics on bi-annual basis; 'Industrial Trends Survey' by Malaysian Industrial Development Authority (MIDA) on bi-annual basis; 'Survey of Industrial Trends' by Central Bank of Malaysia on quarterly basis; 'Business Conditions Survey Report' and 'Consumer Sentiments Survey Report' by Malaysian Institute of Economic Research (MIER) on quarterly basis; and 'Survey on Key Sectors/Industries of the Economy' by Public Bank Berhad on quarterly basis. Of all the above survey reports, 'Business Expectations Survey on Limited Companies' published by the Department of Statistics, Malaysia is consistent and readily available to the general public.

The Department of Statistics conducted their survey by mail on a half yearly basis. The types of information collected and published in the report include the actual values on gross revenue, capital expenditure, employment, and also their respective forecasted values for the next six months. Other information that were included in the report are constraints anticipated and level of output/operation anticipated.

The sectors covered in the survey include Rubber, Oil Palm, Logging, Mining, Manufacturing, Construction, Wholesale, Retail, Hotels, Banks and other Financial Institutions, Insurance, Real Estate and Business Services and Transport.

According to the Department of Statistics, the Business Expectations Survey covers the biggest companies within each of the sector. A total of 220 companies were selected using a three-stage sampling method, based on the list of companies given in the Financial Survey of Limited Companies. In first sampling, the allocation of the 220 companies among the sectors is based on the respective sectors' contribution to gross revenues, employment and net fixed assets in the overall corporate sector. In the second-stage sample selection, the representation of industries within the sector is based on the industries' contribution to gross revenue in the sector. In the final stage, the companies to be selected within each industry would be based on the individual company's contribution to gross revenue. In this case, the companies with the highest gross revenue in the industry would be selected.

In this study, the period of study is from 1978:1 to 1999:1 giving a total of forty-three time series observations. Bi-annual time series data on observed realisation of gross revenue, capital expenditure and employment and their respective forecasted values made by managers of the agricultural firms were compiled from various issues of the 'Business Expectations Survey of Limited Companies' published bi-annually by the Department of Statistics, Malaysia. The agricultural firms referred to in this study are firms

in the rubber sector, oil palm sector, forestry (logging) sector and mining (tin) sector.

THE EMPIRICAL RESULTS

Before estimating equation (1), the stationarity of variables A_t and $_{t-1}F_t$ is evaluated by estimating the non-parametric Phillips-Perron (PP) unit root tests. First, we test the series in levels and then in their first differences. All variables have been transformed into natural logarithm. Table 1 contains these results. Generally, our results do suggest that the unit root hypothesis can be rejected at the 5 percent level for both the actual and anticipated series for gross revenue, capital expenditure and employment in their levels in the cases of rubber and oil palm sectors. The PP test statistics suggest that all six variables are stationary in first difference. For the mining sector, only in the case of gross revenue that both actual and anticipated variables are first difference stationary. Thus, traditional regression analysis based on equation (1) can lead to spurious regression results because these variables are nonstationary in levels, that is, they are I(1).

However, for the forestry sector, where both the actual and anticipated gross revenue, capital expenditure and employment are stationary in levels. Similar conclusion can be said for actual and anticipated capital expenditure of the mining sector. For these variables, ordinary least square regression is appropriate as the series are stationary in their levels, that is, they are I(0). On the other hand, the employment series for the mining sector, our results clearly suggest that actual employment series is I(0) while the anticipated employment series is I(1).

Given that the series are of the same order of integration except for the employment series for the mining sector, we can proceed to estimate equation (1), provided that A_t and $_{t-1}F_t$ is cointegrated for the series that are nonstationary in their levels. According to Fischer (1989), if $A_t \sim I(1)$ and $_{t-1}F_t$ is a rational forecast of A_t based on available information set I_{t-i} at time t-i, then $_{t-1}F_t$ must also be I(1) and that $_{t-1}F_t$ must be cointegrated with A_t. If two or more time series are cointegrated, their OLS regression estimate in levels are efficient and consistent. Table 2 present results on cointegration and the unbiasedness tests.

Results contain in Table 2 indicate that actual values and anticipated values on gross revenue, capital employment and employment are cointegrated for the rubber and oil palm sectors, and also for the gross revenue in the mining sector. The cointegrating regression Durbin-Watson (CRDW) and PP test statistics are significantly different from zero at the 5 percent level. The results suggest that the null of noncointegration can be rejected. Furthermore, the LM test statistics for all equations (11 equations)

indicate that the disturbance term is white noise. However, the joint hypothesis that $\alpha=0$ and $\beta=1$ is firmly rejected in 8 out of 11 equations. Only in the cases of gross revenue equation in the rubber and oil palm sectors and employment equation in the oil palm sector that the calculated *F*-statistics for the null hypothesis that $\alpha=0$ and $\beta=1$ cannot be rejected at the 5 percent significance level. Thus, the null hypothesis of unbiasedness cannot be rejected in the majority of the cases analysed.

The next test for rational expectations examines whether survey data incorporates past information. In this study we used the non-serial correlation and the weak-form efficiency tests. For the former, the information set is the past forecast errors, while for the latter, past actual values are the information sets. These results are presented in Table 3.

In Table 3 we show both results of the efficiency tests using N=1,2 and 3. The non-serial correlation test results suggest that only in the cases of gross revenue in the forestry sector, capital expenditure in the rubber, oil palm and forestry sectors and employment in the rubber sector that the null hypothesis; $\gamma_0=\gamma_i=0$ (i=1,2 and 3) can be rejected at the 5 percent level of significance. Similar finding is obtained with respect to the weak-form efficiency test. The gross revenue equations for the rubber, oil palm and mining sectors, and employment for the oil palm sector, the null hypothesis that $\theta_0=\theta_i=0$ (i=1,2 and 3) as a group can be rejected. The calculated *F*-statistics are significantly different from zero at the 5 percent level. Thus, our efficiency tests results suggest that: (i) for gross revenue for the rubber, oil palm and mining sectors, capital expenditure for the mining sector, and employment for the oil palm and forestry sector, information on lagged forecast errors has been incorporated in the information set at the time the forecast were made; and (ii) for gross revenue for the rubber, oil palm and mining sectors, capital expenditure for the mining sector and employment for the oil palm sector, information on lagged actual values of the variables has been incorporated in the information set at the time the forecast were made.

CONCLUSION

Generally, agricultural firms in Malaysia made non-rational forecasts of their own future actions. They made an upwards bias in their bi-annual forecasts of actual gross revenue, capital expenditure and employment series. Also they have not fully utilised available relevant information (their lagged forecast errors and lagged actual values of the series) at the time the forecasts were made. Our results indicate that great improvement can be achieved in minimizing the forecast errors if this information is incorporated in the information sets.

These results are not surprising. Even in the United States, Carlson (1977), Friedman (1980), Mullineaux (1978) and Runkle (1991) have found that survey data were not rational forecasts of the actual value of the variable in question. Several reasons have been given as to why survey data do not conform to rational expectations hypothesis. It was pointed out that individuals have no incentive to give accurate reports of how much they intend to produce next period. After all, there are no costs incurred for not reporting accurately. Furthermore, there is no guarantee that what they actually forecasted or intended to do next is what they actually do. However, if individuals are paid to made forecasts of their intentions, there is an incentive for the individuals to make accurate reports (Colling and Irwin, 1990; Keane and Runkle, 1990; Runkle, 1991).

On the other hand, Maddala (1977) and Zimmermann (1986) have argued on statistical grounds why survey data does not conform to rational expectations hypothesis. The reasons include data deficiencies, non-linearity in the underlying model, inappropriate information sets or estimation methods, and spurious regression problems. However, Keane and Runkle (1990) have suggested that a practical way of avoiding this econometric problem is the appropriate use of tests of rationality on market participants who have an incentive to conduct accurate forecasts.

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Table 1: Results of Integration Tests

Series		Level Phillips-Perron (PP)	First difference Phillips-Perron PP)
A. Rubber sector			
Goss revenue:	Actual	-1.98	-6.75**
Anticipated		-1.80	-7.38**
Capital expenditure:	Actual	-2.35	-11.00**
Anticipated		-2.47	-8.02**
Employment:	Actual	-2.51	-6.68**
Anticipated		-2.26	-6.69**
B. Oil palm sector			
Goss revenue:	Actual	-0.68	-7.58**
Anticipated		0.37	-5.00**
Capital expenditure:	Actual	-2.62	-10.19**
Anticipated		-1.88	-5.84**
Employment:	Actual	-1.93	-5.80**
Anticipated		-1.99	-5.73**
C. Forestry sector	Actual		
Goss revenue:		-3.96**	-
Anticipated		-3.16**	-
Capital expenditure:	Actual	-3.67**	-
Anticipated		-3.25**	-
Employment:	Actual	-3.45**	-
Anticipated		-3.48**	-
D. Mining sector			
Goss revenue:	Actual	-1.80	-4.91**
Anticipated		-1.76	-4.36**
Capital expenditure:	Actual	-3.67**	-
Anticipated		-4.06**	-
Employment	Actual	-3.13**	-
Anticipated		-2.76	-6.68**

Notes: The relevant tests are derived from the OLS estimation of the following Phillips-Perron (PP) regression: $\Delta y_t = \mu + \alpha y_{t-1} + \varepsilon_t$, where Δy_t denotes the first difference of y_t, μ is a constant (drift term) and ε_t is the disturbance term. Truncation lag length chosen for PP was 3, based on the Bartlett kernel. All estimations was made possible using EViews 3.1. PP critical value is –2.93 (5%). See MacKinnon (1991). Asterisk (**) denotes statistically significant at 5 percent level.

Table 2: The Results of Cointegration and Unbiasedness Tests

	Rubber sector: Gross revenue	Capital ex penditure	Employ ment	Oil palm sector: Gross revenue	Capital expenditure	Employ ment	Forestry sector: Gross revenue	Capital expenditure	Employ ment	Mining sector: Gross revenue	Capital expenditure	Employ ment
Constant(α)	0.5859	0.0355	-0.0312	-0.3886	1.0011	0.7863	2.1592	2.0888	0.7718	0.8559	0.8097	-
	(1.8306)	(0.1135)	(0.4545)	(0.87941	(2.5371)**	(1.4945)	(3.4601)**	(7.4337)**	(2.9892)**	(2.1646)**	(3.2586)**	-
Slope (β)	0.8855	0.8897	0.9895	1.0586	0.7314	0.8066	0.6452	0.3989	0.4883	0.8360	0.6507	-
	(14.704)**	(8.6890)**	(44.160)**	(16.350)**	(8.4580)**	(6.3131)**	(6.0392)**	(4.0168)**	(2.8197)**	(12.242)**	(5.7726)**	-
R-squared	0.8405	0.6480	0.9794	0.9021	0.7115	0.5788	0.5570	0.3574	0.2151	0.8106	0.4877	-
CRDW/D	1.53**	2.12**	2.02**	2.17**	2.28**	1.83**	2.41	1.96	2.06	1.69**	2.03	-
PP(3)	-5.01**	-6.98**	-6.56**	-6.02**	-6.20**	-5.01**	-	-	-	-5.02**	-	-
F-statistics	2.032	15.948	5.541	0.531	20.312	1.595	9.546	27.855	4.472	3.268	5.319	-
(α=0, β=1)	[0.143]	[0.000]**	[0.007]**	[0.593]	[0.000]**	[0.219]	[0.000]**	[0.000]**	[0.020]**	[0.049]**	[0.009]**	
LM $\chi^2(4)$	3.374	3.747	1.583	2.043	2.412	4.283	4.236	2.115	1.453	2.635	2.802	-
	[0.497]	[0.441]	[0.811]	[0.727]	[0.660]	[0.369]	[0374]	[0.714]	[0.834]	[0.620]	[0.591]	-

Notes: Critical value for CRDW at 5% level is 0.78 (see Engle and Yoo. 1987). Critical value for PP is -1.94 (5%) (see MacKinnon, 1991). The LM Chi-square statistic for serial correlation with four lags is 9.48 with four degree of freedom at 5 percent level. Figures in round and square brackets are respectively *t*-statistics and *p*-values. Asterisk (**) denotes statistically significant at 5 percent level.

Table 3: Results of Efficiency Tests

Lag length	Test with respect to lagged forecast error:			Test with respect to lagged actual values:		
	Gross revenue	Capital expenditure	Employ ment	Gross revenue	Capital expenditure	Employ ment
	F-statistics with respect to lag length:					
A. Rubber sector						
1	0.993	15.517	5.389	0.589	16.526	5.357
	[0.379]	[0.000]**	[0.008]**	[0.559]	[0.000]**	[0.008]**
2	0.647	0.447	3.665	0.363	11.435	3.533
	[0.589]	[0.000]**	[0.020]**	[0.779]	[0.000]**	[0.023]**
3	0.486	8.314	2.732	0.281	8.933	2.585
	[0.745]	[0.000]**	[0.043]**	[0.887]	[0.000]**	[0.053]
B. Oil palm sector						
1	0.126	11.959	0.377	0.239	14.340	0.456
	[0.881]	[0.000]**	[0.689]	[0.788]	[0.000]**	[0.638]
2	0.646	8.715	0.544	0.903	8.249	0.562
	[0.592]	[0.000]**	[0.656]	[0.453]	[0.000]**	[0.644]
3	0.500	5.802	0.972	0.667	6.184	1.254
	[0.735]	[0.002]**	[0.440]	[0.620]	[0.001]**	[0.316]
C. Forestry sector						
1	4.734	3.702	1.702	6.963	3.759	4.885
	[0.016]**	[0.037]**	[0.200]	[0.003]**	[0.035]**	[0.015]**
2	2.875	2.161	2.477	2.135	1.928	3.089
	[0.055]	[0.116]	[0.083]	[0.120]	[0.149]	[0.044]**
3	1.864	2.494	2.036	1.820	1.428	2.129
	[0.149]	[0.069]	[0.121]	[0.157]	[0.254]	[0.108]
D. Mining sector						
1	0.639	0.851	-	0.788	0.480	-
	[0.533]	[0.435]	-	[0.462]	[0.622]	-
2	0.824	0.545	-	0.565	0.335	-
	[0.490]	[0.654]	-	[0.641]	[0.799]	-
3	0.866	0.539	-	0.552	0.382	-
	[0.495]	[0.707]	-	[0.698]	[0.819]	-

Notes: When testing for weak-form efficiency tests, lagged actual values of gross revenue, capital expenditure and employment for the forestry sector, and capital expenditure for the mining sector, are in their level form. For the other nonstationary variables in levels, their lagged actual values are estimated in first differences. Figures in square brackets are *p*-values. Asterisk (**) denotes statistically significant at 5 percent level.