Malaysian Journal of Economic Studies Vol. XXXVIII Nos. 1 & 2, 2001 ISSN 1511-4554

The Link Between Wages and Labour Productivity: an Analysis of the Malaysian Manufacturing Industry

Lee-Peng HO and Su-Fei YAP
University of Malaya

Abstract: This paper analyses both the long-run and short-run dynamics of wage formation in the Malaysian manufacturing industry as a whole and also for 13 selected sub-sectors of the industry using error correction modeling. The main objective is to investigate whether the increase in real wages commensurates with changes in labour productivity. Carneiro's (1998) arguments based on the union-firm wage bargaining model was adapted for this purpose. The results of the study indicate that in the long run, labour productivity is positively related to real wages. However, the increase in real wage exceeds the increase in labour productivity, causing an increase in unit labour cost. Unemployment exerts a negative effect on wages as theorised, however its low elasticity suggests some degree of stickiness in wage adjustments. Union density, as a measure of union power has a positive influence on wages. In the short run, the association between real wage changes and labour productivity increases is negative and insignificant statistically. This may be attributed to the lagged adjustment of money wages caused by collective bargaining agreements.

1. Introduction

In view of increased competition resulting from globalisation of economies, the Malaysian government has placed much emphasis on the importance of the relationship between wages and productivity. In recent Malaysia Plans (Malaysia 1996; Malaysia 2001), it is stated that the government, in collaboration with the private sector, will study the various wage schemes that enable firms to link wages to productivity. To maintain competitiveness, it is imperative for firms to ensure that labour productivity growth is higher than wage increases. The rationale of this study is therefore to verify whether increases in industrial wages respond to sectoral performance, that is, the increases in wages commensurate with higher increases in labour productivity. This study analyses both the long-run and short-run dynamics of wage formation in Malaysian manufacturing in aggregate as well as for 13 selected sub-sectors of the manufacturing industry.

There is a lack of local empirical studies concerning wages in Malaysian industries. Nijhar (1976) and Chan (1991) have conducted studies on wage structure but very little attention was paid to explaining the mechanism of wage formation at sectoral levels in the Malaysian economy. Nijhar (1976) conducted a survey on the wage structure in the rubber estates in West Malaysia while Chan (1991) provided a benchmark report on the wage structure and analysed the wage trends at a disaggregated level. A later study by Soon (1991) attempted to assess the influence of non-competitive forces on wage in the Malaysian manufacturing context. The study also looked at the effects of salary scale wage setting on real wage rigidity and employment during the 1985–86 recession.

2. Data and Methodology

Labour productivity is relatively important in influencing wage increases in the labour market. There are various measures of labour productivity. At the simplest level, labour productivity

can be defined as output per worker. Alternatively, labour productivity can also be defined in terms of value-added per worker. Value added is the difference between the sales value of the output less the costs of all intermediate inputs which are not produced internally but used in the production of output. Union density refers to the proportion of the employed labour force which is unionised and as such is a more potent indicator of union power than simple membership.

This study employs annual data from 1975 to 1997. Wages, employment and value-added data were obtained from the Annual Survey of Manufacturing Industries. The number of unions and membership to measure union density were derived from the Annual Trade Unions Report compiled by the Ministry of Human Resources. Rates of employment and the consumer price index were sourced from the Economic Reports. The 13 sub-sectors studied were food, beverage, tobacco, textiles, wood products, paper products, printing and publishing, industrial chemicals, petroleum and coal products, rubber products, non-ferrous metal, machinery except electrical and electrical machinery.

This study adopted the approach of Carneiro (1998) in analysing relative changes of labour productivity on wages in manufacturing industries. The wage equation is described as below:

$$W_t = \beta_0 + \beta_1 P_t + \beta_2 PROD_t + \beta_4 UNEMP_t + \beta_5 UD_t + u_t \quad (1)$$

where consumer price (*P*), labour productivity (*PROD*), unemployment rate (*UNEMP*) and union density (*UD*) are our main explanatory variables, and *W* is the money wage. Our estimation in Section 3 employs logarithms of all the variables.

The short-run wage dynamics of the Malaysian manufacturing sector was modeled using the Engle and Granger (1987) method. The Engle and Granger two-step cointegration procedure incorporates analyses of both the long-run relationship between the variables, and short-run disequilibrium behaviour. In the first stage, the long-run wage equation is estimated by Ordinary Least Squares (OLS) and the residuals are tested for stationarity. The residuals of the long-run wage equations are then kept as the error correction term to capture the long-run disequilibrium in a short-run dynamic model. The short-run dynamic model has the following specification:

$$\Delta rw_t = \beta_0 + \beta_1 \Delta PROD_t + \beta_2 \Delta UNEMP_t + \beta_3 \Delta UD_t + \beta_4 u_{t-1} + \varepsilon_t \quad (2)$$

where u is the error correction term obtained from the residuals of equation (1), β_0 to β_4 are coefficients and ε is an error term assumed to be white noise. So the rate of change in real wages, Δrw_t is determined by the rate of change in labour productivity ($\Delta PROD_t$), unemployment rate ($\Delta UNEMP_t$), union density (ΔUD_t) and feedback via the error correction term (u_{t-1}), representing the deviation between the actual and the long-run equilibrium values of real wages in the previous period. For the estimation process, the variables were transformed into logarithms in Section 3.

The augmented Dickey-Fuller (ADF) unit root test was applied to test if the time series data was stationary to avoid generation of spurious regressions. After establishing the long-run relationship between the variables using OLS, the error correction mechanism (ECM) was applied to evaluate the short-run dynamics between the variables.

3. Empirical Results

All the time series were stationary after taking first differences. Therefore, all the data series were integrated of order one. If elements of the wage equation are cointegrated, the random error variable u_t should be stationary. A unit root test was conducted on the error term based on the ADF test. The ADF statistics rejected the null hypothesis at the 1 per cent significance level indicating a stationary random error. This suggests a long-run equilibrium relationship between the given variables whereby they exhibit a tendency to move together.

3.1 Wage Equation for the Manufacturing Sector

Table 1 reports the results of the long-run wage equation for the Malaysian manufacturing industry as a whole. Based on the OLS regression, the R^2 value indicates that about 96.87 per cent of the variation in real wage (log) is explained by the model. The R^2 is high suggesting that the model fits the data satisfactorily. All signs of the coefficients in the long-run wage equation are consistent with economic theory. The estimated regression shows that the labour productivity is significant at the 1 per cent level and positively related to real wage. This can be attributed to characteristics of the labour itself, such as greater skill or effort as suggested in the efficiency wage theory (Akerlof and Yellen 1986). For every 1 per cent change in labour productivity, real wages increase by 1.96 per cent holding other variables constant. This means that increases in labour cost out-strips that of growth in labour productivity. Over the long run, wages rising faster than labour productivity will lead to an increase in unit labour cost, thus eroding competitiveness of the sector.

The coefficient for the unemployment rate appears to be significant at the 1 per cent level

Table 1: Results of the long-run wage equation

Model: $LRW_t = \beta_0 + \beta_1 LPROD_t + \beta_2 LUNEMP_t + \beta_3 LUD_t + u_t$

Estimated Model	R^2	DW
$\hat{LRW}_t = -19.347 + 1.966 LPROD_t - 0.0.729 LUNEMP_t + 1.219 LUD_t$ (-2.702) (14.598) (-3.160) (1.271)	0.9687	1.1652

Note: Figures in parentheses are *t*-statistics. Variables prefixed with *L* indicate logarithmic transformation.

and it shows a negative relationship. As the number of unemployed workers increase, the excess in labour supply will result in a lowering of wages. In this case, a 1 per cent increase in unemployment rate will decrease real wages by 0.73 per cent. The relatively low elasticity suggests a measure of stickiness in wage adjustments. Union density as a measurement of union power is also significant at the 10 per cent level and asserts a positive impact on real wage changes. A 1 per cent increase in union density will induce a 1.2 per cent increase in real wage. The positive relationship can be explained, as strong trade unions use the argument of rising labour productivity of its members as a basis for demanding higher wages according to the wage bargaining theory (Oswald 1985).

Table 2 presents the results for a short-run wage dynamic model. The coefficients obtained

from the OLS are insignificant except for the unemployment coefficient, which is significant at the 5 per cent level. The results suggest that in the short run, wages are not significantly influenced by labour productivity and union density. The relationship between real wages and labour productivity is negative suggesting that labour productivity gains do not bring higher wages in the short run. The results may be attributed to the phenomenon of rigidities or lags in the adjustment of money wages introduced by collective bargaining, with the collective-bargaining agreements running for several years. However, the unemployment rate depresses wages. For every 1 per cent change in the unemployment rate, real wages decrease by 0.463 per cent.

3.2. Wage Equation for Selected Sub-sectors of the Malaysian Manufacturing Industry

Table 2: Results of the short-run wage equation

Model: $\Delta LRW_t = \beta_0 + \beta_1 \Delta LPROD_t + \beta_2 \Delta LUNEMP_t + \beta_3 \Delta LUD_t + \beta_4 u_{t-1} + \varepsilon_t$

Estimated Model	R^2	DW
$\Delta \hat{LRW}_t = 0.1646 - 0.4438\Delta LPROD_t - 0.463\Delta LUNEMP_t$ (2.341) (–0.592) (–2.048) $+ 0.9515\Delta LUD_t - 0.329u_{t-1}$ (1.014) (–1.546)	0.3347	2.0682

Note: Figures in parentheses are *t*-statistics. Variables prefixed with *L* indicate logarithmic transformation.

In this section, we imposed the same long-run wage structure for the whole of the industry to verify the influences of labour productivity, union density and unemployment rate on wages for 13 selected sub-sectors of the manufacturing sector. In general terms, the estimated long-run relationships between real wages, labour productivity, unemployment and union density performed rather well. The R^2 value for all the sub-sectors was high suggesting that the model fits the data satisfactorily. The residuals of the estimated equations appeared stationary for all the sub-sectors at the 5 per cent level of significance based on the ADF test results. The estimated regression showed labour productivity to be significant and positively related to real wage in all the selected sub-sectors.

Unemployment yielded negative coefficients consistent with economic theory with the exception of the food and tobacco sectors. As for union density, it was associated with a negative sign in some of the sectors which is counter intuitive. It is postulated that wages are determined by firms which respond negatively to union power for these cases.

The results for the short-run wage dynamics are reported in Table 4. The estimated coefficients indicate that changes in sectoral real wages are positively influenced by changes in labour productivity, with the exception of three sectors (beverage, non-ferrous metal and electrical machinery) which yielded negative associations. In the short run, the degree of real wage response to labour productivity was small and not significant statistically. This may be due to a lag in the adjustment of real wage to sectoral performance.

Empirically, the effects of changes in unemployment appear consistent with the theory for most of the sub-sectors except in beverage, tobacco and non-ferrous metal. The positive coefficients in these cases, however, were insignificant. Overall, the coefficients were low, remaining around –0.25 for four out of the ten sub-sectors, and were marginally significant.

Table 3: Long-run wage equation for selected manufacturing sub-sectors

Sub-Sectors	Constant	*LPROD*	*LUNEMP*	*LUD*	R^2	DW	ADF
Food	13.9298	1.0613	0.036	-2.0238	0.8979	1.1922	-2.2959
	(8.1686)	(3.6187)	(0.1578)	(5.663)			
Beverage	6.0500	1.1253	-0.1465	0.0724	0.7452	0.6341	-2.6705
	(2.4064)	(3.9549)	(-0.4677)	(0.0797)			
Tobacco	10.0159	0.8519	0.2572	-0.9625	0.9000	1.2437	-3.1191
	(33.0156)	(10.7459)	(1.0535)	(-5.7924)			
Textiles	10.0159	0.8277	-0.8293	0.5987	0.9236	1.3128	-3.5237
	(8.8904)	(6.2547)	(-3.6808)	(2.9802)			
Wood Products	10.2911	1.3356	-0.4252	-0.0802	0.7703	0.9619	-2.5595
	(8.0349)	(4.4043)	(-1.1352)	(-2.0024)			
Paper Products	8.3616	1.5082	-0.1836	-0.705	0.9686	1.5799	-4.0175
	(6.2614)	(6.6934)	(-0.992)	(-2.4553)			
Printing &	12.3527	1.2672	-0.7088	0.827	0.9674	1.9752	-3.9336
Publishing	(6.8556)	(9.2384)	(-3.4156)	(3.339)			
Industrial Chemical	2.3302	1.1854	-0.3636	-0.4197	0.9788	1.0695	-3.2078
	(2.6101)	(19.3394)	(-1.5575)	(-2.4477)			
Petroleum & Coal	14.7031	0.2315	-1.4569	-1.6546	0.9459	1.4036	-5.0828
	(22.2671)	(2.9689)	(-6.3637)	(-13.450)			
Rubber Products	18.6874	0.7944	-0.0543	-1.9573	0.9365	0.9561	-2.6311
	(3.9704)	(2.7758)	(-0.2796)	(-6.437)			
Non-Ferrous Metal	12.1739	0.3356	-0.090	-1.4987	0.9767	1.1104	-2.7465
	(18.3446)	(2.6974)	(-0.5889)	(-14.057)			
Machinery Except	20.1499	0.7588	-1.2394	-1.2163	0.9711	2.1977	-5.3242
Electrical	(9.1355)	(4.0211)	(-6.4357)	(-5.7173)			
Electrical	9.4717	2.5345	0.0704	-0.737	0.9596	0.7451	-3.4555
Machinery	(10.5087)	(13.7059)	(0.2262)	(-1.3567)			

Note: The dependent variable is LRW_t. Figures in parentheses are *t*-statistics. Variables prefixed with *L* indicate logarithmic transformation.

The error correction term generated the theoretically consistent negative coefficient. The speed of adjustment of short-term disturbances towards the steady state equilibrium was generally quite high, at over 30 per cent in most cases (the exception being beverages, wood products and electrical machinery).

4. Conclusion

The current emerging trend where growth in the wage rate outstrips productivity growth is a cause for concern. In this study, the model proposed by Carneiro (1998) was adopted to analyse the wage formation process in the Malaysian manufacturing industry since this model has not been employed in the Malaysian context. This is based on a conventional model of wage bargaining where the employer-employee relationship is taken into account. This study used the Engle and Granger two-step procedure to assess the path of wage formation. The methodology used explored cointegration amongst nonstationary variables in the long run. The short-run wage dynamic path was also captured. The study details the relationship between

Table 4: Short-run wage equation for selected manufacturing sub-sectors

Sub-Sectors	Constant	$\Delta LPROD_t$	$\Delta LUNEMP_t$	ΔLUD_t	u_{t-1}	R^2
Food	0.0977	0.0577	-0.2654	-0.3892	-0.2825	0.2448
	(2.0419)	(0.1981)	(-1.0629)	(-1.2245)	(-1.676)	
Beverage	0.1249	-0.234	0.0349	0.3315	-0.0109	0.3119
	(2.7156)	(-1.8074)	(0.1272)	(0.9963)	(-0.066)	
Tobacco	0.0395	0.3772	0.0864	-0.5269	-0.4864	0.4069
	(0.7533)	(1.2544)	(0.3178)	(-1.9721)	(-2.0978)	
Textiles	0.0682	0.2808	-0.533	0.0809	-0.4278	0.2557
	(1.2875)	(0.9682)	(-1.9181)	(0.4056)	(-1.9539)	
Wood Products	0.1074	0.0147	-0.5206	-0.0107	-0.1671	0.2953
	(2.4153)	(0.0616)	(-1.9385)	(-0.818)	(-1.5446)	
Paper Products	0.1533	0.2515	-0.134	-0.1278	-0.4486	0.2702
	(3.0422)	(0.7145)	(-0.5861)	(-0.4963)	(-2.1645)	
Printing & Publishing	0.1064	0.1492	-0.4965	0.5838	-0.7839	0.5782
	(2.8007)	(0.5584)	(-2.608)	(2.242)	(-4.323)	
Industrial Chemical	0.0678	0.3635	-0.2603	-0.3445	-0.2909	0.3968
	(1.846)	(1.6108)	(-1.2936)	(-2.3873)	(-1.0963)	
Rubber Products	0.0918	0.0689	-0.2506	-0.621	-0.3475	0.3075
	(2.0789)	(0.2447)	(-1.0674)	(-1.8038)	(-1.8513)	
Petroleum and Coal	0.1405	0.0547	-0.2608	-0.7759	-0.3555	0.6188
(2.9464)	(1.3335)	(-0.8149)	(-4.955)	(-1.9010)		
Non-Ferrous Metal	0.1193	-0.0205	0.1922	-0.7208	-0.7812	0.8000
	(3.6146)	(-0.2385)	(1.1725)	(-4.2598)	(-5.731)	
Machinery Except	0.07576	0.4428	-0.7859	-0.5323	-0.7217	0.5000
Electrical	(1.5506)	(2.3385)	(-3.0394)	(-2.101)	(-3.1523)	
Electrical Machinery	0.2036	-0.1283	-0.0803	-0.1269	-0.194	0.1629
	(4.8023)	(-1.0202)	(-0.2731)	(-0.4222)	(-0.1742)	

Note: The dependent variable is ΔLRW_t. Figures in parentheses are t-statistics. Variables prefixed with *L* indicate logarithmic transformation.

three economic variables with real wages with emphasis on labour productivity.

In terms of policy implications, attempts should be made to minimise the rise in unit labour costs owing to relatively lower productivity growth compared to wage increases in the long run. Climbing costs lower overall price competitiveness of the industry, particularly since manufactures are a key export components. Appropriate and standardised measures of productivity should also be adopted as this avoids biased reporting by workers eager to rationalise wage increments.

Policies should be incorporated permitting more flexibility in wage adjustments, including downsizing salaries in the face of rising unemployment. Results indicate low elasticity, hence wages appear resistant to change. The current wage structure suggests consistency but it may be a little too rigid. Higher wage flexibility will be a valuable factor in optimising the industry's reaction to external shocks.

The findings suggest that unions continue to exert positive pressure on wages in excess of wage increases that account for productivity growth or unemployment change. This may not be necessarily optimal for the industry in terms of long-run adaptability. Policies could

be tailored in such a way as to conditionally link every wage increment to the rate of output growth. Unions could be more pro-active in encouraging their members to enhance skill and knowledge in order that wage bargaining periods are preceded by greater productive efficiency. Improved industrial resilience in the long run would ultimately benefit both employers and employees.

References

Akerlof, G.A. and J. Yellen (eds.) 1986. *Efficiency Wage Models of Labour Markets*. Cambridge: Cambridge University Press.

Carneiro, F.G. 1998. Productivity effects in Brazilian wage determination. *World Development* **26(1):** 139-153.

Carneiro, F.G. and A. Henley. 1996. Long run determinants and short run dynamics of aggregate wages in Brazil. *Aberystwyth Economic Research* **10.**

Chan, P. 1991. A study of wage trends and wage systems in Malaysia. Mimeo, Faculty of Economics & Administration, University of Malaya.

Malaysia. 1996. *Mid-Term Review of the Seventh Malaysian Plan 1996-2000*. Economic Planning Unit, Prime Minister's Department, Malaysia.

Malaysia. 1988. *National Economic Recovery Plan-Agenda for Action*. National Economic Action Council, Economic Planning Unit, Prime Minister's Department, Malaysia.

Malaysia. 1999. *Malaysia Economic Statistics – Time Series*. Kuala Lumpur: Department of Statistics.

Malaysia. 2001. *Eighth Malaysia Plan 2001-2005*. Economic Planning Unit, Prime Minister's Department, Malaysia.

Malaysia Annual Survey of Manufacturing Industries, various issues. Kuala Lumpur: Department of Statistics.

National Productivity Corporation. 1999. *A Handbook on Productivity Linked Wage System*. Petaling Jaya: NPC.

National Productivity Corporation. *Annual Productivity Report*. Various issues. Petaling Jaya: NPC.

Nijhar, K.S. 1976. *Wage Structure: A Case Study in Malaysia*. Kuala Lumpur: Academic Publishers.

Oswald, A. 1985. The economic theory of trade unions: an introductory survey. *Scandinavian Journal of Economics* **87:** 160-193.

Soon, L.Y. 1991. Wage behaviour and labour market adjustment in Malaysia. Faculty of Economics and Administration, University of Malaya. Working Paper Series No. 2 /1991.