THE RELATIONSHIP BETWEEN PRODUCTION QUANTITY AND EMPLOYMENT IN MANUFACTURING SECTOR IN MELAKA

Syafawati Abdul Refai, Hamka Ismail and Mohd Marzuki Abd Hamid [1]

ABSTRAK

Sektor pembuatan merupakan satu sektor yang dinamik yang merangkumi pelbagai jenis industri. Sektor pembuatan juga merupakan antara penyumbang utama kepada Keluaran Dalam Negeri Kasar (KDNK) bagi negeri Melaka iaitu 42.9 peratus pada tahun 2010. Selain sumbangan kepada pertumbuhan ekonomi negeri Melaka, sektor ini juga telah mewujudkan banyak peluang pekerjaan. Pada tahun 2010, sektor pembuatan melibatkan seramai 69,323 orang guna tenaga daripada keseluruhan guna tenaga di Melaka. Artikel ini membincangkan hubungkait antara jumlah pengeluaran dan jumlah guna tenaga untuk melihat kesan penggunaan teknologi bagi sektor pembuatan di negeri Melaka. LMS estimator telah digunakan ke atas data Penyiasatan Pembuatan Bulanan bagi mengkaji hubungkait antara dua pembolehubah. Hasil kajian menunjukkan wujud hubungan yang positif antara kuantiti pengeluaran dan jumlah guna tenaga. Sektor ini perlu melalui beberapa fasa transformasi menerusi pelan dan program yang dilaksanakan oleh kerajaan bagi meningkatkan daya saing dengan mengoptimumkan produktiviti.

Kata kunci: Jumlah Pengeluaran, Jumlah Guna Tenaga, Sektor Pembuatan.

ABSTRACT

The manufacturing sector is a dynamic sector which covers a range of industries. The manufacturing sector is one of the major contributors to the state of Melaka's Growth Domestic Product (GDP) of which in 2010 it contributed 42.9 per cent to the state GDP. In addition to its contribution to the economic growth of Melaka, this sector has also created a lot of jobs opportunity. In the year 2010, the manufacturing sector has employed 69,323 workers of the total workforce in Melaka. This article presents the relationship between production and employment rate to observe the effect of technology usage in the manufacturing sector in Melaka. LMS estimator is apply to Monthly Manufacturing data to examine the relationship between both variables. Findings indicate that there exist a positive relationship between production quantity and total employment. Manufacturing sector has to undergone several phases of transformation through plans and programmes undertaken by the government to improve its competitiveness and optimising its productivity.

Keywords: Total Production, Total Workforce, Manufacturing Sector

[1] Syafawati Abdul Refai is currently Assistant Director of Department of Statistics, Melaka, Hamka Ismail is Assistant Director of Industrial Production and Construction Statistics Division and Mohd Marzuki Abd Hamid is former Director of Department of Statistics, Melaka.

1. INTRODUCTION

Malaysia has undergone significant transformation from its agricultural roots to manufacturing industry as the engine of the country's economic growth which had a major impact on key aspects of the economy such as employment and trade. Today, the manufacturing sector continues to develop rapidly and in order to sustain growth and challenges the government implemented the Third Industrial Master Plan (IMP3) to ensure that the sector remain competitive and innovative.

The manufacturing sector continues to be the driving component of Malaysia's GDP growth where it contributed 27.5 per cent of GDP in 2011. According to the Malaysia Investment Performance 2011 published by Malaysian Investment Development Authority (2012), the manufacturing sector accounted for half of all foreign direct investment (FDI) inflows in year 2011, almost double the 27.0 per cent drawn in by the services sector. In the first seven months of 2012, Malaysia saw RM27.5 billion worth of approved direct investment in the manufacturing sector which was expected to generate 46,137 employment opportunities. Exports of manufactured products accounted for 67.7 per cent of Malaysia's total export in 2011. It increased by 2.0 per cent to RM470.3 billion in 2011 from RM461 billion in 2010.

According to the Economic Census 2011, the value of gross output increased by 27.6 per cent to RM836.5 billion in 2010 compared to RM655.5 billion in 2009. In the period between 2005 and 2010, intermediate input also grew by 4.4 per cent to register RM665.8 billion in 2010. One of the manufacturing sector's contributions to the Malaysian economy is the generation of employment opportunities. The total employees engaged in the manufacturing sector in the year 2010 were 1,812,360 persons, an increase of 8.2 per cent compared with the preceding year. Productivity in this sector, as measured by sales value per employee recorded a growth of 9.6 per cent in 2011.

The manufacturing industry in Melaka is one of the most important sectors and continues to be the prime mover in the growth of the state economy. State of Melaka was ranked in the 5th position among the Malaysian states in terms of its contribution to gross output, particularly manufacturing sector with 8.1 per cent contribution in 2010. On 20 October 2010, State of Melaka was declared a developed state after achieving the 32 criterias set by the Organisation for Economic Cooperation and Development (OECD) to qualify as a developed economy. Melaka Maju 2010 blueprint has targeted the state manufacturing sector contribution to the GDP by year 2020 must be more than 37.7 per cent. The manufacturing sector contributed 41.2 per cent to the state GDP in the year 2012. The total output in Melaka's manufacturing sector increased by 33.8 per cent from RM67.2 billion in 2010 to RM89.9 billion in 2012. As reported by the Annual Survey of Manufacturing Industries 2013 (for reference year 2012), Melaka continues to show positive growth in the manufacturing sector, where the value added sales value expanded by 22.5 per cent to register RM10.4 billion in 2012 as compared to 2010. In the year 2011, the total capital investment for 39 manufacturing projects in Melaka amounted to RM4364.7 million almost triple the RM1631.1 million drawn in 2010. The total employment in this sector registered an increase of 4.6 per cent in 2012 or an addition of 3,203 persons as compared to 2010. Some of the major industries in

Melaka's manufacturing sector includes: refined petroleum products; semi-conductor devices; motor vehicles; basic iron and steel products and prepared animal feeds.

So far, however, there has been little discussion about the effect of production on the total employment in the manufacturing sector in Malaysia especially Melaka. Most studies have only focused on the production and total employment in developing countries. The main purpose of this study is to develop an understanding of the relationship between production and total employment in the manufacturing sector in Melaka. However due to practical constraints, this paper cannot provide a comprehensive review of the total employment rate for Malaysia.

Table 1: Manufacturing Sector Contribution to Melaka's Economy, 2010 & 2012

Description	2010	2012	Growth (%)
Total Output (RM billion)	**67.2**	**89.9**	**33.8**
Value Added (RM billion)	**8.5**	**10.4**	**22.5**

Source: Department of Statistics, Malaysia

2. LITERATURE REVIEW

The manufacturing sector has been the main engine of economic growth in many countries. Most developing countries evolved from a predominantly agricultural based economy to an industrial economy with an increased demand of manufactured goods and the declined of commodity prices. According to some economist, manufacturing is a wealth-producing sector of an economy. As the manufacturing sector entered a new phase of development with an emphasis on high-technology industries, it is expected to create more high-skills jobs opportunity. Manufacturing industries are also responsible for a significant share of many countries economic production and contribution to the GDP. Given the strong positive correlation between research and development and manufacturing, the manufacturing sector plays critical role in enhancing and sustaining an innovative economy.

Manufacturing is one of the most dynamic sectors of the U.S economy. Cited in the paper by Scott (2008), the manufacturing sector in the U.S was responsible for 60.0 per cent of all U.S research and development spending in 2003, with total research and development spending of $123 billion in that year alone. He also stated that scientist and engineers make up 9.0 per cent of the manufacturing labour force, a share that is nearly twice as large as in the rest of the economy. The manufacturing sector in the U.S employed 13.9 million workers in December 2007 or 10.1 per cent of total U.S employment. However, the U.S manufacturing employment reached a cyclical peak in March 1998 where 3.7 million manufacturing jobs were lost between March 1998 and December 2007 when the U.S economy fell into recession in early 2007. 3 million of those jobs were lost after March 2001. He also points out that unlike previous recessions and business cycle recoveries, manufacturing employment failed to recover after the 2001 downturn and average annual employment fell steadily after 2000. There has been no significant increase in

manufacturing productivity growth between 2001 and 2007. The sharp contraction of the U.S manufacturing sector in this decade is largely explained by the rapid growth in manufacturing imports and the manufacturing trade deficit.

Concern about employment in manufacturing sector lately has become magnified as a result of the sharp drop in the manufacturing employment as a faction of the total employment in majority of developed countries. André Bernard (2009) of Statistics Canada (Statcan) wrote that "Canada is far from being the only country having to deal with a downturn in its manufacturing base. The vast majority of other OECD member countries have also recorded major job losses in this industry in the past few years". As noted by Bernard, from 1990 to 2003, employment in manufacturing decreased by 29.0 per cent in the United Kingdom, 24.0 per cent in Japan, 20.0 per cent in Belgium and Sweden and 14.0 per cent in France. Employment in the manufacturing sector in Canada experienced a clear downward trend with successive annual losses of at least 3.0 per cent from 2005 to 2008. Industrial production in the manufacturing sector in Canada also decreased 3.7 per cent in the first two quarters of 2008. However, production generally decreased less than employment, meaning that some of the job losses can be attributed to increased productivity in manufacturing industries. In other words, while production was decreasing, business was also becoming more efficient and could produce more with the same workforce.

There are many factors that cause the decline in manufacturing employment. Cited in the paper of Brauer (2008), the decline in manufacturing employment is associated with two interrelated developments: rapid gains in productivity and increased competition from foreign producers. Competition from overseas helped spur manufacturing firm to boost productivity, but that competition has also dampened demand for goods produced domestically. Over recent decades, manufacturers have continually invested in more and better capital goods and manufacturing techniques in order to remain competitive in world markets. Improvements in productivity are economically beneficial, but a strong growth in productivity and a slower growth in the demand for manufactured goods have necessarily entailed a decline in manufacturing's share of total employment. Other factors that have influenced the decline in manufacturing employment include foreign-outsourcing and the growth in technology usage. Many manufacturing companies are carrying out an increasing amount of production abroad in order to take advantage of low foreign wages. On the other hand, technology usage in many manufacturing firms is unlikely to offer many jobs since they are generally labour-saving, not labour-using.

Despite the decline in the employment rate, world production still experience moderate growth in the first quarter of 2012. According to the report on World Manufacturing Production Statistics for Quarter 1, 2012 (UNIDO), world manufacturing output rose by 3.9 per cent in the first quarter of 2012 compared to the same period in 2011. Overall growth of manufacturing in industrialised countries was estimated at 1.6 per cent compared to the same period of the previous year. Industrialised countries have comparative advantages in high-technology products and capital goods, such as machinery and equipment, medical and precision equipment motor vehicles and other transport equipment. They generally dominate production and export in these industries. In the same report, Japan and the United

States have maintained improved growth prospects in the first few months of 2012, a development that is expected to continue for the rest of the year. Manufacturing has been the key source of economic growth and recovery from the financial crisis for both the United States and Japan. Rising demand has boosted strong manufacturing growths in the United States, where its output in the first quarter of 2012 increased by 5.5 per cent. Similarly, the manufacturing sector has restored Japan's growth where its manufacturing output rose by 2.6 per cent in the first quarter of 2012. At the same time, developing countries maintained a higher industrial growth rate in the first quarter. According to UNIDO estimates, manufacturing output of developing countries during this period grew by 8.7 per cent. Among other developing economies, Chile, Indonesia and Malaysia maintained a higher growth rate in the first quarter of 2012. Strong growth of the manufacturing sector was also observed in Egypt and Tunisia.

3. DATA AND METHODOLOGY

Data

This study explores the data from Monthly Manufacturing Survey (MM) – a monthly survey covering 120 industries out of a total of 197 industries in the manufacturing sector as classified under category D of the MSIC 2000 – between 2010 and 2011. The survey provides data on the latest trends in the principal statistics of the manufacturing sector, specifically on sales value, number of employees, salaries and wages and the main products manufactured. This article's data covers plants located in the state of Melaka.

Methodology

This section described briefly about the statistical techniques applied to analyse the data collected through the Monthly Manufacturing Survey (MM). As the purpose of this article is to determine the impact of production quantity on employment, the method used is Least Median of Squares (LMS) Correlation Coefficient.

The correlation coefficient, sometimes also known as the cross-correlation coefficient indicates the strength and direction of a linear relationship between two random variables. The simple correlation coefficient represents how closely two variables are correlated. It can vary from -1 (perfect negative correlation) through 0 (no correlation) to +1 (perfect positive correlation). It is generally denoted by r and is used to estimate ρ, the population correlation coefficient.

In robust statistic, robust regression is a form of regression analysis design to circumvent some limitations of traditional parametric and non-parametric methods. In particular, least squares estimates for regression models are highly non-robust to outliers. Rousseeuw (1984) and Hample (1975) formulated a robust regression estimator with the highest possible breakdown point, i.e ε* = 50%. The least median of squares estimator is defined as the value that minimises the LMS criterion.

$$\underset{i}{med}\ r_i^2 \text{ where; } r_i = y_i - \sum_{\mathrm{j}}^{\mathrm{p}} \hat{\beta} j\, x_{ij}; i = 0, 1, \ldots, n$$

Despite the robustness of the LMS estimator, which results from its high breakdown point, the LMS has relatively low convergence and hence is relatively inefficient especially when the errors are normally distributed. A way to improve this is to use weighted least square suggested by Rousseeuw and Leroy (1987) where all the observations (x_i, y_i) will be replaced by $(w_i x_i, w_i y_i)$ with the weight

$$w_i = \begin{cases} 1 \; if \; |r_i/s| \; \leq 2.5, \\ 0 \; if \; |r_i/s| \; > 2.5 \end{cases}$$

in which s = 1.4826 $\left\{1 + \frac{5}{n-p}\right\} \sqrt{\underset{i}{med}\, r_i^2}$

Then the point with large LMS residuals is deleted according to the above weight function. The least square estimator on these weight observations can be obtained by minimising $\sum_{i=1}^{n} w_i r_i^2$.

A weighted LMS version of the classical correlation coefficient as proposed by Abdullah (1990) is apply to Monthly Manufacturing data as defined below. Variable *x* represent the total production and variable *y* represent total employment.

$$r_w = \frac{\Sigma w_i (x_i - \bar{x}_w)(y_i - \bar{y}_w)}{\sqrt{[\Sigma w_i (\bar{x}_i - \bar{x}_w)^2 \Sigma w_i (\bar{y}_i - \bar{y}_w)^2}}$$

Where

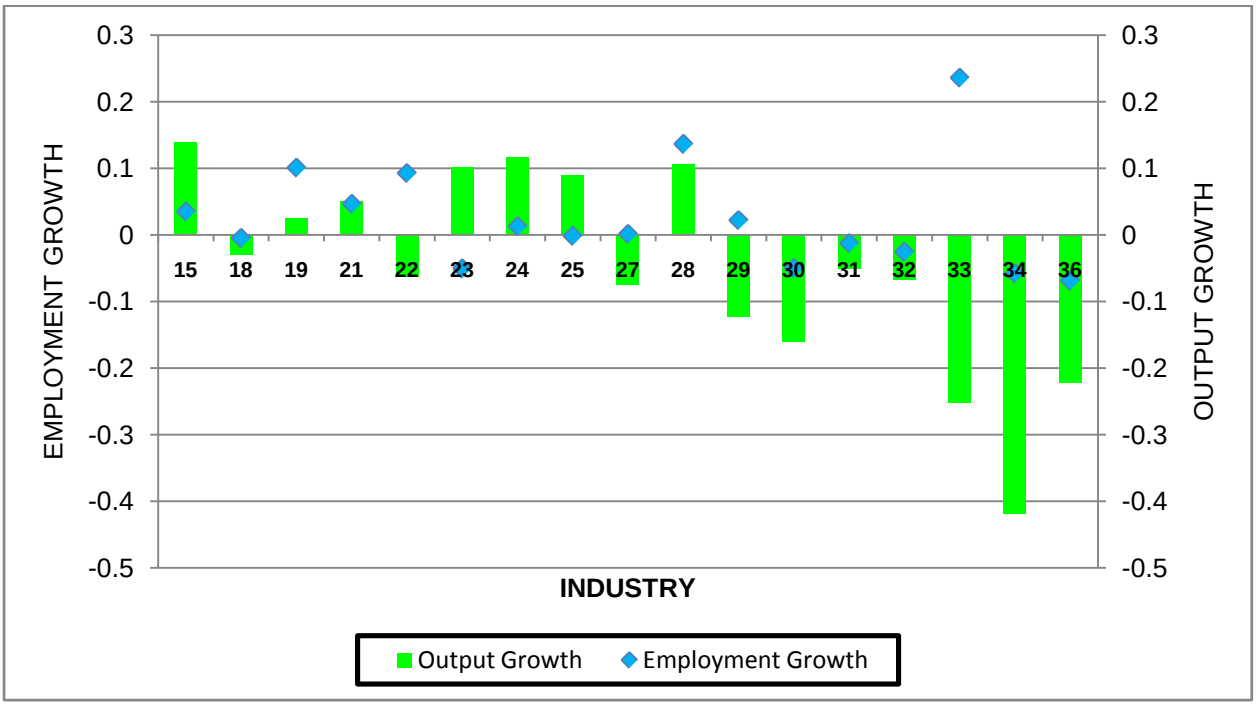
$$\bar{x}_w = \frac{\sum w_i x_i}{\sum w_i} \quad \text{and} \quad \bar{y}_w = \frac{\sum w_i x_i}{\sum w_i}$$

The LMS correlation coefficient can now be expected to have the same maximal breakdown point, i.e. ε^* = 50% as possessed by the LMS regression estimator. The LMS correlation coefficient also performs better than the classical correlation coefficient namely Pearson's product moment correlation coefficient and non-parametric correlation coefficient, Spearman's rho and Kendall's tau (Abdul Refai, 2009). The LMS correlation coefficient can also be viewed as the weighted Person's product moment correlation coefficient which considers only the 'good' observations in the data set. The statistical test and data analysis were done through R 2.15.1 and Microsoft Excel.

4. RESULT

The robust correlation coefficient is obtained by applying LMS correlation coefficient to 112 establishments selected from the Melaka's total establishments covered in the MM survey for the year 2010 and 2011. Figure 1 shows the output growth rate and the employment growth rate by industry for the year 2010 and 2011. The establishments are classified to a Division (two-digit) level of MSIC 2000. Based on Figure 1, only 7 industries recorded a positive growth in total output produce in 2011 as compared to 2010 and a total of 10 industries recorded a downfall in total output produce in 2011. The largest decreased for total output produced was from industry manufacture of motor vehicles, trailers and semi-trailers where the total output decreased 42 percent as compared to 2010.

Figure 1: Output growth rate and employment growth rate by Industry, 2010- 2011

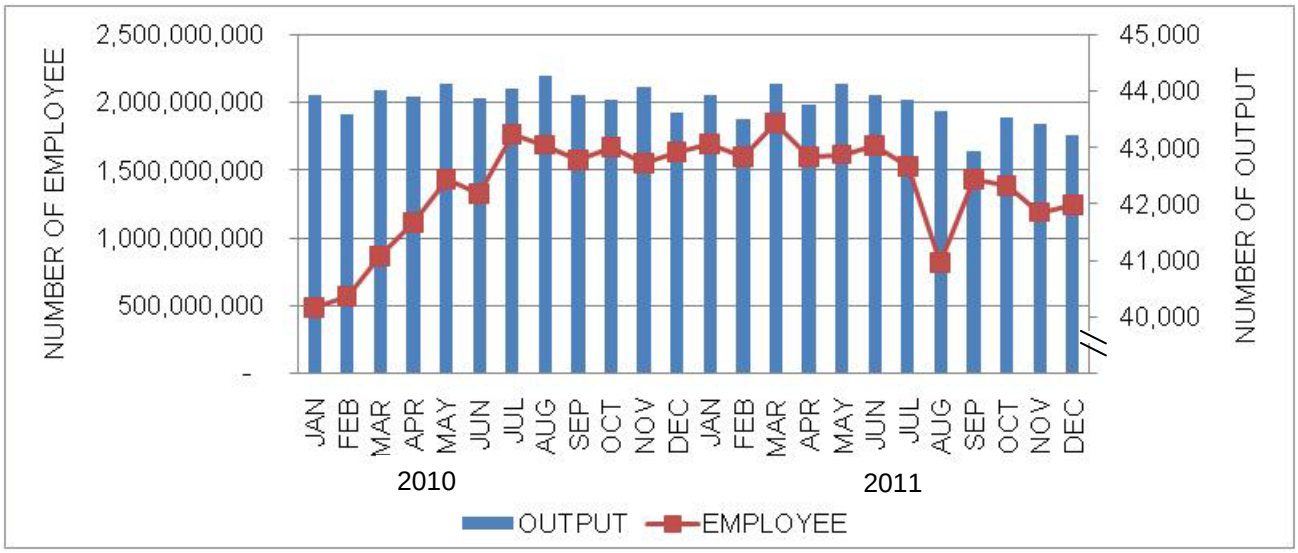


The highest output growth was from industry manufacture of food products and beverages where it increase 14 percent in 2011 as compared to 2010. The average output growth for the 112 establishments in 2011 is 0.64 percent. The average employment growth rate for 9 industries showed an increase between 0.1 percent to 24 percent for the year of 2011.

The highest employment growth rate was from industry manufacture of medical, precision and optical instruments, watches and clocks with 24 percent growth between 2010 and 2011. Industry manufacture of furniture; manufacturing n.e.c. shows the least employment growth where it decreased to 7 percent in the year 2011. The average employment growth rate for the year 2011 as compared to 2010 is 2.29 percent. 11 out of 17 industries showed a positive relationship between output growth and employment growth.

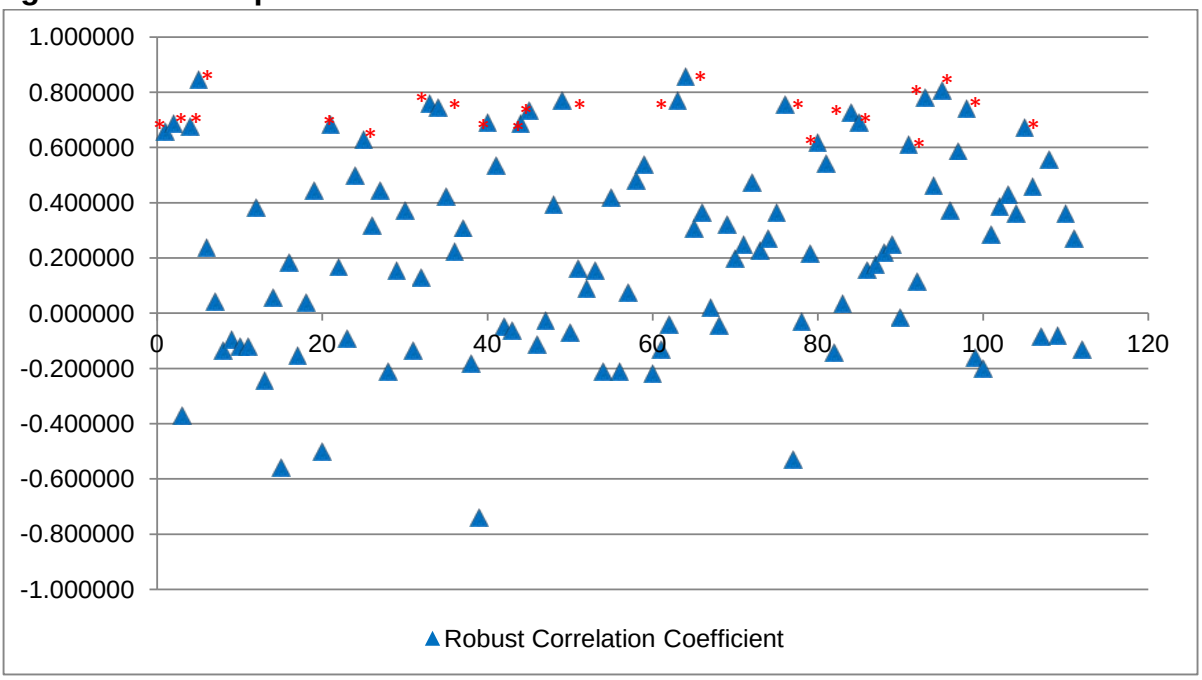
Figure 2 presents the summary statistics for total output and total employment in the manufacturing sector in Melaka. The total employment showed an increased trend for the first seven months of the year 2010 and a slight decreased for the following months. The total employment for the year 2011 is on average of 42,518 employees, however there was a sharp decreased in the total employment for the months of August 2011. The total production for the year 2010 and 2011 was on average of 1.99 billion.

Figure 2: Total output and total employment of manufacturing sector in Melaka



The finding highlights the robust correlation coefficient analysis as shown in Figure 3. The robust correlation coefficient for 69.6 percent establishments falls into the positive quadrant, this implied that there exist a positive relationship between production quantity and total employment in the manufacturing sector in Melaka. The significant level for robust correlation coefficient was set at 0.6. 23 establishments showed a significant correlation between production quantity and employment. The strong correlation between production quantity and employment for these establishments suggest that the manufacturing sector in Melaka was still relying on manpower as their production sources.

Figure 3: Scatter plot of robust correlation coefficient



5. DISCUSSION

Based on the result obtain in the analysis done with LMS correlation coefficient, there exists a positive relationship between the production quantity and the employment on the sample of 112 establishments engaged in the manufacturing sector in Melaka. This shows that with the increase in the production quantity, there will also be an increase of the total employment. In the same way, if the production quantity decreases, the total employment will also decrease. This could further be proven by the value of the robust correlation coefficient for the total of 112 establishments at 0.659.

Based on the value of the output growth rates and employment growth rates found in Figure 1, it could further be proven that the production quantity and employment has a positive relationship. One of the factors that could lead to the positive relationship is establishments have to employ more manpower in order to cater the increase in the demand of manufactured products. The manufacturing sector is partially responsible in the recovery of the economy from the financial crisis experienced in 2009. With the growth of the economy, more establishments could increase their number of employment and production. The majority of the manufacturing establishments in Malaysia are still using semi-automated technology and they still rely on the manpower for the production of manufactured products.

Although the overall trend of the production quantity and employment shows a positive relationship, there also exists a negative relationship for some of the establishments. Based on Figure 3, 30.4 per cent of the total 112 establishments analysed in this study show a negative relationship between production quantity and total employment. The robust correlation coefficient for the 34 establishments falls into the negative quadrant as shown in Figure 3. However, the values of these correlation coefficients are in the range of -0.24 to 0 except for 5 establishments which have the highest negative value. The negative relationship which also can be observed in Figure 1 implies that when the production quantity increases, the employment will be decreased and vice versa. This could be due to the increase of technology usage for some of the establishment.

The manufacturing sector is moving towards higher productivity in order to attract more foreign and domestic investment. This movement could lead to a decrease in the employment and the increase in the production quantity. Furthermore, the increase usage of technology and productivity required a shift from production worker to skilled worker. Due to the higher costs of skilled workers, substitution effects will tend to decrease the total number of employment.[2]

[2] Berman, E., Bound, J. and Griliches, Z. (1993). *Changes In The Demand For Skilled Labor Within U.S. Manufacturing Industries: Evidence From The Annual Survey Of Manufacturing*. National Bureau of Economic Research.

6. CONCLUSION

This study set out to examined empirically the relationship between production quantity and employment in Manufacturing sector in Melaka by employing robust correlation coefficient; LMS estimator. This study has found that generally there exists a positive relationship between the two variables.

The result of this study supports the idea that manufacturing sector is one of the major sectors in generating employment opportunities. However, it is unfortunate that this study was limited only to Melaka thus makes these findings less generalisable to understand the effect of production quantity on total employment for Malaysia. Further research could also be conducted to determine the effectiveness of the method chosen in this study.

As the State of Melaka move towards making the services sector as the main driver of the economic growth, the manufacturing sector has to remain competitive in order to face the dynamic changes in the industry. The usage of high-quality technology and innovations in the manufacturing sector is important for the sector to remain sustainable. The manufacturing sector is the secondary sector, thus if the manufacturing sector experienced a downturn it will more or less affect the other sectors in the Melaka's economy.

REFERENCES

Bernard, A. (2008). *Trends In Manufacturing Employment*. Perspectives on Labor and Income, February 2009. Statistics Canada. Retrieved 3 October 2010, from http://www.statcan.gc.ca/pub/75-001-x/2009102/pdf/10788-eng.pdf

Brauer, D. (2008). *Factors Underlying The Decline In The Manufacturing Employment Since 2000*. Economic And Budget Issue Brief. Congressional Budget Office, United States.

Department of Statistics Malaysia. (2012). *Economic Census 2011*. Melaka, DOSM.

Department of Statistics Malaysia. (2012). *Index of Industrial Production, December 2012*. Retrieved 8 August 2012, from http://www.statistics.gov.my/portal/download_Manufacturing/files/MANUFACTURING/2011/IPP_DEC2011.pdf

Department of Statistics Malaysia. (2012). *National Accounts Gross Domestic Product (GDP), Second Quarter 2012.* Retrieved 14 September 2012, from http://www.statistics.gov.my/portal/download_Akaun/files/quarterly_national/2012/SUKU_KEDUA/KDNK_Q212.pdf

Department of Statistics Malaysia. (2014). *Report on Survey of Manufacturing Industries 2012*. Retrieved 4 August 2015, from https://newss.statistics.gov.my/newssportalx/ep/epFreeDownloadContentSearch.seam?contentId=32035&actionMethod=ep%2FepFreeDownloadContentSearch.xhtml%3AcontentAction.doDisplayContent&cid=11426

Malaysian Investment Development Authority. (2012). *Malaysia Investment Performance 2011*. Retrieved 12 July 2012, from http://www.mida.gov.my/env3/uploads/PerformanceReport/2011/Report.pdf

Mokhtar Abdullah. (1990). On A Robust Correlation Coefficient. The Statistician, 39, 455-460.

Rousseeuw, P.J., Leroy A.M. (1987). Robust Regression And Outlier Detection. John Wiley & Sons. Inc. New York.

Scott, E.R. (2008). *EPI Briefing Paper, issue 221*, United States: Economic Policy Institute

Syafawati Abdul Refai. (2009). A Comparison Between Pearson's, Spearman's, Kendall's, Least Median Of Squares And MM-Estimator Correlation Coefficient. Unpublished paper, University Putra Malaysia.

United Nations Industrial Development Organisation. (2012). World Manufacturing Production. Statistics for Quarter 1, 2012. Retrieved 13 September 2012, from http://www.unido.org/fileadmin/user_media/Publications/Research_and_statistics/Branch_publications/Research_and_Policy/Files/Reports?World_Manufacturing_Production_Reports/WorldManufProductionQ1,2012.pdf

Appendix 1: List of Industries

NO	INDUSTRY	DESCRIPTION
1	15	Manufacture of food products and beverages
2	18	Manufacture of wearing apparel; dressing and dyeing of fur
3	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
4	21	Manufacture of paper and paper products
5	22	Publishing, printing and reproduction of recorded media
6	23	Manufacture of coke, refined petroleum products and nuclear fuel
7	24	Manufacture of chemicals and chemical products
8	25	Manufacture of rubber and plastic products
9	27	Manufacture of basic metals
10	28	Manufacture of fabricated metal products, except machinery and equipment
11	29	Manufacture of machinery and equipment n.e.c.
12	30	Manufacture of office, accounting and computing machinery
13	31	Manufacture of electrical machinery and apparatus n.e.c.
14	32	Manufacture of radio, television and communication equipment and apparatus
15	33	Manufacture of medical, precision and optical instruments, watches and clocks
16	34	Manufacture of motor vehicles, trailers and semi-trailers
17	36	Manufacture of furniture; manufacturing n.e.c.