Output and Staff Number in Hungarian Manufacturing before, during and after the Crisis

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SUMMARY

The paper describes outcomes of recent research about connection between output and staff number related to specific sectors of manufacturing in Hungary. The method was to examine the existence of a linear relationship between the variables with cross correlation and regression modelling. The examined period includes the nadir of the crisis and the first years of recovery. In the textile and food industries co-movement of time series show a strong correlation between output and staff number. There is a strong positive correlation in the case of the automotive industry, but no linear relationship can be proved between the variables in the chemical industry.

Keywords: manufacturing; sector; staff number; output
Journal of Economic Literature (JEL) code: M20, M21, N60

INTRODUCTION, GOAL OF THE RESEARCH

The human resource or labour force, as one of the basic factors of production, is one of the main resources of corporate activity. Many factors affect the staff number employed in the sectors and the changes in that number. The three most significant factors are: increase in productivity caused by technological development, changes in sector output and changes in staff costs. Zimmermann presented the results of a study conducted on the data of 16 German manufacturing enterprises, the most important conclusion of which is that an increase in demand increases the demand for labour as well (Zimmerman 1991). Based on German data, Zimmermann found no correlation between the changes in labour costs and the sector labour demand. Based on their observations concerning the entire manufacturing of 28 developing countries, Mehta & Mohanty (1993) found that an increase in sector output increases the sector labour demand.

Based on the above research findings, I focus on the observation of output and number changes as the main research goal. In addition I pay attention to discovering the possible effects of labour costs on the staff number. To characterise the sectors I also observed other factors (ratio of export revenue, changes in gross added value, R&D intensity). Four sectors were included in the analysis: the manufacture of textiles, textile products, leather and leather products; the manufacture of food products, beverages and tobacco; the manufacture of transport equipment; and the manufacture of chemicals, chemical products and man-made fibres.

The following perspectives were dominant with regards to the choice: the availability and comparability of data concerning the sector, the role of the sector in employment and its conjunctural features. In the course of the analysis I avoid the use of the expressions labour demand or employment in order to separate the analysis this way from special labour economy questions (my analysis investigated the number of staff). For similar reasons I will not deal with the topics of job creation and job destruction, or adaptation costs. Based on Surányi (2002), the adaptation costs in Hungary are asymmetric, but low. This could serve as reason for I do not investigate this question here.

METHODOLOGY OF THE RESEARCH

I used the sector data of eleven years (2001-2011) for the analysis. Most of the data comes from the company tax databases of the National Tax and Customs Administration of Hungary (hereinafter: NTCA). Data concerning labour costs was obtained from the databases of the Hungarian Central Statistical Office. The NTCA gathers the data in the course of yearly mandatory data provision from Hungarian enterprises. The obligation

concerns every enterprise operating in Hungary having double-entry bookkeeping. The Office produces sector-level data by summarising the company data, so the database represents the significant majority of Hungarian enterprises. The output is indicated on nominal values, so I calculated the output values based on 2001 prices. I used sector producer price indexes to define real values.

I first tested the correlation between the time series with cross-correlation calculations and then with regression alignment where a significant linear connection occurred. I decreased the possible significant autocorrelation distortion by using chain ratios. I consider the labour homogenous.

THEORETICAL BACKGROUND

Several empirical research results have been published worldwide that analyse the effect of different independent variables on labour demand or to some category close to staff numbers. Table 1 contains a brief review of frequently examined variables and the outcomes. Based on their research conducted on the processing industries of 28 developing countries, Mehta & Mohanty (1993) state that technological development has a tendency to decrease the staff number. Zimmermann (1991) came to the same conclusion observing German manufacturing sectors, finding that increase in demand for the product of an enterprise and the increase of output increase the demand for labour. Examination of the effects of technological development is included in both influential works, and their results also match; that is, technological development has a tendency to decrease the staff number. Falk & Koebel (2002) pointed out that the increase in output also increases the demand for heterogenic labour force. Considering labour costs, Zimmermann (1991) found that it had no defining role in the 1980s in German manufacturing. Instead he found changes in product market demand – that can be related to the changes in output – and technological development to have effective force. International studies concerning the wage flexibility of labour demand usually have found the labour market of the United States to be more flexible than the markets of the Euro zone. This is in connection with the industrial traditions and the greater power of European trade unions. The literature about Hungary mentions that in the end of the 1990s wages were not a significant part of company policies. At that time the most important challenges were the capital market and the labour market limitations. As a result of (basically beneficial) increases in the minimum wages that started in the beginning of the 2000s which were realised in several steps changes in wages again had a serious impact of staff number in certain sectors (e.g. in the textile industry). (Concerning miminum wages it could be interesting for foreign readers that Hungary has more than one minimum wages, depending on the educational level of the employee, which is quite unusual.)

Some studies have been published about the new European Union member states in this topic with regards to the change of regime. The most influential works abroad are, among others, Singer (1996) on the Czech Republic; Basu et al. (2000) on Poland, Hungary, the Czech Republic, Slovakia and Russia; and Brown & Earle (2005) on Hungary, Romania, Russia and Ukraine. These works present the effects of the structural changes accompanying the regime change on sector employment.

Important results in Hungary were published by Kőrösi (1997, 2000, 2002), Köllő (1998), and Kertesi & Köllő (2002), among others. Kőrösi states that capital costs do not significantly affect the labour demand Kőrösi (2000). The most important conclusion of Kőrösi (2002) is that changes in productivity do not affect directly the labour demand in a significant way (but greatly affect its production flexibility and to a smaller extent its wage flexibility, too). Among the international results concerning productivity Davis et al. (1998) and later Nordhaus (2005) found when observing manufacturing in the USA that an increase in productivity positively affects the sector, while Mahmood (2008) did not find a connection between the two variables when observing the SMEs of Australian manufacturing. Mann (2011) came to the conclusion that the increase in productivity decreases sector employment rates from his simulations based on sector life curves. The results of Falk & Koebel (2002) showed that sector capital increase enhances the heterogenic nature of labour demand. Yun (2008) came to the conclusion based on research on Swedish manufacturing that the effects of the intensity of R&D and commercial openness are dependent on the skill requirements characteristic of the sector.

In summary, it can be stated that many factors can affect the staff number employed in the sectors. The research results relevant here are unanimous that among the factors affecting the number of the workers (labour demand), the effect of the changes in output is obvious. Observed for a long enough time, the staff number in the sector (labour demand) changes in the same direction as the change in output in the sectors of manufacturing.

A similarly obvious relationship can be seen between technological development and changes in the staff number in the sector. This study does not examine this latest correlation. A negative direction relationship is usually considered to be found between labour costs and changes in the staff number, but the known research results did not prove it in the case of the manufacturing of Germany (Zimmermann 1991). Based on the above, my research involving four sectors of the Hungarian manufacturing primarily analyses the past correlation between the output and the staff number. In addition I try to predict the sectors in which possible future wage changes (e.g., further raising the minimum wage) could cause a significant change.

Table 1

Source	Sample	Independent variable	Dependent variable	Connection	Remarks
Mehta and Mohanty 1993	28 emerging countries manufacturing	change in technology	labour demand	negative	
		output		positive	
		input substitution		neutral	
William Nordhaus 2005	USA manufacturing	productivity growth	employment	positive	
OECD 2007	OECD members	offshoring	labour demand	no connection or slightly positive	
Muhammad Mahmood 2008	Australia manufacturing SMEs	labour productivity	employment	no connection	
Martin Falk and Bertrand M. Koebel 2002	Germany manufacturing	output	demand for heterogenous labour	positive	
		capital growth		positive	
Lihong Yun 2008	Sweden manufacturing	R&D intensity	demand for labour	positive and negative	positive in „high skilled sectors", negative in „low-skilled sectors"
Stefan Mann 2011	based on simulation model	productivity	employment	negative	consecutively by industry life cycle
K. F. Zimmermann 1991	Germany 16 manufacturing sectors	technological advance	employment	negative	in some cases
		demand for products		positive	in every case
		labor costs		not significant determinant	
Davis et al. 1998	USA manufacturing	capital intensity	net employment growth	negative	less capital intensive creates more jobs
		energy intensity		negative	depends on energy prices
		total factor productivity growth		positive	

Source: collected by the author

RESEARCH RESULTS

Manufacture of Textiles, Textile Products, Leather and Leather Products

Sector Characteristics

Before the change of regime this sector was considered to be one of the greatest employers in the Hungarian economy. As the result of continuous transformation, nowadays contract work for European factories has become a characteristic business solution. In the course of the process European textile manufacturing ended up with a competitive disadvantage compared to its Asian rivals, so the market prospect of Hungarian production based on contract work also deteriorated.

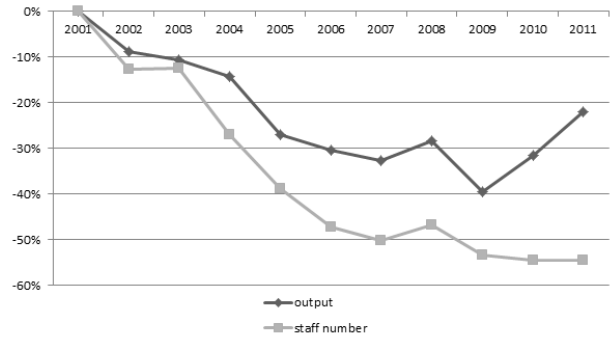
The staff number in the sector decreased to less than half during the examined period. The ratio of textile production decreased to about 30% within the sector and the production of other textile products became dominant. (In 2011 the division of employees was: 30% textile production, 44% clothing production, 26% leather, leather products, footwear production. Within textile production: 16% weaving textile threads, 6% textile weaving, 5% textile preparation, 73% production of other textile products.) In 2011 the ratio of export revenue was 72%, higher than the manufacturing average (61%). The labour costs to total costs ratio was 23%. This is significantly higher than the manufacturing average (9%). The average wages are low, 58% of the average characteristic of manufacturing. Labour intensive production is specific in the sector, connected to low wages. Technological development is relatively slow in this sector.

Output, Staff Number and Work Productivity

The staff number in the sector decreased by 55% (43,852 employees) between 2001 and 2011. The output decreased by 22% calculated at 2001 prices (to 290.2 billion HUF). The increase in producer price was 9.6% during the 11 years examined. Work productivity increased significantly (from 3.86 M HUF/employee to 6.62 M HUF/employee), due to the decrease in staff number exceeding the decrease in output.

The correlation between the time series is strong (0.74). (To decrease autocorrelation I measured the strength of the correlation with chain ratios, which basically gives lower correlation values than if it had

been calculated from the original data). It can be clearly seen in Fig. 1 that by 2009 the output had decreased to 60% of the 2001 value, while the staff number also decreased by 50%. As the effects of the crisis passed, the output significantly grew from 2009 to 2011, while the staff number stagnated.



Source: calculations of the author based on NTCA database

Figure 1. Output and stuff number base ratios in the textile industry

Conclusion

The increasing work productivity is the consequence of the general market problems, the decrease of output. Raising minimum wages can have an effect, decreasing the staff number, because wages are relatively low and the labour costs to total costs ratio is high. The increase in output experienced since 2009 is not accompanied by an increase in the staff number (although its tendency to decrease has stopped), which is positive from a work productivity perspective, and negative from the perspective of sector employment goals.

Manufacture of Food Products, Beverages and Tobacco

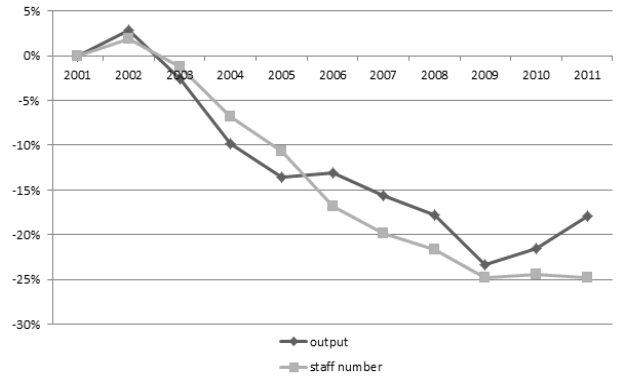
Sector Characteristics

We can find two well separated groups of enterprises in the sector: enterprises adapted for mass production and enterprises producing goods by traditional methods. The food industry is a sector with slow technological development. The labour costs to total costs ratio is around 9%, which corresponds with the average value in the manufacturing. Average wages decreased to 80% of the manufacturing average by 2011. The ratio of export revenue is low (28%).

Output, Staff Number and Work Productivity

The staff number decreased by 25% from 2001 until 2011 (to 91,033 employees), meanwhile the output became lower by 18% calculated at 2001 prices. The cumulative producer price index is 51% in the full period; calculated on nominal value the output showed growth. Work productivity changed from 17 billion HUF/ employee to 19 M HUF/employee.

The correlation between the change in output and in staff number is moderately strong (0.59). It is a weaker strength than the correlation measured in the textile industry, but since the measured value concerns chain ratios, linear correlation can be qualified as strong. Similar to the textile industry, the two examined variables are characterised by decreasing tendencies until 2009, after which output started to grow (Fig. 2), and the decrease in the staff number stopped.



Source: calculations of the author based on NTCA data-base

Figure 2. Output and staff number base ratios in the food industry

Conclusions

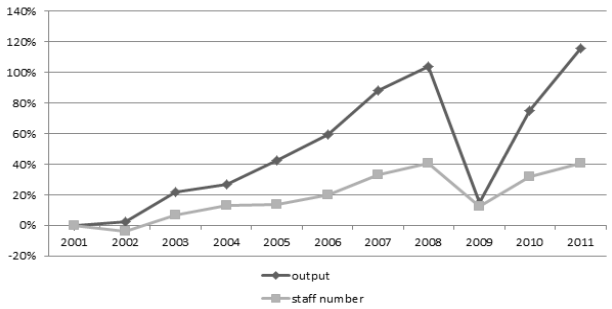
Both output and the staff number significantly decreased before the crisis. The results indicate that the decrease of output had a role in the decrease in the staff number. When the industry was starting to overcome the crisis, the decrease in the staff number stopped, but enterprises did not replace the labour dismissed earlier, despite their increased production. This process is beneficial from the perspective of work productivity, but is very harmful from the perspective of employment. In the case of an increase in labour costs or a raise in the minimum wages, it is nearly certain that the staff number will decrease in this sector.

Manufacture of Vehicles

Sector Characteristics

In the sector the importance of suppliers is steadily growing, both in the value chain and in employment. In the past years several significant green field investments and factory expansions were realised in Hungary. Labour costs to total costs ratio make up 13% of all expenditures (the overall manufacturing ratio is 9%). The average wage is 18% higher than the manufacturing average (in 2011). The sector produces 92% of goods for export. Vehicle production gives 43% of the R&D costs of all manufacturing. The gross added value grew by 151% in

11 years. The technological development pace of the sector is rapid.



Source: calculations of the author based on NTCA data-base

Figure 3. Output and staff number base ratios in the automotive industry

Output, Staff Number, Work Productivity

The 2011 output of the sector is 116% higher than the 2001 level. (3,568 billion HUF on real value). The cumulative producer's price index is only 10% considering the 10 years, so nominal value data did not decrease significantly due to the method of deflation. The staff number is 40% higher than it was in 2001 (54,858 employees). Work productivity is exceptionally high, moreover, it grew by 55% within 10 years (to 65 M HUF/employee). The correlation between output and the changes in the staff number is very strong (0.93). Based on this we can assume that the increase in productivity is primarily due to the increase in output. In Fig. 3 it can be clearly seen that the output decreased back to almost the 2003 level in 2009, and the staff number decreased to the 2004 level due to the crisis. The sudden great depression was followed by fast growth from 2009, so by 2011 output exceeded and the staff number again reached its 2008 level.

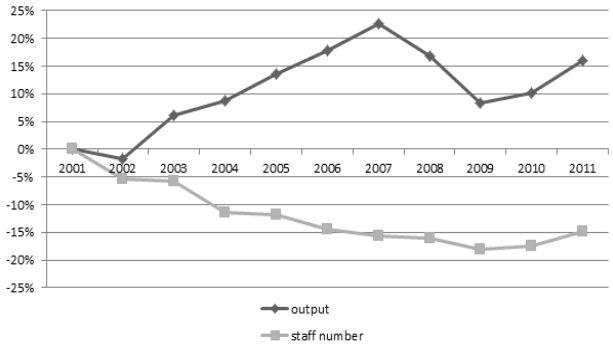
Conclusions

There is a strong correlation between the time series of sector output and staff number. A very significant increase occurred in both series of data, considering the full period. The ratio of output increase is almost three times the ratio of the increase in the staff number, which results in the beneficial situation that besides expanding the sector employment a significant increase of productivity also occurred. During the period the average wages were relatively high and growing.

Manufacture of Chemicals, Chemical Products and Man-made Fibres

Sector Characteristics

The petrochemical industry and pharmaceutical industry are two great fields of the Hungarian chemical industry. The sector is classified as a sector with rapid technological development. The labour costs to total costs ratio in 2011 was the same as the 9% ratio that is usual in the manufacturing. Wages exceed the average manufacturing value by 39%. The ratio of export revenue is below average (55M HUF/employee). The chemical industry accounts for one quarter of the total R&D costs of manufacturing.



Source: calculations of the author based on NTCA database

Figure 4. Output and staff number base ratios in the chemical industry

Output, Staff Number and Work Productivity

During the examined 11 years output increased by 16% (to 901 billion HUF). Without the correction with the 104% cumulated producer price index the nominal output shows a 137% increase. The staff number decreased by 15% during the period (to 27,623 employees), and work productivity increased by 37.5%. We can observe an increase in real value output until 2007, while the number of workers decreases (Fig. 4). From 2007 the output also starts to decrease, and from 2009 both time series show an increase. The cross correlation value calculated for the full period is 0.26, which does not assume a real linear connection.

Conclusions

Compared to the previously examined sectors the changes that occurred in the chemical industry have a unique picture. This is the only sector where there is no actual connection between output and the changes in the staff number in the beginning of the period, and from 2009 the data change rise in parallel. The rate of technological development is fast, and we see that the staff number decreased, despite the significant increase in output before 2007. If we assume that the statements of Zimmermann (1991) and Mehta & Mohanty (1993) concerning technological development are true for Hungarian manufacturing, then we can state that the tendency of technological development to decrease the staff number is strong, and the tendency of the increase in output to increase the number of the workers is accidental.

SUMMARY

The study presents the results of the research done on the correlations between sector output and the staff number concerning four sectors of the Hungarian manufacturing. In addition I examined the possible effects of labour costs on the staff number. The data come from a period between 2001 and 2011, and I calculated the output on year 2001 values. In the textile industry, decreasing output and staff number is characteristic. Tests concerning the co-movement of time series show a strong correlation between output and the changes in staff number. In the food industry the staff number also decreased together with the decrease in output. The cross-correlation between the two variables is strong, although weaker than in the textile industry. In both the textile industry and the food industry we can see that the decrease in output before the crisis strongly correlated with the decrease in the staff number. Unfortunately, the correlation gets weaker during the period of overcoming the crisis: although the increase in production stopped the further decrease in the staff number, it did not increase the staff number. The forced increase of wages can have a tendency to decrease the staff number in both sectors of industry. Vehicle production is a high productivity sector with fast technological development. Output increased very significantly, even on real value, followed by a smaller but still significant rate of increase in the staff number. Changes in the two factors are strongly connected; the correlation between them is strong, as was expected. Results measured in the period of the crisis present new proof for the well-known dependency of the sector on economic trends. An increase in output and decrease in the staff number can be found in the chemical industry, though no clear correlation can be proved between the changes of the two characteristics. Accepting the unanimous statements of researchers on the topic, my results can be interpreted to mean that, the effects of technological development on decreases in the staff number is strong, and the tendency of an increase in production to increase the staff number is relatively weak in the sector. Summarizing the results we could come to the conclusion that in regards to sector policies, we have to be careful when making predictions or implement measures with a common assumption about manufacturing. There are significant differences among sectors according to the effect of growth on new labour generated. In the textile and food industry demonstrative correlation were measured (in a period of decreasing output), but in the chemical industry it is not proved to be true. In the automotive industry the correlation is strong. One of the reasons that chemical industry has specific features can be traced back to a unique profession structure. Investigating this question could be the topic of a different research. However that kind of project would demand special knowledge about labour skills and profession structure with regard to Hungarian labour market. My intention in contrast is to develop the research by involve input prices, primarily the effects of the cost of labour.

REFERENCES

BASU, S. & ESTRIN, S. & SVEJNAR, J. (2000). Employment and wages in enterprises under communism and in transition: evidence from Central Europe and Russia. William Davidson Institute Working Paper 440.
http://deepblue.lib.umich.edu/bitstream/2027.42/39824/3/wp440.pdf

BROWN, D. & EARLE, J. (2005). Does privatization hurt workers? – Lessons in comprehensive manufacturing firm panel data in Hungary, Romania, Russia and Ukraine. BWP, 10, MTA KTI, Budapest.

DAVIS, S. J., HALTIWANGER, J. & SCHUCH, S. (1998). Job creation and destruction. Cambridge, MA: MIT Press.

FALK, M. & KOEBEL, B. M. (2002). Outsourcing, imports and labour demand. The ScandiNTCAian Journal of Economics, Volume 104, No. 4.

KERTESI, G. & KÖLLŐ, J. (2002). Labour demand with heterogeneous labour inputs after the transition in Hungary, 1992–99–and the potential consequences of the increase of minimum wage in 2001 and 2002. BWP, 5., MTA KTI, Budapest.
http://konyvtar.mutf.hu/kozos/Temaportal/K%C3%A9t%20v%C3%A1ls%C3%A1g%20k%C3%B6z%C3%B6tt%20-%20Ecostat.pdf

KÖLLŐ, J. (1998). Employment and wage setting in three stages of Hungary's labour market transition. In: Enterprise Restructuring and Unemployment in Models of Transition. EDI Development Studies, The World Bank–EDI, pp 57–108.

KŐRÖSI, G. (1997). Labour demand during transition in Hungary. William Davidson Institute Working Paper, Issue 116., pp 19
http://deepblue.lib.umich.edu/bitstream/2027.42/39506/3/wp116.pdf

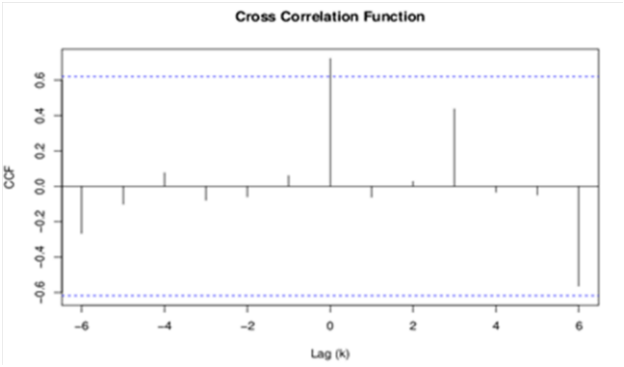
KŐRÖSI, G. (2000). Labour demand of corporations. BWP, 3., MTA KTI, Budapest, pp 68.

KŐRÖSI, G. (2002). Labour demand and efficiency in Hungary. BWPLM, Issue 3, Budapest.

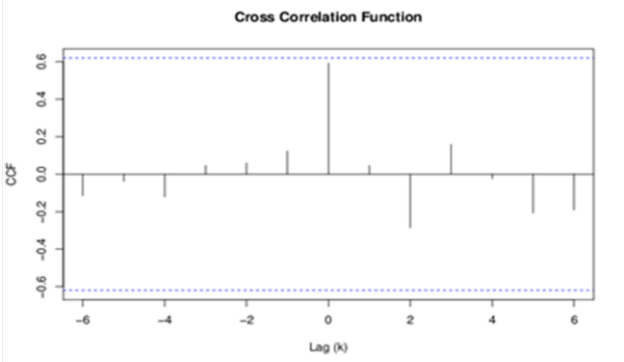
MAHMOOD, M. (2008). Labour productivity and employment in Australian manufacturing SMEs. International Entrepreneurship and Management Journal, Volume 4, Issue 1, pp 51-62.
MANN, S. (2011). Sectors matter! Exploring Mesoeconomics. Ettenhausen: Springer.
MEHTA, R. & MOHANTY, S. K. (1993). Demand for labour in manufacturing sector: a decomposition analysis for developing countries. Indian Journal of Industrial Relations, Volume 29, No. 2.
NORDHAUS, W. (2005). The sources of the productivity rebound and the manufacturing employment puzzle. http://www.nber.org/papers/w11354
SINGER, M. (1996). Dynamic labor demand estimation, stability of coefficients. Case of Czech Republic. CERGE-EI https://iweb.cerge-ei.cz/pdf/wp/Wp99.pdf
YUN, L. (2008). Technical progress and labour demand in swedish manufacturing firms. Journal of industry, Competition and Trade from Theory to Policy, Volume 8, Issue 2, pp 147-167.
ZIMMERMANN, K. F. (1991). The employment consequences of technological advance, demand and labor costs in 16 German industries. Empirical Economics, Volume 16, Issue 2, pp 253-266.

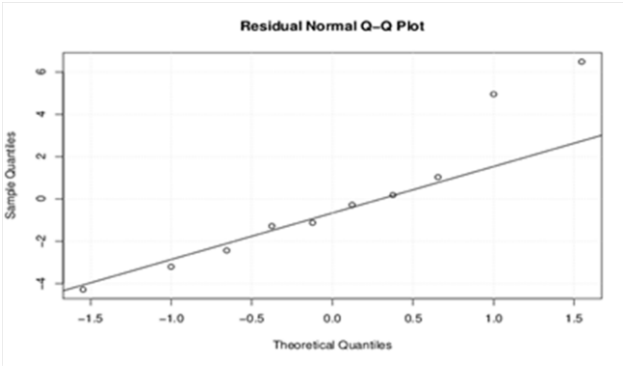
Appendices

Appendix A: Textile industry



Appendix B: Food industry





Appendix C: Automotive industry