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MEASURING TOTAL PRODUCTIVITY OF TURKISH MANUFACTURING INDUSTRY BASED ON ACCOUNTING DATA

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ABSTRACT

Productivity is still an important performance measure for the firm level and macroeconomic level. This study addresses total productivity measurement based on RAPMODS using basic accounting data for Turkish manufacturing industry for the period of 2006 to 2016. The results obtained from the analysis allows us to understand the total productivity and the source of the productivity changes related to partial productivities of the Turkish manufacturing industry. Furthermore, the potential productivity improvement areas are interpreted owing to these results.

Keywords: *Total Productivity, Performance Measurement, Manufacturing Industry, Turkey*

TÜRK İMALAT SANAYİ TOPLAM VERİMLİLİĞİNİN MUHASEBE VERİLERİNE DAYALI OLARAK ÖLÇÜLMESİ

ÖZ

Verimlilik, hem işletme düzeyinde hem de makroekonomik seviye için halen önemli bir performans ölçütüdür. Bu çalışma, temel muhasebe verilerini kullanan RAPMODS yöntemiyle 2006-2016 dönemleri arasında Türk imalat sanayisinin toplam verimlilik ölçümünün yapılmasına dayanmaktadır. Analiz sonucunda, toplam verimlilik ve kısmi verimlilik ölçütleri ile birlikte Türk imalat sanayinde verimlilik değişimlerinin kaynakları mali veriler üzerinden değerlendirilmiştir. Ayrıca, bu sonuçlara bağlı olarak potansiyel verimlilik iyileştirme alanları da ortaya konulmuştur.

Anahtar Sözcükler: *Toplam Verimlilik, Performans Ölçümü, İmalat Sanayi, Türkiye*

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INTRODUCTION

The role of productivity in national welfare is widely recognised. The main source of the economic growth is productivity increases in the firms as micro units of the economy. Slowing down in productivity increase may cause slackened growth and stagnation in national economy.

Productivity is the optimized utilization of all available resources, investigation into the best known resources and generating new resources, through creative thinking, research and development and by the use of all possible improvement techniques, methods and approaches for the production and distribution of quality goods and services (Ramsay, 1973). Improvement in productivity is necessary to remain competitive and improve the profitability for the firm level (Prokopenko, 1987:6). Productivity is still one of the main components performance. Without productivity analysis, there can be no proper diagnosis of problems and solutions to improve productivity (Rao & Miller, 2003). Productivity measures include single factor, multi factor or total factor productivity measures. The choice of the measures depends on the purpose of the decision makers. Productivity measurement can be made in firm level, industry level or country level.

As productivity applies everywhere, it would not be difficult to appreciate that it opens up the relevant possibility for many expressions. Different professions and branches of learning have given expression to the concept of productivity. The economist's view; productivity is the relationship between output and its associated inputs when the output and inputs are expressed in real terms. The engineer's view; conceptually the engineering approach to productivity grows out of the efficiency of a machine. The accountant's view; accountant concern themselves with the financial performance of the organizations through ratios. The industrial and organisational psychologist's view; it is based on the dimensions of organisational effectiveness. The manager's view; it is based on a number of situations and functions. In this study, we used the accountant views concept for evaluating productivity, which has provided ways and means of using monetary parameters to provide measurements for the study of economic effectiveness of systems.

Productivity is an important dimension of performance measurement and there are many performance measurement approaches such as Balanced Scorecard, EFQM Excellence Model, Objective Matrix (OMAX), Performance Prism, etc. Most of these

performance measurement systems seem theoretically sound, but practically difficult to implement (Rao, Chhabria, Gunasekaran, & Mandal, 2018).

This study addresses the RAPMODS system as a practical productivity measurement framework. This methodology uses basic accounting data as APC Model (Miller & Rao, 1989) and Sumath Total Productivity Model (Sumanth, 1997). By means of RAPMODS system the total productivity and partial productivity of Turkish manufacturing industry is evaluated for the 2006-2016 period. This study is the first practical implementation of total productivity measurement approach for industrial level in Turkey.

The rest of the paper is organized as follows: After the introduction, in Section 2 the literature review is given on the subject and in Section 3 the details of the RAPMODS system is given. Then in Section 4 the implementation results are presented and Section 5 is about conclusion.

LITERATURE REVIEW

RAPMODS System is a total productivity measurement approach. This approach has been applied widely by means of consulting activities in India, Australia, Cyprus, Malaysia, Mauritius, Philippines, Singapore, Vietnam and Thailand (http://www.endescointl.com/index.html). Özsever et al. (2009) developed a decision support system to monitor and analyse the productivity of SMEs. The researchers used RAPMODS as one of the productivity analysis tool. Demirtaş and Tokat (2012) applied the complementary steps of productivity management using RAPMODS in a small manufacturing company. Balinea (2018) implemented RAPMODS to analyse the productivity of commercial banks in Mongolian. Andai (2015), investigated the relationship between labour practices and firm productivity using RAPMODS in the export processing zones in Kenya. Balkan (2019) conducted productivity analysis of a textile firm using RAPMODS.

We can mention other total productivity measurement approaches in the literature. Miller and Rao (1989) compared the results of American Productivity Center's (APC) total factor model, and the Ethyl Corporation's "Profitability = Productivity + Price Recovery" model. Rao (2006), applied APC model through spreadsheet application using real world data of Harlingen Waterworks. By means of the study problem areas related to productivity and profitability were identified in the firm. Waters and

Tretheway (1999), the link between productivity and price performance was shown for Canadian Railways for the period 1956-1995. Rao and Miller (2004), described how an expert system can be used at each stage of the productivity management process in firm level and also they discussed the fitnessof expert systems applications. Rao et al. (2018), used APC model to evaluate the competition and corporate financial performances in micro-irrigation firms. By means of the results obtained from APC model provided cues for improvement areas to management. Furthermore, the results of SWOT analysis were presented to develop relevant strategies in the long term. Rao et al. (2005), developed an exper system called Production Evaluation Technology (PET) based on total factor productivity analysis. This system includes not only measurement but also productivity interpretationand evaluation. Phusavat and Photaranon (2006) applied a multi factor productivity measurement approach based on accounting data in a government pharmaceutical organization. This measurement approach based on APC model. Hannula (2002) applied total productivity measurement based on partial productivities (labor productivity, capital productivity, material productivity and energy productivity) in an industrial company manufacturing tyres. Lilly et al. (2007) developed a computer program combining partial productivity and total productivity measurement using real-world data from Nigerian petroleum-product marketing company. Rao and Mandal (2012) used APC model to analyse the impact of investment on information technology (IT) on productivity and profitability. Rao (2007) used APC model for a golf course management company. Rao and Pushavat (2013), compared APC model and Economic Value Added (EVA) model to measure the performance of a wastewater plant.

To our best knowledge, there isn't any study on total productivity measurement approach based on Ramsay model. This paper fills in the gap in total productivity measurement on Ramsay model. In addition to this, there is any papers on sectoral analysis using total productivity measurement approach.

TOTAL PRODUCTIVITY MEASUREMENT BASED ON ACCOUNTING DATA

Traditionally, performance measures have been primarily based on management accounting systems. This has resulted in most measures focusing on financial data (i.e. return on investment, return on sales, price variances, sales per employee, productivity and profit per unit

production). Of these performance measures productivity has been considered the primary indicator of performance (Ghalayini and Noble, 1996).

The total productivity measurement methodology is based on Ramsay Productivity Modelling System (RAPMODS). RAPMODS is a dynamic approach to enterprise productivity measurement, productivity based financial budgeting, total economic monitoring and control in an enterprise. The resources consumed by an enterprise, are expressed in monetary terms and the outputs of it are also expressed in the same units or monetary values. As a result of using the same monetary units for both the outputs and inputs, it becomes possible for the measurements of productivity to be computed in dimensionless units which expressed in the form of numbers providing the facility of understanding the level of productivity achieved in respect of a single factor, multifactor or aggregate productivity of an enterprise (Ramsay, 1973).

Total productivity is commonly used as the measure of competitiveness at the business unit and even at the national level (Porter, 1994). At the business unit level, productivity measures belong mainly to the group of non-financial measures. Any of the operational stages of a business unit, including purchasing, marketing, finance, sales, and support services, contribute to total productivity (Hannula, 2002).

Firm management can identify norms to monitor productivity and can foster productivity enhancement. This measurement system supply quick and easy determination of profit/loss and other financial outcomes of an enterprise for a specific period. This could be carried out at the financial budgeting stage for more effective planning and at the end of any operational period such as a year, quarter, month or shorter period as may be required.

This approach has opportunities on inter-firm comparisons. Benchmarking studies can be made comparing total and partial productivity measures of the companies in the same sector. Thus firms can be stated their relative position according to their rivals. Comparing the departments in the same organization can be made by means of this approach. Such productivity measurements and indices may be fed back to groups of people in the enterprise on an inter-period basis, to apprise the workforce of their productivity achievements or shortfalls. This would be valuable especially if an employee participation plan is in place.

The success of enterprises are assessed using financial measures. But there are some limitations of these measures because they rely on

simple cost accounting systems. An improved cost accounting system will not entirely solve the problem with financial measures, other measures than cost are needed to measure adequately manufacturing performance relative to a competitive strategy (White, 1996).

Financial measures are not applicable to the new management techniques that give operators responsible and autonomy (Ghalayini, et al., 1997) Traditional measures have three common ratios as profit margins, return on assets (ROA) and return on equity (ROE) and these measures are not directly related to manufacturing strategies.

RAPMODS combines financial measures and productivity ratios under several spesific indicator including the information of all enterprise accounting and manufacturing process input and output data.

The system is neither a substitute for a financial accounting system nor a substitute for a cost accounting system. It uses financial and cost information as inputs. It is a productivity measurement, productivity budgeting, total economic monitoring and control approach useful for all enterprises. Also, it provides a capstone, the benefits of which may not be adequately seen otherwise (Ramsay, 1973).

The RAPMODS System consists of these stages which encompasses application of the system at the aggregate level of an enterprise. This covers:

• *Identifications of outputs and inputs:* In this stage it is determined which productivity measurements and indices, productivity based financial budgets and economic monitoring and control is required.

• *Selection of a reference period:* It is usually of one year duration. An important criterion in choosing the reference period is that the data should be free of abnormalities.

• *Data collection:* The required data is obtained from accounting department for the analyse period.

• *Making relevant computations:* This stage consists of identification of outputs and inputs in financial parameters, fixed and current asset heads and any other category of asset heads in an enterprise, computation of average values of fixed assets, current assets and other assets if any. After that, computation of factor, multifactor, overall and total productivity measures of the enterprise in respect of the reference period chosen is made.

• *Management:* Corporate objectives for the forthcoming operational/financial period expressed including financial terms productivity measures are identified through simulations, financial budgets with provisions for inflation are developed.

The system output which constitutes the goods and services produced by an enterprise is expressed in monetary terms arrived at by computing the net sales value of system output for a period of time. This may easily be extracted from the financial records.

The RAPMODS system output extracted from the accounting records may be arrived at as follows:

Output = Sales + Finished Goods + Work in Progress + Other Income (1)

Value Added = Output – Raw Materials - Outsourced Benefits and Services (2)

To calculate the productivity input values are needed and the components of system inputs can be grouped under six heads as follows:

Wages input: direct labour, indirect labour, overtime payments, workmans compensation, employment incidentals

Salaries input: salaries expenditure, pension fund payments, employment incidentals

Machines and equipment input: depreciation, insurance, plant hire and lease, power, fuel, oil and gas, repairs and maintenance expenses (including labour, materials, lubricants etc.)

Material input: raw materials used to produce the finished product, indirect materials, bought out items

Other inputs: depreciation of vehicles, fuel used vehicles and heating, vehicle leasing, electricity for the office, telephones and other communication expenses, building maintenance expenses, rent, rates, taxes and insurance, packing and palleting, shipping, entertainment, advertising and publicity, travel.

Interest on bank loans and bank charges: bank and other interest payments on borrowings including such payments to financial institutions, bank charges, relevant incidental expenses.

Consider the general expressions for productivity measurement of the economic system in respect of an enterprise.

Productivity = System Output / System Input (3)

If a single input is considered, such an input is termed partial input. Productivity of this partial input is expressed as:

Partial Productivity = System Output / Partial System Input (4)

If two or more inputs are considered it is then expressed as:

Multifactor Productivity = System Output / Multifactor System Input (5)

When all the inputs are included, then the aggregate expression for productivity is:

Total Productivity = System Output / Total System Input (6)

Considering the following inputs heads of a manufacturing enterprise (wages input (WI), machines and equipment inputs (MEI), materials input (MI), other inputs (OI)), their factor productivity measures have been defined and as follows:

Labour Productivity: X = RSO / WI (7)

Machine and Equipment Productivity: Y = RSO / MEI (8)

Materials Productivity: Z = RSO / MI (9)

All Other Inputs Productivity W = RSO / OI (10)

The reciprocal of the Total Productivity Measurement (TPM) of an enterprise constituting an economic system is equal to the sum of the reciprocals of the factor productivity measures of all input resources.

(1/TPM) = (1/X+1/Y+1/Z+1/W) (11)

The total productivity measure of an economic enterprise bears a relationship to the percent profit/loss to system output.

*Percent Profit/Loss = (1-1/TPM)*100* (12)

Capital productivity is the velocity of circulation of assets in an enterprise. This may be computed on an annual basis or for shorter periods such as monthly, quarterly or half yearly on an equivalent of annual basis. Capital Productivity (N) is expressed as follows:

N = (RSO/TCE) (13)

where,

TCE (Average Total Capital Employed) = Average Fixed Assets (FA) + Average Current Assets (CA) + Average of Other Assets (OA) (14)

if any.

The average value of an asset = [(opening value + closing value) / 2] (15)

for a specific period of time.

*ROI (Return on Investment) = [Profit / TCE (Total Capital Employed)]*100 = [1- (1/TPM)]*N*100* (16)

COMPUTATIONAL RESULTS

In this study, partial and total productivity measurement of manufacturing industry of Turkey is made through 2006-2016 period. The manufacturing industry is consists of the 24 sector based on NACE activity classifications system. The data used in study is obtained from official records and deflated. The RAPMODS need at least two periods of

data for the analysis and in this study we used 11 year period's data. In Table 1 distribution of number of firms in Turkish manufacturing industry by years is given. Total number of firms in Turkish manufacturing industry is 261.707 in 2006 and 396.511 in 2016. Increase in the number of firms in Turkish manufacturing industry is 52%. The analysis in this study is made using overall data of these firms.

Table 1: Total Number of Firms in Turkish Manufacturing Industry by Years

Year	Number of firms
2006	261.077
2007	321.013
2008	332.580
2009	332.559
2010	335.849
2011	344.135
2012	355.169
2013	391.344
2014	386.441
2015	397.072
2016	396.511

In Table 2 the deflated values of accounting data used for analysis is given. Total input cost of Turkish manufacturing industry increases from 375.689 in 2006 to 1.190.683 million Turkish Liras in 2016. This means total input cost increases in a rate of 217 %. The increment rate is 390 % in other expenses, 348% in outsourced benefits and services, 339% in employee fees and expenses, 309% in financing expenses, 273% in raw materials, 227% in general administrative expenses, 217% in research and development expenses, 212% in marketing, sales and distribution expenses and 80% in depreciation through years 2006 to 2016. Total output of Turkish manufacturing industry increases from 466.382 in 2006 to 1.538.086 million Turkish Liras in 2016. This means total input cost increases in a rate of 229 %. The increment in total output is higher than the total input cost.

Table 2: Input and Output Data of Total Manufacturing Industry in Millions Turkish Liras (Deflated)

DATA	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Raw Materials	31.058	33.692	35.584	38.344	44.077	54.571	61.212	71.748	80.211	101.379	115.787
Employee Fees and Expenses	1.948	2.130	2.210	2.565	2.891	3.331	4.124	4.916	5.542	6.992	8.559
Outsourced Benefits and Services	2.264	2.967	3.524	3.743	3.986	4.212	6.058	7.351	8.318	9.958	10.150
Depreciation	173.768	171.144	169.223	197.520	194.211	199.723	221.752	242.789	247.803	284.144	312.045
Financing Expenses	11.394	8.523	20.851	14.228	11.890	21.235	15.967	28.007	25.917	42.376	46.624
Research and Development Expenses	912	926	1.034	1.079	1.134	1.325	1.670	2.058	2.083	2.455	2.895
Marketing, Sales and Distribution Expenses	18.366	19.587	21.177	23.589	25.285	29.496	34.669	40.165	43.008	50.469	57.339
General Administrative Expenses	18.011	19.720	21.232	23.804	24.711	28.561	33.705	38.585	43.014	51.398	58.822
Other expenses	117.968	143.317	177.343	152.135	195.316	322.219	371.263	412.437	458.737	525.309	578.462
TOTAL INPUT COST	375.690	402.006	452.178	457.007	503.501	664.672	750.421	848.055	914.634	1.074.480	1.190.683
Finished - Semi Finished Product	73.866	82.334	89.775	98.024	110.993	138.510	157.262	185.627	202.905	251.118	294.538
Net Sales (Production)	392.517	425.534	463.234	475.277	527.175	683.373	783.129	877.255	958.246	1.121.451	1.243.548
TOTAL OUTPUT	466.383	507.868	553.009	573.302	638.168	821.883	940.391	1.062.882	1.161.151	1.372.568	1.538.086
Previous Year Current Assets	-	185.862	206.701	273.132	267.854	314.633	402.083	453.144	513.715	623.624	758.623
Current Assets	197.587	219.162	245.308	287.119	322.083	384.010	446.263	542.076	595.529	751.527	870.512
Previous Year Tangible Fixed Assets	-	92.178	100.538	128.950	126.526	134.003	161.423	183.111	203.663	246.054	281.498
Current Tangible Fixed Assets	97.992	106.599	115.814	135.626	137.176	154.168	180.331	214.907	234.969	278.864	318.518
Current Year Investments	11.655	12.805	13.552	14.001	13.742	16.614	20.484	29.903	32.842	31.442	37.095

Using Equations 1-15 total productivity of Turkish manufacturing industry is calculated and in Table 3 total productivity values are given for the 2006-2016 period.

According to the results, the total productivity of manufacturing industry has an increase trend from 2011 to 2016. In 2016, total productivity reaches its highest value of 1,29 and the lowest total productivity value is in 2008 with a value of 1,22. If we consider the economic crisis in 2008, the result is compatible with the general economic indicators.

Since total productivity is composed of partial productivities, we can analyse which partial productivity values are the source of the changes in total productivity. For this purpose, we consider the year 2006 as base value and we calculate the total productivity and partial productivity changes. In Table 4 changes in total productivity and partial productivity values are given. The columns headers mean the periods. P1

is change in year 2007 according to year 2006 and the productivity values for this period is calculated dividing the productivity value of 2007 by the productivity value of 2006. Other periods' values are calculated using the same approach.

Table 3: Total Productivity Values of Turkish Manufacturing Industry

Years	TP = Output / Total Input Cost
2006	1,24
2007	1,26
2008	1,22
2009	1,25
2010	1,27
2011	1,24
2012	1,25
2013	1,25
2014	1,27
2015	1,28
2016	1,29

Table 4: Changes in Total Productivity and Partial Productivity Values

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
TOTAL PRODUCTIVITY	**1,018**	0,985	**1,011**	**1,021**	0,996	**1,009**	**1,010**	**1,023**	**1,029**	**1,041**
Raw Materials Productivity	**1,004**	**1,035**	0,996	0,964	**1,003**	**1,023**	0,987	0,964	0,902	0,885
Employee Fees and Expenses Productivity	0,996	**1,045**	0,934	0,922	**1,031**	0,952	0,903	0,875	0,820	0,751
Outsourced Benefits and Services Productivity	0,831	0,762	0,744	0,777	0,947	0,753	0,702	0,678	0,669	0,736
Depreciation Productivity	**1,106**	**1,218**	**1,081**	**1,224**	**1,533**	**1,580**	**1,631**	**1,746**	**1,800**	**1,837**
Financing Expenses Productivity	**1,456**	0,648	0,984	**1,311**	0,946	**1,439**	0,927	**1,095**	0,791	0,806
Research and Development Expenses Productivity	**1,073**	**1,047**	**1,039**	**1,101**	**1,214**	**1,102**	**1,011**	**1,091**	**1,094**	**1,039**
Marketing, Sales and Distribution Expenses Productivity	**1,021**	**1,028**	0,957	0,994	**1,097**	**1,068**	**1,042**	**1,063**	**1,071**	**1,056**
General Administrative Expenses Productivity	0,995	**1,006**	0,930	0,997	**1,111**	**1,077**	**1,064**	**1,043**	**1,031**	**1,010**
Other Expenses Productivity	0,896	0,880	**1,208**	0,867	0,781	0,993	**1,017**	0,982	**1,032**	**1,018**

In all years except for 2008 and 2011 total productivity increases according to year 2006. According to the results in Table 3 total productivity of Turkish manufacturing industry increases 4,01% in 2016 according to 2006. In addition to this, depreciation, research and development, marketing, sales and distribution, general administrative

expenses and other expenses productivities increase 83,7%, 3,9%, 5,6%, 1% and 1,8% respectively. The source of the increase in total productivity is these increasing partial productivity items, raw materials, employee fees and expenses, outsourced benefits and services and financing expenses productivities decrease in 2016 according to year 2006. To gain higher increase in total productivity raw materials productivity, employee fees and expenses productivity, outsourced benefits and services productivity and financing expenses productivity should be increased.

The results of Output and Value Added is given in Table 5 evaluating with this methodology. Value added means the welfare created by the internal processes of the firms. In Figure 2 the value added is closer to output values. This can be interpreted as Turkish manufacturing industry has a potential of productivity increase using their own production dynamics.

Table 5: The Output and Value Added Results, 2006-2016

Years	OUTPUT	VALUE ADDED
2006	466.383	433.061
2007	507.868	471.208
2008	553.009	513.901
2009	573.302	531.214
2010	638.168	590.105
2011	821.883	763.100
2012	940.391	873.120
2013	1.062.882	983.783
2014	1.161.151	1.072.622
2015	1.372.568	1.261.231
2016	1.538.086	1.412.149

According to these results, there is no increase in the Value Added in the same level as Output Change within 11 years. Moreover, it is observed that both values did not increase very rapidly until 2010 and followed a more dynamic increase after 2011. The main reason for the static outlook in 2008 and 2009 is the Producer Price Index, which can be understood as a result of the fact that the sales prices of the manufacturing industry products do not rise much, with an annual increase of 1,23 percent. The reason of the increasing gap between output and value added through 2006-2016 is increment in the cost of raw materials and outsourced benefits and services. It is thought that

raw materials prices increase higher than producer price index or raw materials dependency of the production process raises. In addition to this, outsourced benefits and services could be raised owing to the management decisions for professionalization.

Table 6: Comparison of TP, Capital Productivity and Output/System Conversion Cost

Years	TP = Output / Total Input Cost	Output / System Conversion Cost	Capital Productivity = Output / Total Capital Used
2006	1,24	1,36	1,64
2007	1,26	1,39	1,76
2008	1,22	1,34	1,72
2009	1,25	1,38	1,44
2010	1,27	1,40	1,54
2011	1,24	1,36	1,72
2012	1,25	1,38	1,64
2013	1,25	1,38	1,59
2014	1,27	1,41	1,57
2015	1,28	1,43	1,49
2016	1,29	1,44	1,43

The purpose of the production in an enterprise can be defined as convert to the outsourced benefits and services and raw materials with production resources (labour, machine and equipment, capital stock) of the enterprises. Total factor productivity measures the success of mentioned area and it is desired to be high. In addition to the cost of converting the system covers the expenditure on raw materials and the benefits and services which is provided production resources. The more output per system conversion cost or value added per system conversion cost is high, the more enterprises is productive. The results in Table 6 are interpreted with this information; while the system costing 1 TL, the average cost of conversion is 1,39 TL; as the output is 1,26 TL compared to total input cost 1TL. The indicator related to the system conversion cost of the manufacturing industry is higher than the total productivity means that Turkish manufacturing industry have worked efficiently in their business processes. Moreover, all indicators except capital productivity traced a similar path. Capital productivity corresponded to 1 TL total input cost in 2006, while obtaining 1,64 units of output as it has a output of 1,44 in 2009. The main reason for this situation is that the

manufacturing industry increase their capital ratios by having difficulty in price recovery.

Table 7: 2006-2016 Years Annual Average of Partial Factor Productivity by Value Added

Partial Factor Productivity by Value Added	Average
Value Added / Raw Materials	13,60
Value Added / Employee Fees and Expenses	206,11
Value Added / Outsourced Benefits and Services	149,07
Value Added / Depreciation	3,56
Value Added / Financing Expenses	39,28
Value Added / Research and Development Expenses	507,91
Value Added / Marketing, Sales and Distribution Expenses	24,35
Value Added / General Administrative Expenses	24,54

The partial factor productivity for each input are calculated and the results are given in Table 7. It is possible to calculate the partial productivity for each item of the inputs by reproducing the input items in the intended cases. There is 13,60 units value added was obtained for 1 unit of raw material by annual percentage. The maximum value added is the research and development item, which was obtained as 507,91 units in 1 unit.

Table 8: Relationship between Profit and Return on Investment

Years	Profit / Output (%)	Return on Investment= Profit /Total Capital Used (%)
2006	19,45	31,94
2007	20,84	36,62
2008	18,23	31,45
2009	20,28	29,19
2010	21,10	32,60
2011	19,13	32,97
2012	20,20	33,06
2013	20,21	32,22
2014	21,23	33,26
2015	21,72	32,45
2016	22,59	32,24

According to the model, one factor that affects the profit or loss of an enterprise is the total factor productivity. Therefore, the change in total factor productivity will also affect the profit or loss (the profit is the gross profit). According to the model definition, the annual average rate of the manufacturing industry is 20,45% in Table 8. The return on

investment measures return on used total capital, investments made with an average annual return rate of 32,55% will pay off in a short period in three years.

CONCLUSION

In this study, a total productivity approach proposed by Ramsay (1973) is used to analyse the productivity performance of Turkish manufacturing industry. The study contains data of the 24 sectors in manufacturing industry based on NACE Rev. 2 classification for the period 2006-2016.

According to the computational results, the total productivity of Turkish manufacturing industry has an increase trend from 2011 to 2016. Total productivity of Turkish manufacturing industry increases 4,01% in 2016 according to 2006. Furthermore, depreciation, research and development, marketing, sales and distribution, general administrative expenses and other expenses productivities increase. The source of the increase in total productivity is these increasing partial productivity items, Raw materials, employee fees and expenses, outsourced benefits and services and financing expenses productivities decrease in 2016 according to year 2006. It was seen that, value added is closer to output values. This was interpreted as Turkish manufacturing industry has a potential of productivity increase using their own production dynamics. In addition to this, the system conversion cost of the manufacturing industry is higher than the total productivity and it means Turkish manufacturing industry have worked efficiently in their business processes. Finally, the return on investment measures return on used total capital, investments made with an average annual return rate of 32,55% and the meaning of this value is the investment will pay off in three years period.

This study fulfills a gap for the analysing the Turkish manufacturing industry using total productivity approach with basic accounting data. For future researches, the same analysis can be made for the industrial sectors separately and for benchmarking studies for the firms. Further researches may include sensitivity analysis and predictive analysis for the industrial and sectoral level. In addition to this different total productivity measurement methods can also be used and the results can be compared.

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