Application of Productivity Index with Craig Harris Method on Tea Product

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Abstract. Tea is one of the plantation commodities that contribute greatly to the country’s foreign exchange and also absorbs lots of manpower. The demand for tea products on the world market should be directly proportional to demand in tea plantations. Based on preliminary data, was found that profit tea plantations in 2016 and 2017 experienced a decline in 7.7%. Declining in profit is closely related to the productivity of the plantation. For that reason, this study aims to get a productivity index on the company so that problems that occur in the company can be known. Craig Harris method is used to calculate the productivity of various variables that affect the production process such as labor, materials, capital and others. The calculation of productivity is important to be done so that company can conduct further analysis of the factors that affect productivity. By Craig Harris method, the partial productivity index decreased for labor and materials by 10.2% and 10.4%, while the total productivity index was 1.2%. From the calculation of partial productivity index and total productivity index then analysis the results, that the company is expected to make efforts to increase productivity.

1. Introduction
Tea is one of the most popular beverage products consumed by people around the world including Indonesia. The tea industry in Indonesia must search for a comprehensive productivity improvement strategy to overcome the challenge of high competition from other tea producing countries like China, India, Kenya, Srilanka and Bangladesh. North Sumatera becomes the third largest tea producing province in Indonesia [1]. Almost a half of Indonesia’s tea production is exported abroad. The main export markets are Russia, UK, and Pakistan. Indonesia tea is known for having the highest levels of catechins (natural antioxidants) in the world. However, if the tea were compared with other major tea producing countries, the production of tea products (per hectare tea garden) in Indonesia is low. The low productivity of tea products in Indonesia due to lack of ability to optimize production [2].

The low productivity of and the increase of production costs become a serious challenge facing by Indonesian tea industry. Low productivity performance has an impact on the decrease in profitability. The level of productivity achieved by the company is an indicator of how efficient the company to combining resources which are available in the company.

Productivity is defined as a quantitative relationship between output and input [3]. Productivity measurement is a quantitative-objective method, regarded in terms of its relevance for the internal control of a company [4]. Productivity is generally agreed as one of the key areas that reflect long-term performance, especially for organizations or production units [5-9]. Productivity measurement models
can be classified as: partial-factor, total-factor and surrogate measures, which are used by public or private organizations [10]. The goal of productivity measurement is improvement of productivity, which involves a combination of increased effectiveness and a better use of available resources [11].

Productivity type has been classified in economic terms as: partial productivity, total factor productivity, and total productivity. Partial Productivity is a ratio of gross or net output to a single factor input. Partial productivity is further divided by the type of input as: labor productivity, capital productivity, material productivity, and energy productivity. Total Factor Productivity is a ratio of gross or net output to total labor and capital input expressed in monetary equivalents. Total Productivity, which is, ratio of gross or net output to total inputs including labor, capital, material, energy and others, all expressed in monetary equivalents [12]. Kendrick Creamer method suitable for computing productivity indexes at the company level.

Craig and Harris (1972-75) using the index approach at the company level, they define total productivity measure. This method is suitable for computation of productivity at firm level, service sector and yields physical productivity. But it is not suitable for tea industry because it does not take into account all inputs relevant to tea industry [13]. Craig Harris method is suitable to calculation of productivity for firm level and service sector and yields physical productivity [14]. However Craig Harris method is not suitable for the computation of the TFP status of a pre-serial industry since it does not take to the calculation of all the inputs relevant to a pre-serial industry. Craig Harris method shows the total productivity of a firm is determined as the ratio of total output to the sum of input factors of labor, capital, raw material & other miscellaneous goods and services [13, 15].

As a pre-requisite for productivity improvement programme follows productivity measurement. However, previous literature survey reveals that no study has been undertaken so far on the productivity measurement of a tea industry especially in Indonesia. The productivity measurement methods presented in the literature are usually too intricate and difficult to apply. Many productivity measurement studies have been conducted in various industries in the world, both manufacturing and service industries [11, 14, 16]. Several productivity studies have also been conducted in the tea industry in India [13, 15]. Until now, there are not many studies on measurement of tea product productivity in Indonesia, yet. The main purpose of this study is to identify the output and inputs peculiar to tea industry and to develop a productivity measurement model specific to the tea industry based on productivity accounting model to assess the productivity status using those inputs and output.

2. Methodology
Measurement of productivity is done in industries that produce tea products in Indonesia. This research is classified as a case study research which concentrate on productivity measurement. This study uses a set of data which collected from 2015-2017 for the calculation of productivity. Research begins with the selection of industries that are being the focus of research. Next, identify the productivity problems which are facing by the tea industry. Before doing the calculation of tea product productivity, first determined the same unit for input and output. The same unit of input and output is in rupiah. The final step is to determine the right productivity measurement method.

In practice, there are many models for measuring productivity. The measurement of productivity in this study follows the Craig Harris method. Total Productivity with Craig Harris Method are calculated by the equation below [3].

\[ P_t = \frac{Q_t}{L+C+R+M} \]  

(1)

\( P_t \) is total productivity, \( Q_t \) is tea product output, \( L \) is total labor input, \( C \) is total input capital, \( R \) is total input raw materials, and \( M \) total other inputs. Partial productivity is the ratio of output to one class of input. For example, labor productivity, capital productivity etc. Total productivity measure is easy to calculate and more accurate representation of the total picture of tea product because it is easily related to total cost, considering all quantifiable inputs and outputs.
3. Results and discussion

The data used as labor input is the realization of the funds used to pay the salary of labor each year which includes the costs incurred by the company in the form of salaries, hires, and subsidies for managers, heads of departments, assistant agencies, and foremen & clerks. Capital input is accumulated from amortization and depreciation of capital goods such as equipment, machinery, etc. The cost of raw materials is the accumulation of all the materials cost used for producing tea products including the main ingredients, additives, and supporting materials. Other inputs of the tea product company include machine and equipment maintenance costs, administration fees, tax fees, and more.

To calculate the productivity of a company, done by comparing the input and output. The inputs and outputs used based on 2015-2017 period with the rupiah which are described in Table 1.

| Item       | Year (in million rupiahs) |
|------------|---------------------------|
|            | 2015          | 2016          | 2017          |
| **Input**  |              |               |               |
| - Labor    | 25.963,21    | 30.095,40    | 32.469,49    |
| - Materials| 16.420,64    | 19.883,14    | 21.838,08    |
| - Capital  | 5.122,06     | 4.121,95     | 4.211,89     |
| - Others   | 2.923,61     | 2.795,92     | 3.270,51     |
| Total input| 50.429,51    | 56.896,41    | 61.789,97    |
| **Output** | 58.639,29    | 66.786,65    | 69.226,01    |

Productivity calculation had done in this research using Craig Harris method. Craig Harris is a productivity measurement method for measuring total productivity and illustrates the overall efficiency and growth rate of the company by assuming that the company's objectives are on profit-maximized. This productivity calculation consists of partial productivity and total productivity. Partial productivity is done by comparing output to one of the factors. There are labor cost, raw material cost, capital cost, and other expenses. Recapitulation of partial productivity calculation for each input can be seen in Figure 1.

Total productivity calculation is done by comparing the output with the total input totals of total labor cost, raw material cost, capital cost, and other costs in each period. According to the Craig-Harris model, productivity is measured using equation number 1. $P_t$ is the total productivity, $O_t$ is the tea output, $L$ is the labor input, $C$ is the capital input, $R$ is the input of the raw material, and $M$ is the other inputs. Based on the above formula, the recapitulation of partial productivity calculation can be seen in Figure 1.
Based on the recapitulation from Figure 1 and Figure 2, it was found that the level of labor productivity reached the lowest point in 2017 with a value of 2.13 due to the number of working hours which is not well utilized by the operators. The level of productivity of raw materials also reached the lowest point in 2017 caused by several factors such as the amount of raw materials used more than the base period, rising raw material costs, or companies that do not use raw materials storage. The level of capital productivity reached its lowest point in 2015 due to the year's minimum revenue. Productivity levels for other things like machine maintenance costs, and other costs also hit a low point in 2015 due to the maintenance of less organized engines. The recapitulation of total productivity in 2015 until 2017 can be seen in Figure 2.

For the total productivity level, through productivity measurement with the period of 2015-2017, it was found that the highest total productivity was in 2016 at a value of 1.17. While the lowest total productivity existed in 2017 is 1.12.
The activity of productivity measurement needs to be done by each company to know the existing condition. So obtained information about the achievement of targets and position of the company. From productivity measurement can be known the strengths and weaknesses of the company so it can be improved. A good company can increase its productivity from year to year.

Furthermore is calculated productivity index for partial productivity and total productivity. Calculation of productivity index requires a baseline period as a comparison for the next period. In the calculation of tea industry productivity uses the base period of 2015. Because it is assumed that in 2015, it has a stable level of productivity, so the productivity index for the basic period is 1 (the most stable). The recapitulation of productivity index calculation results can be seen in Table 2.

| Item          | 2015 | 2016 | 2017 |
|---------------|------|------|------|
| **Partial Productivity** |      |      |      |
| - Labor       | 1.00 | 0.98 | 0.94 |
| - Materials   | 1.00 | 0.94 | 0.89 |
| - Capital     | 1.00 | 1.42 | 1.44 |
| - Others      | 1.00 | 1.19 | 1.06 |
| **Total Productivity** | 1.00 | 1.01 | 0.96 |

Based on the graph, that labor and material productivity decrease from year to year. Labor productivity decreased with the index value of 0.98 in 2016 and 0.94 in 2017. For material productivity, the value of the index decreased by a value of 0.94 in 2016 and 0.89 in 2017. Capital productivity increased in 2016 with index values of 1.42 and 1.44 in 2017. While other productivity increased in 2016 but decreased in 2017. Other productivity increased by an index value of 1.19 but experienced decline of 1.06 in 2017. For total productivity, the index value increased in 2016 by 1.01 and decreased by the year 2017 of 0.96. A special study is needed on each factor that lead to a decrease in productivity. Fishbone diagram or related method can be use to determine causes of the decreased productivity.

4. Conclusions
Craig Harris method is used to calculate the productivity of various variables that affect the production process such as labor, materials, capital and others. The calculation of productivity is important to be done so that company can conduct further analysis of the factors that affect productivity. By Craig Harris method, the partial productivity index decreased for labor and materials by 10.2% and 10.4%, while the total productivity index was 1.2%. From the calculation of partial productivity index and total productivity index, the company is expected to make efforts to increase productivity.

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