Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 3, June 2021:825- 833

Research Article

# The Impact of Optimized Electricity Tariff Changes on Malaysian Economy

[1,*] Noriza Mohd Saad, [2] Norhayati Mat Husin, [3] Asiyyah Sakiinah Dzulkefli, [4] Ahmad Lutfi Mohayiddin, [5] Mohamad Taufik Mohd Arshad

## Abstract

This study discusses the impact of the current electricity tariff, represented by optimized tariff calculation, towards 124 Malaysian sectors' cost of production using the 2015 Malaysian IO Table. Overall, the findings show that 1) current optimized electricity tariff only led to a 0.55 percent increase in the current cost of production, and 2) there are only 0.77 percent changes in the cost of production if the electricity tariff rate is increased by 5 percent based on scenario analyses. This implies that the impacts of electricity tariff rate changes are not large and could be even smaller, as sectors have the option to rearrange their activities in favor of other factors of production, including labor and capital. Additionally, the results revealed a positive relationship between the composition of employees' compensation (CE) in value-added (VA) and the price impact on its production costs.

***Keywords:*** Input-Output, Electricity Tariff, Cost Of Production, Scenario Analysis, Compensation Of Employees (CE), Value-Added (VA)

## 1. Introduction

Electricity in the form of the final product is an essential factor of production being supplied by the utility industry to ensure that the whole economy could operate as usual. The electricity supply mainly depends on the market demand formed by a large number of sectors. Cramton [1] describes the electricity market as a properly designed market-derived not from an unsystematic marketplace but under an appropriate regulatory body that regulates the industry. In the case of Malaysia, it is the Energy Commission (EC) established as a regulatory agency under the Energy Commission Act 2001 to regulate the electricity and gas supply industry at the reticulation stage, looking at technical, safety, and economic aspects.

[1]Fakulti Pengurusan dan Perniagaan, Universiti Teknologi MARA
Cawangan Kelantan, 18500 Machang, Malaysia
[2]College of Business Management & Accounting, Universiti Tenaga Nasional, 43000 Kajang, Malaysia
[3]Insititute of Energy Policy and Research (IEPRe), College of Business Management & Accounting, Universiti Tenaga Nasional, 43000 Kajang, Malaysia
[4,5]Regulatory Economics, Strategy and Regulatory Division,
Tenaga Nasional Berhad, 50470 Kuala Lumpur, Malaysia

With all sectors interdepending between one another, electricity will have an impact both directly and indirectly on other sectors' production processes. For instance, in the case of an electricity supply shortage, the power outage would substantially affect the production process of electricity-intensive sectors. This, in return, will give an indirect effect towards sectors depending on the former electricity-intensive sectors. Additionally, any changes in the electricity tariff rate may affect the production of these sectors.

While energy is regarded as essential, the country experiencing rapid development will be demanding even more [8]. This will include Malaysia, and thus, the decision to change the energy prices must be made with the full awareness that many businesses at the production level may be affected. However, a thorough analysis must be conducted in response to the call to avoid overestimating effects. As such, the net impacts must be calculated using a proper and reliable tool [6]. Going further, any changes in the energy price will surely impact the economy. [4] had earlier explored the removal impact of energy subsidies in China on other sectors and general market price. They found that removing energy subsidies, in general, would increase the energy price, and the impact would be severe on the energy-extensive industry such as electricity, gas, transport, and storage, as well as the manufacture of chemicals. In particular, the removal of electricity subsidy would have the second-highest impact on industrial sectors' price after oil products. On the bright side, [8] highlighted public awareness towards electricity usage in Malaysia had been sparked when the government announced an average electricity tariff rise of 14.89% in January 2014.

In response to this call for a more thorough analysis, this present study will employ an IO model (also known as Leontief model), which had been applied expansively in many energy-related studies, to analyze the impact of changes in electricity tariff on the Malaysian economy Through this model the interdependence of all sectors in the economy will be analyzed, including the consumption of energy by each business. Overall, this model has been widely recognized for its significant contribution towards energy policy development, including electricity. The basic framework of this model is essentially constructed for a specific geographical region concerning the production of various sectors in the economy [1,7]. On that note, to the knowledge of this present study, the IO model is one of the most appropriate tools that can be used to investigate the true impact of electricity tariff changes on the Malaysian economy, particularly in the form of production costs.

## 2. Data and Methodology

The operation of the model relies mainly on a mixed endo-exogenous IO price model. Using Microsoft Excel to perform all simulation processes, this study fully utilized secondary data of the 2015 Malaysia IO price table published by the Department of Statistics Malaysia (DOSM). The primary datasets were originally obtained from The Malaysian Economic Censuses. Published in five-year intervals, this table provides comprehensive data on each sector and the interlinkages between them, which could tell the interdependencies of every sector. The standard being used by this table is known as the Malaysia Standard Industrial Classification (MSIC). For publication purposes, the number of productions is aggregated up to a maximum of 124 sectors. When joined together, the symmetric 124-by-124 table will provide a visualization of the flow of goods and services within the Malaysian economy, portraying the economic interdependence that exists from sectoral interaction within that particular year looking at (a) the number of products bought by each sector as their inputs represented by the column vector and (b) the number of products sold as outputs represented by the row vector happened in the Malaysian economy as a portrayal of economic interdependence which exists from sectoral interaction within that particular year [5].

To derive the price impact from the electricity tariff changes, this study primarily utilized the optimized electricity tariff result obtained from previous research [6]. According to the study, the cost of services (COS) formed based on (a) capacity charge (fixed cost) and (b) energy charge (variable cost) to utility has been translated in terms of (a) base tariff and (b) imbalance cost pass-through (ICPT). The COS is then considered an objective function that can be minimized using the robust approach of (a) goal programming and (b) stochastic optimization. The result from the simulation is the mentioned optimized electricity tariff. Moving forward, three different scenarios, namely Scenario 1, 2, and 3, will also be adopted based on (a) three levels of percentage market demand, i.e., 0.8, 1.5, and 2; and (b) customer growth of 1. The weighted average of tariff changes under each scenario will then be fed into the IO model to simulate the price impact.

$$\text{Price Level} = \text{Electricity Price} + \text{Imported Commodities} + \text{Tax} + \text{Labor} + \text{Capital}$$

In brief, the price level will be treated as the endogenous variable in which it depends mainly on few exogenous variables, namely (a) electricity price, (b) imported commodities, (c) tax, (d) labor, and (e) capital. In this study, only electricity price data is incorporated from external while data of the rest variables are taken from the IO table's internal and existing data. Plus, only the impact of electricity price changes will be given special focus.

In general, the price impacts from each scenario presented in percentage unit will then be captured to show how the optimized electricity tariff changes will impact the overall economy. However, to go into further detail, each sector's price impact value will be analysed to explain the dependency level of each towards electricity. Thus, sectors with high price impact value are considered as electricity-intensive in which any changes made on electricity price will significantly impact these sectors because they are very reliant on electricity to operate their businesses.

## 3. Results and Discussion

The first sub-section will analyse the impact of optimized electricity tariff on the cost of production of 124 sectors in the Malaysian economy. The next sub-section aims to investigate the impact on the cost of production under three different possible scenarios. As mentioned previously, the optimized tariff rate under Scenario 1, 2, and 3 will be based on (a) three levels of percentage market demand, i.e., 0.8, 1.5, and 2; and (b) customer growth of 1. The weighted average of tariff changes under each scenario will be fed into the model to simulate the price impact. Next, under the third sub-section, the study focuses the findings into four broad sectors in the economy, namely (a) agriculture, (b) manufacturing, (c) construction, and (d) services. The final sub-section is to analyse the relationship between CE/VA and the price impact. This is to examine the influences of CE/VA value on sectoral production costs, which implies that the product with higher labour value will proportionally be impacted more. This study investigates on CE/VA relationship with the price impact to see the significance of electricity tariff changes on future employability (since businesses will restructure their factor of production to minimize costs).

**Impact of Optimized Current Electricity Tariff Changes on Costs of Production**

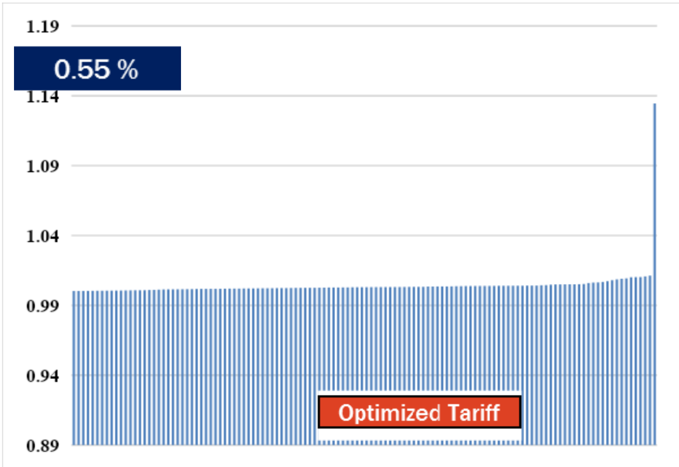


**Figure 1: Price impact from optimized current electricity tariff changes. Three sectors are highlighted according to the least (paddy sector), on average (processing and preserving of fruits & vegetables) and most affected (electricity and gas).**

Figure 1 shows the price impact of the cost of production for each sector where the weighted average of tariff changes is 0.135. The 'paddy sector' is the least affected by the rate changes represented by only 1.00026 price impact while the 'electricity and gas' sector is the most impacted by the changes with a change value of 1.1345. Since the latter is heavily relying on electricity in its productions, it is expected that an increase in electricity tariff will significantly impact their production costs. The result for the sector, which is affected at the median level, is also highlighted. In this case, it is the 'processing and preserving of fruits & vegetables' sector with a 1.00029 price impact value. On average, it is found that under the optimized current electricity tariff, the economy will grow at 0.55 percent.

**Impact of Optimized Future Electricity Tariff Changes (Based on 3 Scenarios) on Costs of Productio**

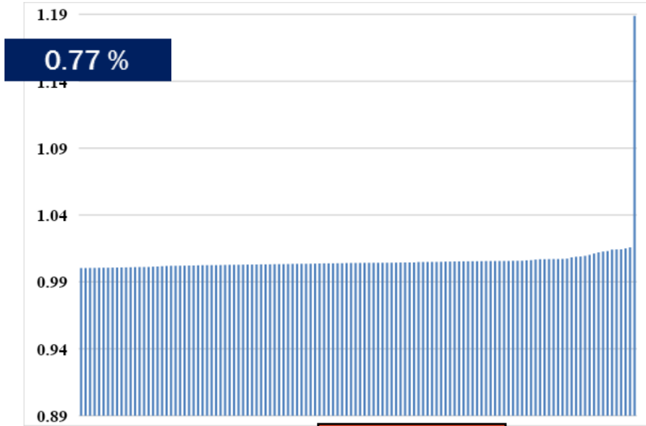


**Figure 2: Price impact from optimized future electricity tariff changes under Scenario 1. Three sectors are highlighted according to the least (paddy sector), on average (processing and preserving of fruits & vegetables) and most affected (electricity and gas).**

Figure 2 shows the result from future electricity tariff changes under the first scenario in which it is assumed that the market demand and customer growth would increase at 0.8 and 1 percent, respectively. The weighted average of the optimized future electricity tariff changes under Scenario 1 (henceforth, Optimized Tariff 1) is expected to be at 0.189. On average, the overall economy under Scenario 1 is expected to grow at 0.77 percent. Once again, the 'paddy sector', which is the least dependent on electricity, is the least affected one in which the price impact value is 1.00031. The 'electricity and gas' is the most affected indicated by 1.18877 value, and the 'processing and preserving of fruits & vegetable' sector is considered moderately impacted with a value of 1.00417. In general, it could be summarized that there are incremental in the price impact values experienced by each sector in comparison to the previous optimized tariff scenario.

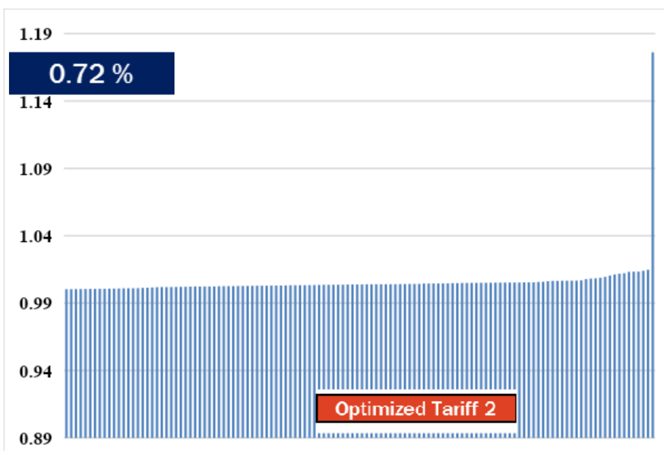


**Figure 3: Price impact from optimized future electricity tariff changes under Scenario 2. Three sectors are highlighted according to the least (paddy sector), on average (processing and preserving of fruits & vegetables) and most affected (electricity and gas).**

Figure 3 shows the price impact from future electricity tariff changes under Scenario 2 (henceforth, Optimized Tariff 2). In this case, the market demand and customer growth are assumed to be at 1.5 and 1 percent, respectively. As shown in Figure 2, the weighted average of tariff changes under Sce 0.68 % .176. With the reduction in projected growth rate compared to the first scenario indicated by 0.72 percent (0.05 percent less), the 'paddy sector' remains as the least affected sector with the price impact value is at 1.00026, while the 'electricity and gas' as the most affected with the price impact value of 1.17616 and the 'processing and preserving of fruits & vegetable' sector is at median level with 1.00389 price impact value.

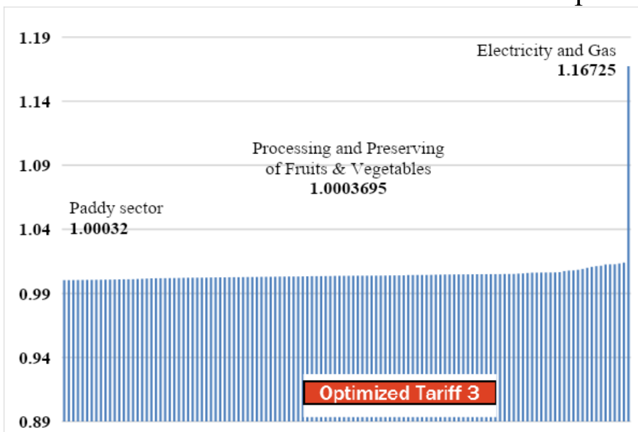


**Figure 4: Price impact from optimized future electricity tariff changes under Scenario 3. Three sectors are highlighted according to the least (paddy sector), on average (processing and preserving of fruits & vegetables) and most affected (electricity and gas).**

Figure 4 shows the price impact from future electricity tariff changes under Scenario 3 (henceforth, Optimized Tariff 3). With a higher market demand of 2 percent and stagnant customer growth of 1 percent, the 'paddy' sector remains as the least affected sector at 1.00032 (slightly higher from Scenario 1 and 2) while the 'electricity and gas' as the most affected sector with a value of 1.16725 (slightly lower than the former two scenarios) and the 'processing and preserving of fruits & vegetables' sector as moderately affected at1.0003695 (much lower than Scenario 1 and 2). Overall, the economy is expected to grow at 0.68 percent on average (0.13 percent higher than under the Optimized Tariff but 0.09 and 0.04 percent lower than Scenario 1 and 2, respectively). A simple comparison between all three scenarios shows that the widespread impact under Scenario 3 will be the least, while Scenario 1 will be the most significant.

## The Impacts of Electricity Tariff Changes Towards the Costs of Production (According to 4 Broad Sectors)

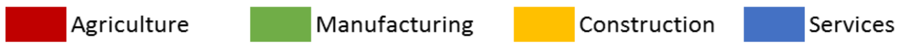


**Figure 5: Impact of electricity tariff changes towards the costs of production according to 4 broad sectors.**

Figure 5 depicts the impact of electricity tariff changes on the costs of production according to four broad sectors in Malaysia, namely (a) agriculture, (b) manufacturing, (c) construction, and (d) services. Technically, towards the end of the horizontal axis, the price impact value will be higher. Thus, based on the sectoral distribution above, the manufacturing sector will be the most affected one indicated by the large spread of the manufacturing sector, especially towards the horizontal axis. Thus, the manufacturing sector can be considered an electricity-intensive sector that relies highly on electricity to perform its business. On the contrary, the above figure demonstrates that the agriculture sector bears the smallest impact on their production costs indicated by the spread of the agriculture sector that concentrated at the beginning of the horizontal axis. On the other hand, most construction sectors spread in the middle, denoting that this sector will also be affected by the electricity tariff increases but not as much as the manufacturing sector. Also, only a few under services sectors are depicted as being heavily impacted, where most of them are considered less impacted by the higher concentration of services sector spread at the beginning of the horizontal axis rather than at its end.

**Composition of Compensation of Employees in Value-Added (CE/VA) Against Price Impact (Based on Optimized Tariff Scenario)**

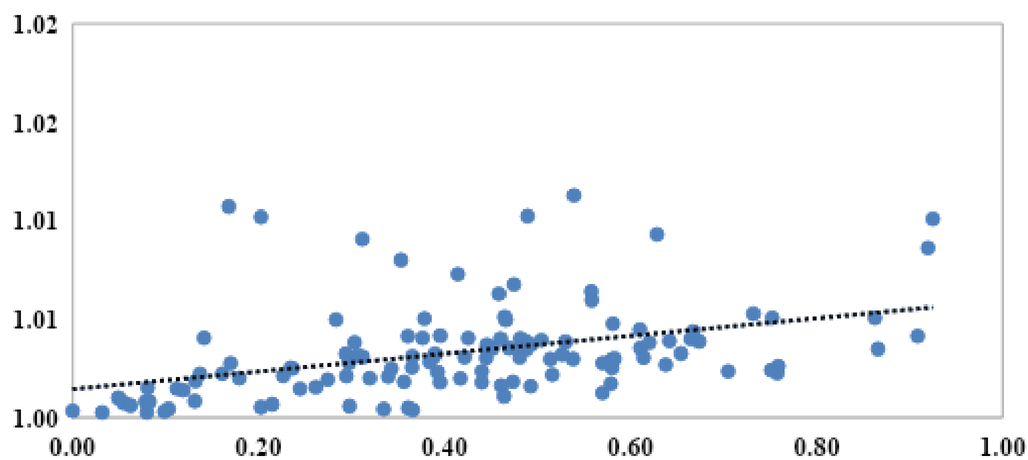


**Figure 6: The composition of compensation of employees (CE) in value-added (VA) against price impact (based on optimized tariff scenario). The dotted line illustrates the relationship trend between CE/VA and the price impact.**

Figure 6 portrays the positive relationship between CE/VA and the price impact. Based on the above illustration, the higher the CE/VA, the higher would be the weightage on its cost of production. In other words, sectors with higher CE/VA are most likely to be affected by the increase in the electricity tariff rate. In this case, 'non-profit institutions serving households' sector recorded the highest CE/VA value of 0.93. As a result, with a weighted-average of tariff changes of 0.135 under the optimized tariff scenario, the price impact of this sector is also depicted as amongst the highest and other electricity-intensive sectors. This proves that CE/VA is significant in determining the price impact on production costs if the electricity tariff rate changes.

## 4. Conclusion

In conclusion, the impact of electricity tariff changes is based on sectoral dependence on electricity. Thus, it is obvious that the ‘electricity and gas’ sector is the most affected by the remarkably high or highest price impact value. Conversely, the ‘paddy’ sector remains the least affected sector depicted by the consistently lowest price impact value under each scenario. Furthermore, the production costs for the rest seem to have not much difference. As for the four broad sectors, the spread pattern alongside the horizontal axis ranked following the price impact value provides evidence that the manufacturing sector is electricity-intensive while the agriculture sector is non-electricity intensive. Additionally, the dispersion of the construction sector, which is concentrated in the middle, stipulates that it will only receive average impact relative to others. Simultaneously, the services sector's dispersion size tells that only a few under this sector will be impacted heavily while most of it will receive a relatively smaller impact. Finally, looking at CE/VA against price impact, it could be summarized that there is a positive relationship between the two. This means that high CE/VA sectors affected more while those with lower CE/VA affected less.

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