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CONFERENCE ON MANAGEMENT AND ENGINEERING IN INDUSTRY (CMEI) 2021

CURRENT PERSPECTIVE AND FUTURE DIRECTIONS OF INDUSTRY 4.0 IN ENGINEERING & MANAGEMENT

TANGERANG, 23rd - 24th MARCH 2021

MASTER OF MECHANICAL ENGINEERING
SWISS GERMAN UNIVERSITY

Preface from the Chairman of the Conference on Management and Engineering in Industry (CMEI)

Dena Hendriana, B.Sc., S.M., Sc.D.

Head Department of Master of Mechanical Engineering, Faculty of Engineering and Information Technology, Swiss German University

Welcome to the third Conference on Management and Engineering in Industry (CMEI). This is conference is conducted by Master of Mechanical Engineering in the Swiss German University at Alam Sutera, Tangerang, Indonesia. The conference is open for all academic community to share the knowledge in the areas of management and engineering which are applicable in the industry. It is held on Tuesday and Wednesday, 23 - 24 March 2021 in the campus of Swiss German University at Prominence Tower, Alam Sutera. The theme of this conference is ”Current Perspective and Future Directions of Industry 4.0 in Engineering & Management”. This theme is aligned with Master of Mechanical Engineering vision and mission to prepare our students for the era of Industry 4.0 in the global economic.

There are forty-nine papers presented in this event with the topics related to the theme. We thank reviewers who have been working hard to improve the quality of the papers until this conference proceeding ready to be published on time. We thank all the members of the committee who prepare and run the event. We thank Rector, Vice Rectors, and Dean of Faculty of Engineering and Information Technology for their support on this event.

We thank God that we have run the event of the conference smoothly and published the conference proceeding on time. We hope that this event is beneficial for everybody and also the proceeding to be beneficial for the readers.

Best Wishes,

Dena Hendriana, B.Sc., S.M., Sc.D.

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2. Dr. Ir. Henry Nasution, M. T.
3. Dr. Ir. Gembong Baskoro, M. Sc.
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CMEI 2021 PROGRAM

23 – 24 March 2021

Date: 24 March 2021

Time	Location	Activities
08.00 – 09.00		Zoom Preparation
Keynote Session (Moderator: Dr. Gembong Baskoro)		
09.00 – 09.30	Zoom Meeting Room	**Keynote Speaker 3: Ir. Reni Yanita, M.Si[*] (Arah dan Kebijakan Kementerian Perindustrian dalam Pelaksanaan Transformasi Industri 4.0)** **[*]Staf Ahli Menteri Bidang Percepatan Transformasi Industri 4.0**
09.30 – 09.45		**Question & Answer**
09.50 – 15.00	**Parallel Session**	
15.20 – 15.40	Zoom Meeting Room	**Announcement of the Best Paper (Head of Master Mechanical Engineering)**
15.40 – 16.00	Zoom Meeting Room	**Closing of the Seminar (Head of Master Mechanical Engineering)**

CMEI 2021 Parallel Session

Date: 24 March 2021
Room: Meeting Room (Emerging Areas of Engineering Management)

Moderator: Dr. Ir. Henry Nasution, M. T.

Time	Presenter	Title
09.50 – 10.10	Ahmad Anwari, Edi Sofyan, Sumarsono Sudarto, Gembong Baskoro, Dena Hendriana	Improving Talent Performances by Using Integrated Learning Development Program in Indonesia Leading Heavy Equipment Distributor
10.10 – 10.30	Bakhtiar Burhan, Hanny J. Berchmans, Dena Hendriana, Henry Nasution, Gembong Baskoro	Green Building Analysis of PT United Tractors on Existing Building Based on the Latest Rating Tools Green Building Council Indonesia
10.30 – 10.50	Daniela Dea Hapsari, Sumarsono Sudarto, Gembong Baskoro	Improving Concrete Waste Rate Generation of Structure Projects in Leading Construction Firm in Indonesia
10.50 – 11.10	Dedi Emawan, Aditya Tirta Pratama, Henry Nasution	Application of Analytic Hierarchy Process (AHP) to Develop the Weighting of Key Performance Indicators on Gas Engine Power Plants
11.10 – 11.30	Iwan Kendarwan Kaldjat, Aditya Tirta Pratama, Dena Hendriana	A Study on Sensible Excise Policy by Considering Acceptable Industry Volume, Government Revenue and Employment for Hand Made Kretek Cigarettes
11.30 – 11.50	Mohammad Yoga Baskoro, Sumarsono, Gembong Baskoro	Availability Improvement by Implementing Customize Maintenance Strategy in Rental Operation of Indonesian Forklift Distributor Company
11.50 – 13.00	**LUNCH BREAK**	
13.00 – 13.20	Egi Gumilar, Dena Hendriana, Hanny J Berchmans, Gembong Baskoro, Henry Nasution	Study of Rooftop Solar PV Policies that Have an Impact on Techno-Economic, and Socio-Environment in a Leading Heavy Equipment Company in Indonesia

13.20 – 13.40	Satriyo Widy Prasetyo, Gembong Baskoro, Dena Hendriana, Henry Nasution, Hanny J. Berchmans	Integrating Audit System Of AGC, ISO14001, ISO45001 to Improve Implementation of the Management Systems in Leading Heavy Equipment Companies
13.40 – 14.00	Yonta Wasfadhita, Gembong Baskoro, Eka Budiarto, Dena Hendriana, Henry Nasution	Assessing Sustainability Impact of Autonomous Haul System in Indonesian Open Pit Coal Mining Company
14.00 – 14.20	Baladi, Dena Hendriana, Edi Sofyan	Improving of the Mechanic Qualification Standard Related to Customer Satisfaction at Leading Heavy Equipment Distributor Company in Indonesia

Content

A Study on Sensible Excise Policy by Considering Acceptable Industry Volume, Government Revenue and Employment for Hand Made *Kretek* Cigarettes

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Abstract*—Tobacco industry in Indonesia has been contributing to Indonesia Economy and is currently contributing to the government revenue in the range of 8% – 9%. During the past 5 years the government has increased excise higher than inflation, and in 2019 the increase is the highest in the history of the tobacco industry. Due to the excessive increase, the excise department has predicted the decline in industry volume of 15% in 2021 (this study was done, before the decline released by the government). The purpose (objective) of the thesis is to study a scenario on how to balance: government revenue, industry volume and employment. System dynamics is used as methodology to analyze a complex policy situation. The methodology translates correlation among all the aspects that influenced the policy (Government Revenue, Employment, and Industry Volume) and being used in this thesis. The study has found that for handmade cigarettes (SKT), the government has implemented over-protective policy that expected to give positive impacts the segment. The Machine-made segments (SKM and SKM) are impacted by the over-protective policy. The industry sustainability will be impacted by over protection policy for SKT, considering impact to the other segments. SKT is only 20% of the market share.

Keywords*—excise, SKT (hand-made clove cigarette), SKM (machine-made kretek cigarette), SPM (machine-made white cigarette), system dynamics.

I. Introduction

A. Background

Cigarettes is one of the prevalent products being consumed by the Indonesian population. It is divided into three main product types or segments: machine-made white cigarettes (SPM), machine-made clove cigarettes (SKM) and hand-made clove cigarettes (SKT). The main difference between the three segments is the way the cigarettes are produced. In 2004, 81% of manufacturing employment were women, focusing on the SKT segment being the most labor-intensive manufacturing process among all cigarette segments [1]. Today, women still make up the larger percentage of the manufacturer employment. The most recent statistics regarding consumption is as follows [2]: 39.9% smoking prevalence, with male's rate at 76.3% and women at the rate of 3.6%. As of October 2019, more than 50% of smokers consume above 5 cigarettes per day, where 10% of smokers consume more than 20 cigarettes per day [3]. Therefore, there is a demand for cigarettes that the industry needs to supply for.

Cigarettes, therefore, are very lucrative from one perspective, where there is a market demand for the industry to provide, and from the other, where there is a demand for employment to fulfil the production that will be needed to provide for the number of cigarettes demanded by the consumers. However, this industry is subjected to heavy excise, as there is an opportunity for the government to gain from how lucrative the industry is, for both good and bad.

Excise is defined by the Indonesian Law (UU No.39 2007), which states that a good/product that is subjected to excise has the following characteristics: consumption has to be controlled; its distribution has to be regulated; its consumption has a negative effect on life. Indonesia has adopted a specific system since 2009. In the system, there are three main principles that define the specific excise of a cigarette stick:

1. Product segment or type of cigarette. SKT, SPM, and SKM have all been determined by the government a value that defines the segment, each according to type of production (machine-made and/or handmade) and raw material used (clove and/or no clove)
2. Production process of cigarettes. There are further segments of excise within the segments of types of cigarettes, categorized by tiers that relate to a production level of a company for a specific segment. A tier categorizes the capacity of a company to produce a particular segment.
3. Price of cigarettes within the tier. The government defines minimum price of cigarettes for each tier. The current specific system applies two different types:

excise rate and price per stick. Price per stick refers to the minimum price a type of cigarette is required to be sold at, whereas rate is the amount that has to be paid to the government sale of one stick.

The Indonesian tobacco industry has been consistently one of the most important contributors to the State Budget (APBN). Ernst & Young [4] found that the industry alone contributed an approximate value of Rp. 159 Trillion in 2018, which was done by an Excise tax of several product categories produced by the industry. During the period of 2012-2017, the cigarette sector alone consistently contributed an average of 10.4% of the state budget, or about Rp. 732 Trillion in those five years. In the 2017 fiscal year alone, the industry's tax contribution is Rp. 200 Trillion, which is equivalent to 61.4% of the industry size. This shows that the tobacco industry is one of the most valuable industries of the country, and most of its output is being put into the government.

However, Ernst & Young [4] also found that there was a disproportionate trend between the government's interest, and the industry itself. For 5 years (2013 - 2017), average increase of excise is higher than inflation. In 2014, there was no increase of excise due to the introduction of direct upfront VAT of 9.1% to the collection system (for the industry). While the government received a great amount of tax revenue, and also imposes relatively high tariff, the sales volume of the industry has a negative growth during 2015-2017 period. Government intervention might have had a bad impact on industry's production. Evident in 2017, where the worst sales volume trend coincided with revenue to significantly decrease; the policy enacted then may not have worked best.

B. *Objective*

The inefficiency of government policy with regards to industry, particularly industry volume and employment, is due to be analyzed for government and industry to all benefit from their relationship. The government's major goal is to generate revenue by increasing the excise rate as well as price of cigarettes. However, there is evidence that the industry could be harmed by this, because there is a recent trend of increasing revenue with decreasing volume of production and employment.

The objective of the thesis is to study the excise policy and its effects study on how to balance excise revenue, employment and tobacco industry, particularly employment and industry volume of the SKT segment. The desired result is a scenario that represents the interest of all key stakeholders, particularly the government's interest in revenue and industry's interest in labour security, where labour is maximized in security and productivity.

This study will focus on SKT segment, since employment is the important part of the production process, and it represents the health of the industry.

II. Literature Review

A. *Theoretical Perspective*

Excise tax, by economics definition, is a tax charged on each unit of product that is sold [5]. Recall that the Indonesian Law of 2007 (UU No.37 2007) states that the function of excise in Indonesia is to balance a product's cost, benefit and externalities, so that the product can be properly regulated and be beneficial for the government.

Simple microeconomics theory of excise tax would show two possible outcomes of a tax policy on producers or consumers: either the producers will be less willing to provide cigarettes to the market because the tax forces producers to sell at a higher price to compensate for the excise obligation needed to be paid; or the consumers will be less willing to purchase cigarettes from the market because consumers have to pay a higher price to pay the government. In theory, therefore, excise tax can discourage market activity when looked at simply and with strong assumptions [5].

A few econometrics and statistics methods have been used previously in examining is problem: Suprihanti et al. [6] studied the effects of excise policy on domestic agroindustry of tobacco and cloves using two-staged least squares regression; the ministry of industry roadmap made for 2019-2024 period use forecast regression with an autoregressive model to predict the industry's state with its past and current state [7]; and a few authors have used what is called the fixed effects regression, among them the [8], [9], and [10]. While econometrics and statistics are methodology to solve economic problems, other methods are also valid, particularly system dynamics where there is the opportunity to be ahead of conventional methods previously mentioned from the perspective of correlation of variables and the account of many influences [11].

System dynamics is a method to examine a complex system's behavior over time. A complex system includes many elements/variables that interact with each other. Using conceptual diagrams and a branch of mathematics to model the system, information could be extracted from it to understand how these relationships cause certain outcomes over time [12]. Other methods of analysis may be rigorous to explain a portion of the whole scheme, but it is also short-sighted. In the case of thinking from the perspective of system dynamics, all aspects of the system of interest can be constructed and simulated, and depending on the scope of analysis hence a more complete finding can be attained [13].

System dynamics is built from two diagrams as foundations, the causal loop diagram, and the stock flow diagram. In the context of tobacco/cigarette industry, a causal loop diagram depicts relationships within facets of the industry processes and how sectors of the industry are related to one another. The stock flow diagram usually follows the causal loop diagram by quantifying these industry processes and other causal relationships.

B. *Past Literature*

Adiatama et al. [15] is the most relevant among these past pieces of literature, which is a study of the effects of 2010 PMK on the state of the industry, ranging from profitability to more specific elements such as health of consumers, and raw material stock. Employment is also limited in terms of coverage. Therefore, this thesis is contributing to the development of this methodology in this industry. Table 1 also shows that it is also encouraged for others to continue using system dynamic to study Indonesian excise policy that has many influencing factors and their dynamic interrelation. Other literature with system dynamics method include [11] and [16], which analyze cigarette-related policy analysis outside of Indonesia.

While literature that were found preceded this study had implemented this method, this study provides an updated emphasis on the potential of this method for policy analysis in the cigarettes industry, and also contribute to the analysis by incorporating the effects of excise increase that spans 10 years from 2010-2019.

III. Methodology

Albin [17] outlines an interpretation of the modelling process into four steps as follows:

1. Conceptualization: define the purpose of the model and basic mechanisms
2. Formulation: convert feedback diagrams to equations
3. Testing: simulate the model and test the model's assumptions and behavior
4. Implementation: test model's response to policy scenarios

Fig. 1 visually shows a modified diagram of system dynamic process [18], that has the same foundation as the description by Albin. In the process, the formulation of causal loop diagram and stock flow diagram is situated on the 2nd and 3rd step of the Albin explanation, and the 2nd, 3rd and 4th step of the diagram [18]. Simulation will not go past testing until the model passes the test, by showing success in replicating the actual data. This is one of the many options of validity measurement for the model to be a predictor for hypothetical scenarios in the 4th step, Implementation [13].

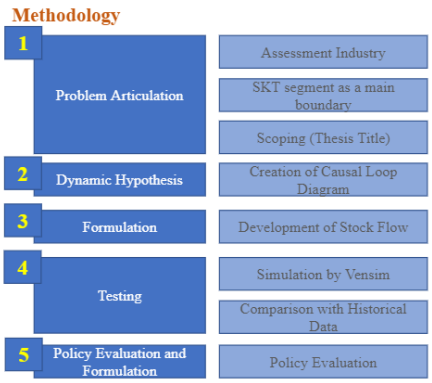


Fig. 1. The process of constructing the system dynamics model [18]

Data is collected from several sources: Historical excise policy data from 2010-2019 is collected from the Ministry of Finance, specifically the laws that are publicly available; Industry volume and Excise revenue data is collected from the Ministry of Finance (Directorate Customs and Excise); Employment data is collected from the Ministry of Industry and population data is collected from various sources, including World Bank documents.

In this thesis, data is used in various ways. There are descriptive statistics throughout the thesis, where it serves as a narrative drive for the thesis. Fig. 1, for example, drives the narration to urge the creation of this thesis by showing there is a dynamic relationship among key points of the industry and excise policy, and a disproportionate trend between change in excise revenue and change in industry volume. Finally, data is used in the system dynamics process, where actual data of variables of interest is compared with the simulation results of the model. This validation test is a method to improve the model to become a valid simulator of the system in question.

IV. Results and Analysis

A. *Model Validation*

The analysis is broken down into two different kinds of models: the simple and complex model. These separate models were found in order, following the formulation and testing steps seen on Fig. 1 as part of validating the model by matching the values of excise revenue, industry volume, and employment with actual data from 2010-2019. This validation strategy should confirm the model's capability in representing the behavior of this system that involves the industry government, which validates the results of the values when scenarios are introduced for prediction [13].

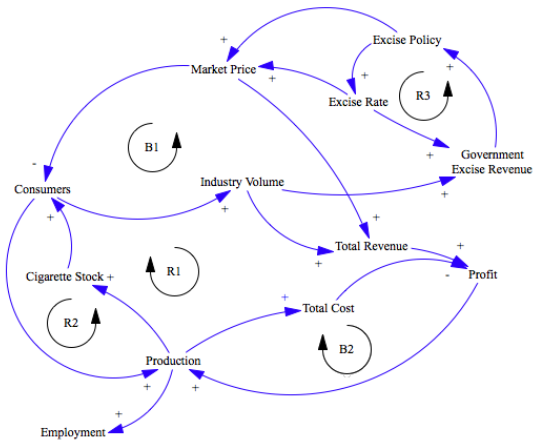


Fig. 2. Causal loop diagram of the system dynamics model

Fig. 2 shows the causal loop diagram. The specific causal relationships and intuitive foundation are explained by breaking down and categorizing the variables according to industry process as follows:

- Production

Production process of the industry creates Cigarette Stock that is ready to be sold in the market. Consumers are prepared to purchase and consume cigarettes, and their demand influences the size of Production because companies' production are driven by the demand of cigarettes, among other indicators. Consumer's purchase causes the accumulation of Industry Volume, which is the total sales of cigarette sticks. Industry Volume multiplied by Market Price equals to Total Industry Revenue. Total Industry Revenue goes to Profit, and some of the revenue goes to pay for the Total Cost of the whole production process. Total Cost, by definition, is how much does the production process cost to process products. If costs are high, Production is inefficient, therefore the amount is short of how many sticks can potentially be produced.

- Sales

Industry Volume accumulates by the demand of the Consumers, which translates into purchase of cigarettes. Government Excise Revenue is driven by the Excise Policy that the government designs for the industry. The current excise policy is the specific excise, which is a rate (currency unit, not a percentage) that consumers pay at purchase, and the company pays in advance to the government to be able to sell (company purchase stamps that will be put on the cigarette pack, called '*banderol*'. The current excise policy also makes compulsory a minimum price that these products are to be sold, therefore Market Price is also caused by the Excise Policy the government puts in place. Government Excise Revenue is the excise rate for *SKT* multiplied by Industry Volume.

There are five identifiable feedback loops that were naturally formed from these determined causal relationships (R is a positive loop, and B is a negative loop), explained below with the restrictions of the simple model:

1. R1, explains the fact that producers will continue to profit every fiscal year, if there are no changes in consumer preferences, or any other external factors that interfere with consumption or production.
2. R2, is a reference to the fact that production driven by demand is a positive chain of relationships that drive the system to potentially accumulate profits.
3. R3, is a reference to the government's efforts in promoting increase in revenue. Government revenue is driven by the rate it gives to the industry and product sales. Moreover, historically, the government has been in general increasing excise for the past ten years.
4. B1, is a negative link between Market Price and Consumers. In theory, *ceteris paribus*, if price increases, then consumers will be discouraged to purchase. This loop is also a reference to the law that defines excise tax in Indonesia. That is, excise is implemented to regulate cigarettes consumption.
5. B2, is the effect of costs and profits on producers, which is self-explanatory in the nature of costs.

The simple model that came out of these intuitive explanation as well as the causal loop diagram resulted in a wayward simulation, shown on Fig. 4. Although the simple model is rooted in logical foundations, it is too simple for several reasons. The simple model's process follow a linear process: the production of cigarettes is driven by the demand of the consumers, who are constantly interested in consuming cigarettes. Production is processed by a constant effort done by workers in manufacturing sites (factories) without any interfering factors that reduce the rate in which cigarettes are made in a day for the whole fiscal year. Sales is always constant by, again, the consumers always interested in consuming cigarettes at the same rate of cigarettes per day, without any interfering factors that reduce the rate in which cigarettes are consumed in a day by these people. The fraction of smokers does not change, which is attributable to the balance of people quitting and starting, as well as the lack of discouragement from consuming less. Sales, then, accumulates to industry volume, which is sales in a particular year, and the excise revenue accumulates every year with these dynamics explained, as well as a constant excise rate every year, estimated according to the 2019 rate by the Ministry of Finance. However, the 'effects' from all these 'causes' in the cause-effect relationship do not circulate back to the 'causes', meaning every year employment, industry volume and excise revenue are affected by the same strict situation explained earlier. The model is also focused only on the linear cause-effect that goes to excise revenue.

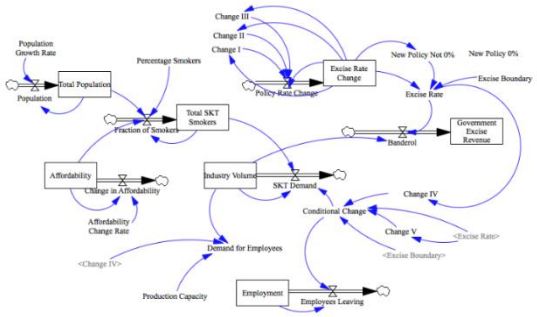
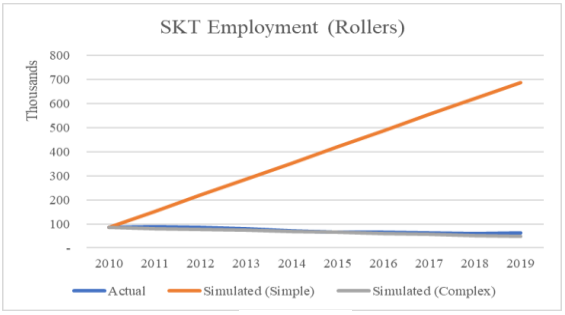


Fig. 3. Stock flow diagram of the complex model, an improvement from the simple model

This linear process is improved upon through the formulation of the complex model. Its stock flow diagram is shown on Fig. 4. The complex model returns the effects of accumulation of excise revenue to volume and employment. Specific changes and added factors to the model are as follow:

- Change in employment to SKT rollers. This is an assumption that is based on the belief that producers rely on the demand of consumers to produce a certain number of cigarettes in a year.

- Affordability factor. This refers to the price effect on consumers (demand): if prices increase, consumers would buy less. In the complex model, this affordability is a percentage factor that affects the total SKT consumers in a year, supported by the relative income price (RIP) percentage as the representative value for affordability and price effect [19]. This is a reference to the return factor of excise increase on consumers.



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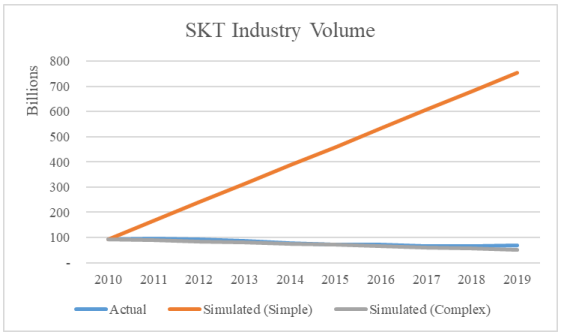

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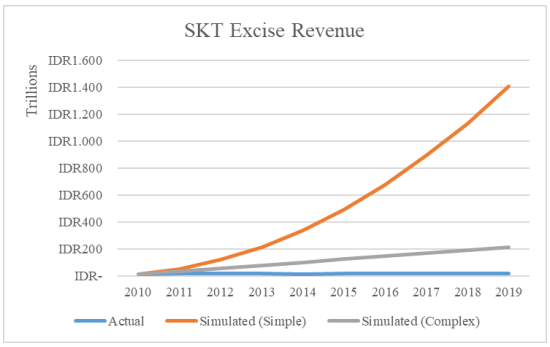
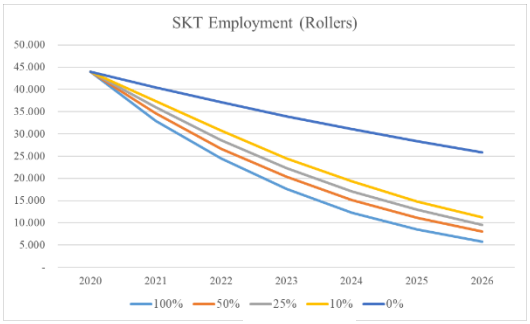


(c)

Fig. 4. Simulated results of simple and complex model, compared to actual values from 2010-2019: (a) Employment, (b) Industry volume and (c) Excise revenue

- Dynamic Population factor. The population factor is assumed to be changed according to the growth rate of population from 2010-2019.
- Excise rate. The government has been increasing excise every year and sadly the increase has been, in average, higher than inflation plus economic growth. The industry has been impacted by the increase and volume industry has been the parameter to the impact so far.
- Conditional change factor. This conditional change factor is the returning factor of excise increase given based on [20]. This is an assumption regarding change in industry volume if there is 1% increase in excise rate.

B. *Policy Analysis*



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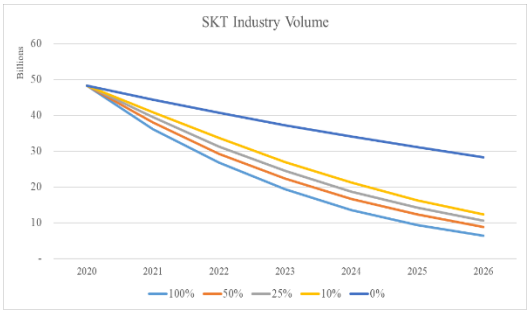

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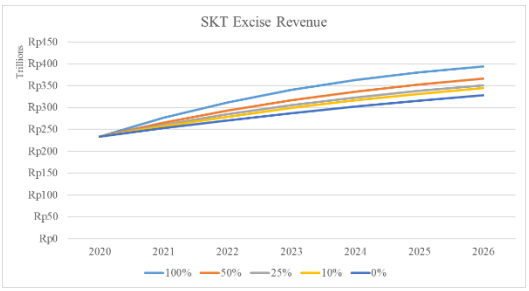

(c)

Fig. 5. Simulation results of policy effects of 0%, 10%, 25%, 50% and 100% from 2021-2026

Fig. 4 shows the improvement of the model when these additions are introduced. With all the adjustments discussed earlier, the model has become closer in proximity to actual values from 2010-2019. Therefore, policy analysis can be performed with this complex model.

Fig. 5 shows the simulation of policy analysis. Scenarios of 0%, 10%, 25%, 50% and 100% excise increases are introduced.

Regarding employment, is shown to have a decreasing trend. It has always been the government intention to protect employment, but the trend has shown otherwise. It is politically correct for every policy announcement, that the government mention their policy consideration is to protect employment. The actual data has the same trend with the complex model simulation trend results for various scenarios (0%, 10%, 25%, 50%, 100%) that shows decreasing trend. Volume industry shows the same trend that has a decreasing trend, which logically acceptable: industry volume would require employment. With the scenario of 0% excise increase, the government would still have decreasing trend on employment but in a slower pace. One of conceptual interpretation, regarding tax incidence would be that the burden of the excise is more inclined to the producers, because by simulation and actual data, employment has been decreasing and could decrease even further in the future with further increase in excise.

The industry volume trend is decreasing, similar to employment. The model has accommodated the relationship between industry volume and employment. The relationship between employment and industry volume shall be proportional. The decreasing trend is most probably caused consistently by excise rate increase. For the scenario of 0% excise increase, the volume industry is in decline trend but slower pace compares to the other scenario. The Indonesian Tobacco Farmers Association highlighted historical decline trend based on excise increase policy [20]. It is apparent that the excise increase policy impacts the industry volume.

The revenue trend is in line with government expectation from the industry, to contribute more to the government revenue. The government revenue has shown the increasing trend due to the influencing factors supporting the increase, such as perpetual purchase done by the SKT smokers over time. Affordability factors in as an influencer to decrease this purchase, as theoretically understood. However, the increase in excise factor overpowers this affordability factor. Thus, further increase in excise will increase excise revenue.

There is a significant gap between 0% increase and 10% increase for both employment and industry volume. An explanation of the gap is the compounding increase of excise rate increase effect. This is also a result of the way the boundaries of the thesis is, which affect the equations and the output of these equations. There should be another study that further develop these boundaries that will enhance the model and explain the gap more clearly.

V. Conclusion

This thesis is a study on the impacts of excise policy on the Indonesian cigarettes industry, specifically SKT segment, particularly its effects on employment, industry volume and excise revenue. Given the assumptions and boundaries of the model already discussed, it is found that the 0% policy is the best policy compared to other policy scenarios. According to this thesis' model, any policy scenario will have negative implications, particularly for industry volume and employment.

This thesis should serve as a convincing proof to apply system dynamics to policy analysis for cigarette industry excise. This is an alternative for a more complete analysis that should help produce better policies.

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