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Impacts assessment of market-based economic instruments on the NDC targets of waste sector in Indonesia: AIM/CGE

(Please do not quote this paper as it is still working progress and will be updated accordingly)

Ambiyah Abdullah[1*], Toshihiko Masui[1]

[1] National Institute for Environmental Studies (NIES), Tsukuba, Japan

[*]Corresponding author email address: ambiyah@gmail.com

Abstract

In 2016, the Indonesian government had set a target to reduce the total GHG emission from the waste sector by 0.4% and 1% by 2030 without and with any international assistance respectively. Municipal solid waste is the largest source of the total GHG emission of waste sector in Indonesia. Therefore, the improvement of municipal solid waste is one of the current high agendas of the Indonesian government. In 2017, the Indonesian government had set targets to reduce up to 30% of municipal solid waste amount and 70% of waste handling rate by 2025. To support the realization of these targets, the Ministry of Environment and Forestry together with the Ministry of Finance of Indonesia announced the main economic instruments (production and consumption taxes and specific financial supports) to be applied to all plastic products and municipal solid waste sectors in Indonesia respectively. These market instruments are expected to also bring the additional financial sources for the government to achieve national targets of waste sector in Indonesia. On the other hand, these market instruments will also indirectly affect the NDC targets of waste sector in Indonesia.

This study aims to assess the impacts of the above-mentioned market -based economic instruments on NDC targets of waste sector in Indonesia. This study uses the AIM/CGE model which is based on the 2010 Indonesian IO table with a more detailed disaggregation on electricity and tax accounts. The disaggregation of electricity and consumption tax is done using the several national statistical data and GTAP 9 database respectively. The finding shows the implementation of 5% increase in consumption tax on all plastic products can be less economic cost and be a priority policy option for the Indonesian government. This can be combined with the adequate amount of special financial support to be spent on the waste and recycling sector with the aim to reduce the sectoral GDP losses of consumption tax. The Indonesian government needs to consider seizing the current scale of financial support for the MSW sector in Indonesia.

Keywords: Indonesia, municipal solid waste, NDC targets, market-based economic instruments, AIM/CGE

1 Introduction

Municipal solid waste is one of the key environmental issues in Indonesia. In 2018, the total municipal solid waste generated in Indonesia is estimated to approximately 66.5 Million tones (MOEF, 2018). The total municipal solid waste generation in Indonesia is estimated to increase along with the increase of population (World Bank, 2018). The waste generation per capita per day in Indonesia is estimated to 0.68 kg/capita/day (World Bank, 2018). It is similar with the national standard of waste generation per capita per day used by the Indonesian government in 2002 (SNI 2002). Among other sources, household is accounted for the largest share (up to 75%) of the total MSW in Indonesia (World Bank, 2018). According to the statistical data of the Ministry of Environment and Forestry of Indonesia, organic waste, plastic, and paper are accounted for largest share of total MSW composition in Indonesia in 2017 for approximately 60%, 14%, and 9% respectively. According to the new study conducted by the Economic Intelligence Unit, Indonesia is the second largest food waster in the world. It generates approximately 300 kg of food waste per person per year. The recent studies conducted by the GIZ and the World Bank in 2018, Indonesia generates for approximately 3.2 million tones in 2014 and 30% leakage of waste is plastic. Municipal solid waste is also recognized as the third important sector for NDC target by 2030. It is set to reduce the GHG

emissions from waste sector for approximately 0.38% and 1% by 2030 without and with the international assistances (UNFCCC, 2016).

To tackle the problems on municipal solid waste in Indonesia, the Indonesian government had announced several national regulations such as the 2017 National Policy and Strategy on solid waste management (called as JAKSTRANAS in Bahasa), and the 2017 National Action Plan on Marine Debris. These two targets aim to reduce up to 30% of municipal solid waste (approximately 21 million tons), to increase up to 70% of handling rate (approximately 50 million tons), and to reduce up to 70% of plastic waste or marine debris by 2025 respectively. In line with these targets, three main measures are set, on which aim to reduce waste generation per capita, to reduce waste generation at sources, and to decrease waste disposed to landfill and environment (BPK, 2017). Moreover, the Ministry of Environment and Forestry together with the Ministry of Finance of Indonesia had also announced market-based economic instruments (consumption tax on plastic bag, levy or production and import taxes on all plastic products, and feed-in tariffs or special financial support) to support the realization of the national targets on solid waste sector in Indonesia.

Among three market-based economic instruments mentioned above, the feed-in tariff had been announced and formerly used economic instrument particularly related to clean energy and electricity sectors in Indonesia. In 2018, the feed-in tariff instrument had been introduced by the Indonesian government to support the realization of waste generated electricity power plants in 12 selected cities in Indonesia. However, this policy has been updated with the newly announced regulation of the Ministry of Environment and Forestry number P.24/MENLHK/2019 about the solid waste support fund for municipal solid waste treatment in 12 cities. This new regulation allows the utilization of the national government budget to be used as financial support or subsidy for solid waste treatment in the 12 selected cities governments in Indonesia. The local government of the selected 12 cities can request the financial support from the national government for solid waste management treatment fee based on the amounts of treated municipal solid waste at final disposal center. This is supposed to help the acceleration of municipal solid waste utilization into waste electricity power plant in Indonesia.

Other economic instruments are levy or tax imposed on plastic bag and the plastic products. The initial levy or tax was imposed on plastic bag in several cities in Indonesia in 2019. The percentage of plastic bag levy or duty was small (approximately IDR 200 or US$ 0.01 per sheet). Moreover, in 2020, the Ministry of Finance had submitted the formal request to the Indonesian Parliament to approve the levy or taxes imposed on plastic bag in all cities in Indonesia. On February 20, the Indonesian Parliament approved the imposing levy or tax on all plastic products in Indonesia. However, the tax will be imposed on producer or importer based on the production and imported amount of plastics. The approved new tax or levy for plastic products is production and import taxes.

Against this background, this study aims to assess the impacts of the above-mentioned market instruments (special financial support (budget) for waste disposal management fee for the electricity power plant and production or import taxes on plastic products) on NDC targets (GHG emission reduction) of waste sector in Indonesia using the computable general equilibrium. In line with this, three research questions are set. First is what are the macroeconomic impacts of the current main economic instruments on waste sector (special financial support for waste disposal management fee for the electricity power plant and production and consumption taxes on all plastic products). Second is what are the impacts of these current main economic instruments on NDC targets (GHG emission reduction) targets of waste sector in Indonesia. Third is what are the impacts of these market-based economic instruments on climate government budget in Indonesia. The remaining of this paper is structured as follows. The second part presents the data model and simulation used in the study. The third part presents the simulation scenarios used in this study. The fourth part presents the findings and discussion. The last part presents the conclusion and policy recommendation.

2 Methodology

2.1 Data

This study uses the 2010 Indonesian IO table published by Bureau of Central Statistics of Indonesia as main data for CGE analysis. The 2010 Indonesian IO table originally has 185 sectors classification without specifically disaggregate the renewable electricity sectors, consumption and export taxes. Therefore, this study disaggregates original electricity sector into several sectors related to renewable energy sectors and consumption and export taxes based on several national statistical data and GTAP 9 database respectively.

This study disaggregates the original one electricity sector of the 2010 Indonesian IO table into five new electricity sectors: (i) coal-fired electricity, (ii) oil-fired electricity, (iii) gas-fired electricity, (iv) geothermal-fired electricity, (v) hydropower-fired electricity, (vi) solar PV-fired electricity, (vii) wind-fired electricity, (viii) bioenergy-fired electricity, (ix) waste-fired electricity, and (x) nuclear-fired electricity sectors. To disaggregate the electricity sector, this study uses two steps as follows. First is to disaggregate the original electricity sector at column side into the above-mentioned new electricity sectors using each of power plant production in 2010 and the average electricity selling price from the state-owned electricity company. Second is to disaggregate the similar sectors at row side follows the same approach. Third is to aggregate the sectors into 46 sectors classification as base data used for the AIM/CGE model. Other statistical data used in disaggregation of electricity related sectors of the 2010 Indonesian IO table are 2010 financial statement of the state-owned electricity company (called as PLN in Bahasa), 2015 electricity statistics of PLN, and 2015 Indonesia mineral and coal information.

To single-out the consumption tax from the original 2010 Indonesian IO table, this study uses the private consumption tax data of Indonesia obtained from the GTAP 9 database. The private consumption tax data of the GTAP 9 database is available in percentage share and based on year 2011. This study assumes the tax percentage hasn't changed from base year 2010. Since the GTAP 9 database uses different sectors classification, the first step used in this study is to map the 57 sectors classification into 46 sectors classification. Second is this study aggregated the mapped sectors classification of the private domestic consumption tax of GTAP database to have the same sectors classification as 46 sectors of the 2010 Indonesian IO table used in this study. Third is calculates the values of consumption tax from the total consumption of the 2010 Indonesian IO table.

The third data used in this study is GHG emission data of Indonesia in base year 2010 (to have the same base year with the 2010 Indonesian IO table). This study uses the GHG emission data based on the inventory data published by the Ministry of Environment and Forestry of Indonesia. Other data is the emission factor data of energy sectors, which is based on the data from the Ministry of Energy and Mineral Resources of Indonesia and BPPT.

2.2 Model

This study uses the AIM/CGE [country] model of Indonesia developed by the National Institute for Environmental Studies (NIES), Japan. The AIM/CGE has been widely used for both mitigation and adaptation (Fujimori et al, 2014; Hasegawa et al, 2014; Fujimori et al, 2015; Siagian et al, 2016; Dai et al, 2017; Takakura et al, 2017). The AIM/CGE country model is based on neo-classical theory and a recursive dynamic model. The AIM/CGE [country] model presents the summary of the interlinkages of economic transactions among economic actors and sectors in Indonesia based on the 2010 Indonesian economic structure presented at the 2010 Indonesian IO table. The AIM/CGE [Indonesia] model assumes that production sector uses material, energy and non-energy sectors presented at the intermediate input transaction, capital and labor based on the Leontief function. The elasticity substitution between capital and labor is assumed using Cobb-Douglas function. Small country assumption is used for the international trade part under the AIM/CGE [Indonesia] model. Moreover, CES function is assumed for the share between domestic and imported goods. The more detailed explanation of the model framework of the AIM/CGE [country] model can be found at the previous study conducted by Boonpanya and Masui (2020).

3 Simulation scenarios

This study applies three types of simulation scenarios in this study to assess the impacts of the above-mentioned economic instruments imposed in waste sector in Indonesia. The first type of simulation scenario

assumes that consumption and production taxes of all plastic products, feed-in tariff for waste power plant and financial support for waste and recycling service sector in Indonesia increase by 5% compared to BAU. The second type of simulation scenario follows the first type of simulation scenario with percentage increase is by 10%. The third type of simulation scenario assumes the simultaneous application of 5% increase of consumption tax of all plastic products and 5% increase of financial support to be spent for waste and recycling service sector in Indonesia. The above-mentioned simulation scenarios are used as exogenous shocks in the AIM/CGE model (see table 1).

Table 1. Simulation scenarios used in this study

No	Exogenous shocks	SIM type 1	SIM type 2	SIM type 3
1.	Consumption tax of plastic products	5%	10%	5%
2.	Production tax of plastic products	5%	10%	NA
3.	Feed-in tariff for waste electricity power plant	5%	10%	NA
4.	Special financial support for waste and recycling service sector	5%	10%	5%

Source: Authors' compilation

4 Findings and discussion

The findings of all above-mentioned simulation scenarios show that although the GDP of several sectors will decrease, the total GDP under some simulation scenarios increase. Under the implementation of 10% increase of consumption tax on all plastic products will create the highest GDP surplus among other simulation scenarios. It will create the total GDP increase for approximately 0.009% (IDR 6 trillion) compared to its value under BAU. The implementation of 5% increase of consumption tax on all plastic products combined with 5% increase of special financial support budget from the national government on waste and recycling service sector will create the same GDP surplus as the implementation of 5% consumption tax on all plastic products alone. The total GDP increase is approximately 0.005% (IDR 3 trillion) compared to the values under BAU. The implementation of 5% of production tax on all plastic products will create the total GDP surplus for approximately 0.003% (IDR 2 trillion) compared to the GDP value under BAU. The total GDP surplus are not found under the implementation of remaining simulation scenarios such as 5% increase of feed-in tariff on waste-electricity power plant and 10% increase of special financial support for waste sector. This indicates that among the proposed simulation scenarios, the implementation of 10% increase of consumption tax on all plastic products and the combination between 5% of consumption tax on all plastic products and 5% special financial support budget on waste and recycling service sector would be the two priority policy options for the Indonesian government. However, the further analysis on its impacts on sectoral GDP would give more robust results and policy insights (see Figure 1).

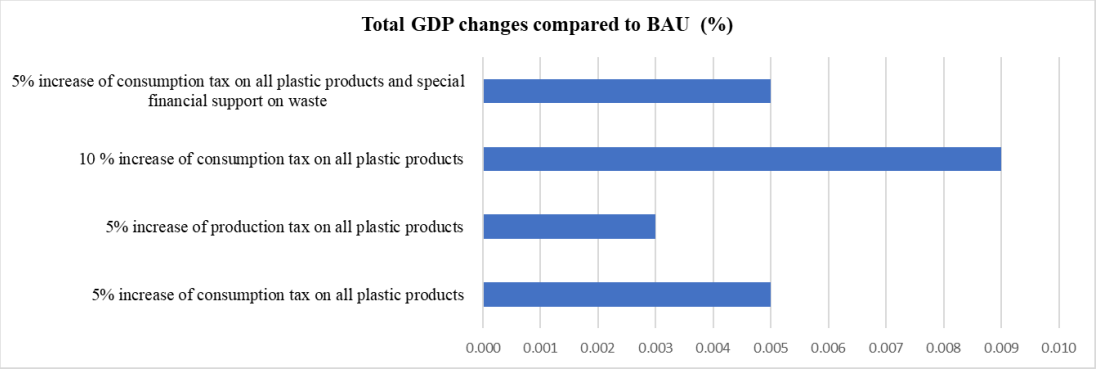

Figure 1. Total GDP changes compared to BAU (%)

Source: Authors' calculation

The findings on sectoral GDP changes show that the implementation of the above-mentioned simulation scenarios will create the GDP surplus and deficits in the relevant sectors. The findings of all above-mentioned simulation scenarios show that the most negatively affected sectors are specialty chemical products, other manufacture, and other crops sectors. The sectoral GDP of specialty chemical products and other manufacture will decrease for approximately -23% and 2% compared to BAU values respectively. The largest sectoral GDP decrease of specialty chemical products might be due to high dependency of plastic products on specialty chemical products in the production process. This is called as backward negative effect. The implementation of the above-mentioned simulation scenarios also show that the sectoral GDP of plastic products will decrease for approximately -0.6% under 10% increase of consumption tax on plastic products. However, the sectoral GDP of plastic product will be lower and has same value under the implementation of 5% consumption tax, 5% consumption tax combined with special financial support on waste sector, and 5% production tax on plastic products. Surprisingly, the findings also show that the sectoral GDP impacts of 5% increase of consumption tax without and with special financial support on waste are the same value. This indicates that probably the amount of 5% special financial support is not adequate to cover the GDP losses of some sectors.

However, the findings also show the most benefited sectors are public administration, education and research and coal mining sectors. These results are in line with the expected outcome of the selected policies that it will bring the additional government budget revenues. The large portion of the government budget revenue in Indonesia is spent on public administration and education and research sectors. The sectoral GDP increase of coal mining sector is probably due to increase consumption of coal mining from other substituted sector of plastic products such as paper product (see Figure 2).

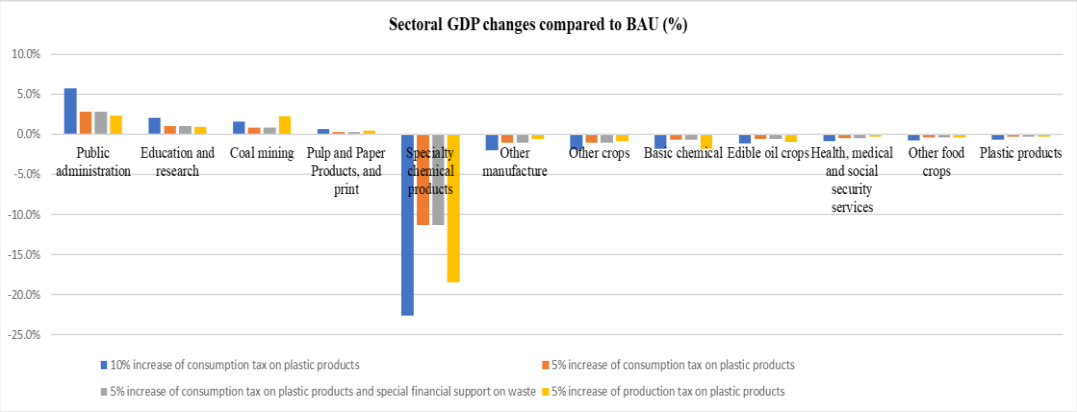

Fig 2. Sectoral GDP changes compared to BAU (%)

Source: Authors' calculation

5 Preliminary conclusion and policy recommendation

The findings show that the implementation of the above-mentioned policy simulation scenarios show that the implementation of 10% consumption tax on all plastic products causes the highest total GDP surplus compared to other simulation scenarios. However, it also causes the highest sectoral GDP losses of plastic products and specialty chemical products compared to other simulation scenarios. The implementation of 5% production tax on all plastic products causes smallest total GDP surplus compared to other simulation scenarios results. It also causes the same value of sectoral GDP losses with the implementation of 5% increase of consumption tax on all plastic products without and with special financial supports on waste sector. Moreover, the same results on total and sectoral GDP impacts are found under the implementation of 5% increase of consumption tax on all plastic products without and with special financial support on waste sector. This indicates two policy insights for the policy makers in Indonesia as follows. First is 5% increase of consumption tax on plastic product would be less cost and priority option for the Indonesian government. Second is the adequate amount of special financial support for waste sector can be combined

with the 5% increase of consumption tax on all plastic products wit the aim to reduce the negative sectoral GDP losses.