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The Pro-Climate Policy Carbon Tax, Is It Also Pro-Poor Policy?

(An analysis of the impact of the carbon tax policy on the provincial economy, unemployment rate, and poverty)

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Abstrak

The Indonesian government introduced a carbon tax on April 1st, 2022. For the first stage, a carbon tax of IDR 30 per kilogram of CO2 will be applied to the coal-fired Steam Power Plant (PLTU) using a cap-and-tax mechanism. This study analyzes the impact of carbon tax policies according to different economic structures. Which region and sector are most affected? Furthermore, what is the effect of the carbon tax policy on economic growth, the unemployment rate, and poverty? There is a potential carbon tax revenue of IDR 5,846 billion. However, due to the cap-and-tax scheme, this study only allocates a potential tax revenue of IDR 1,000 billion. This potential tax revenue will be injected into further simulations. The first simulation shows that West Papua, East Kalimantan, and South Sumatra are the most severely affected provinces. It is rational since the coal mining and coal processing industries dominate their economy. Provinces with significant agriculture shares, such as the Special Region of Yogyakarta, North Sumatra, and West Sumatra, are the least affected by the policy. Simulation II is done by reallocating carbon tax revenues to the agricultural sector. The result shows that, although GDP increased by IDR 1,299.41 billion (0.0084%), it is not enough to shift the economy back to its previous state. On the other hand, although the economy continues to contract, the unemployment rate has decreased. The carbon tax has put 5,116 people out of work, mainly workers in the mining and coal processing sectors, and therefore, the unemployment rate increased by 0.0039%. However, the reallocation of tax revenues to the agricultural sector creates 23,483 new jobs, bringing unemployment down by 0.0183%. Finally, although economic growth is still slightly declining (-0.0112%), unemployment, poverty, and inequality are improving.

Keywords: IRIO; Carbon Tax; poverty; climate; policy.

I. Introduction

Through the Law on the Harmonization of Tax Regulations, Indonesia will introduce a carbon tax on April 1st, 2022. In the first stage, a carbon tax will be applied to the coal-fired Steam Power Plant (PLTU) using a tax mechanism based on emission limits (cap and tax). A tariff of IDR 30 per kilogram of carbon dioxide ( ) equivalent will be applied to the emissions exceeding the set cap. In the implementation mechanism, taxpayers can take advantage of carbon certificates purchased on the carbon market to reduce their carbon tax. Implementing this carbon tax proves the Indonesian government's commitment to controlling climate change as a priority development agenda. Indonesia is one of the countries that will implement carbon tax first compared to other emerging economic powers, especially in the Asia Pacific region.

The main objective of imposing a carbon tax is to change the behavior of economic actors to switch to low-carbon green economic activities. Also, the carbon tax is in line with the government's efforts to achieve the target of reducing greenhouse gas emissions by 29% on its own and 41% with international support by 2030. In addition, the imposition of a carbon tax provides a solid signal to support carbon markets, technological innovation, and investment to be more efficient, low-carbon, and environmentally friendly. In addition, the revenues from carbon taxes can be used to fund sustainable development, invest in environmentally friendly technologies, or provide support to low-income communities through social programs.

1.1. Research Background

Apart from changing the behavior of economic actors to switch to low-carbon green economic activities, implementing a carbon tax in the electricity sector can also lead to higher electricity prices due to increased production costs. The purchasing power of the people, especially the lower class, is getting weaker due to the high prices of manufactured goods and services. Also, entrepreneurs need help to compete in the export market. This difficulty is due to electricity being widely used to operate factory production machines. Therefore, it will have an impact on the level of welfare. In addition, the increase in costs encourages entrepreneurs to reduce business expenses, one of which is labor, which can potentially increase unemployment and poverty. Therefore, to help poor households, the government has implemented various policies, including the electricity subsidy program for the poor. The subsidy program is expected to put the brakes on the spike in poverty due to rising electricity prices.

As one of the big countries in Asia and Pacific countries, Indonesia consists of 34 administrative regions (provinces) with diverse economic structures. Some provinces' economies rely on the primary sector, such as agriculture, plantations, livestock, or mining. Some provinces' economies are dominated by the industrial sector, while the services sector mainly supports other provinces' economies. The various economic structures of the provinces in Indonesia will undoubtedly have a different response if the carbon tax is applied to Indonesia. Therefore, the Indonesian and regional governments must identify the vulnerable economic sectors and prepare the right policy scenarios for each province to mitigate the impact of the carbon tax implementation.

1.2. Research Questions

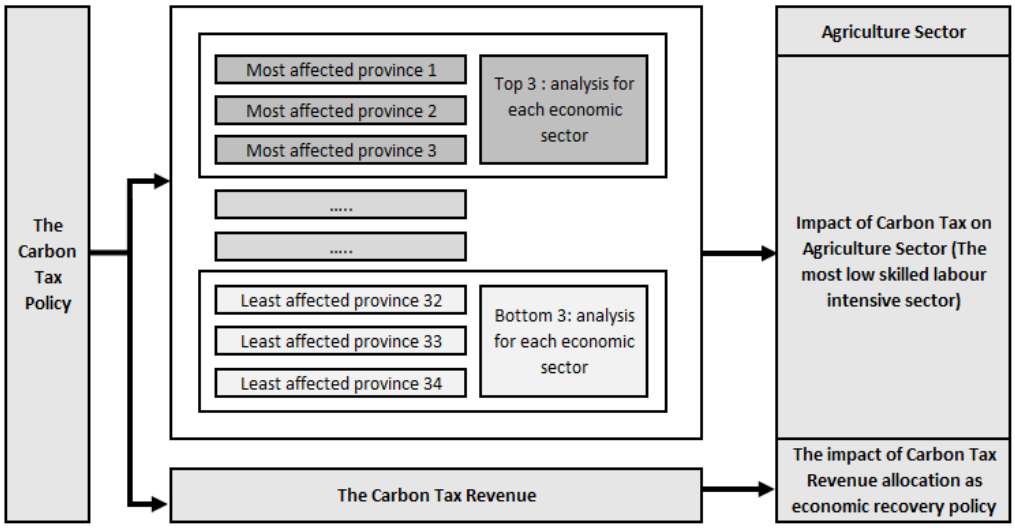
Based on the research background, this study aims to analyze the impact of carbon tax policy on the regional economy (provincial level) and national employment and poverty. For more detail, research questions include:

1. Identify which provinces in Indonesia are vulnerable (most affected) and the most resistant (least vulnerable) to carbon tax policies.

2. Analyze what causes one province's economy to be more vulnerable than another.
3. Identify how the carbon tax policy affects employment and poverty.
4. Identify which economic sectors are most affected by the carbon tax policy.
5. Identify the best policy simulation to restore the economy in the most affected sector.

1.3. Research Framework

According to many previous studies, the carbon tax could harm the country's economy. By using Inter-regional Input-Output, this research will further identify how provinces in Indonesia will respond to this policy. The three provinces with the most significant impact and the three provinces least affected are then compared to find out why the same policy causes different levels of severity in different provinces. In addition, a simulation of the reallocation of tax revenues will be carried out for the most affected economic sectors to determine the best recovery policy.



Picture 1. Research Framework

1.4. Literature Review

Each economic sector will respond differently to the carbon tax policy, where the carbon-intensive sector is relatively more sensitive than the low-carbon sector. It is because the carbon-intensive sector has a fairly high dependence on fossil fuels such as coal, oil, or gas. A study written in 2013 on the impact of carbon taxes on the energy sector in Ireland by Valeria in Cosmo and Marie Hyland divides the Irish economy into five sectors; residential, industrial, commercial, agricultural, and transport. As a result, each economic sector gives a different response. In addition, it was found that the industrial and commercial sectors experienced the fastest growth for the share of electricity in total energy demand. At the same time, oil remains an essential fuel in the residential and transport sectors. It is because these sectors are highly dependent on energy availability compared to other sectors. Also, a carbon tax of €41 per tonne of CO2 would lead to a 0.21 percent contraction in GDP. Where the spread of contraction occurs in these sectors is influenced by the structure of the economy.

Thomas Confrey, John FitzGerald, Laura Malaguzzi Valeri & Richard S. J. Tol 2008

conducted another study. The research entitled "The Impact of a Carbon Tax on Economic Growth and Carbon Dioxide Emissions in Ireland" analyzed the medium-term effects of a carbon tax on growth and CO2 emissions in Ireland. They find that most of the effect on the economy is due to changes in the competitiveness of the manufacturing and market services sectors. These results hold even if we allow changes in energy prices to have an enhanced (detrimental) effect on Ireland's competitiveness.

Khaerul Azis, Mohammad & Widodo, Tri (2019) conducted a study in Indonesia titled "The Impact of Carbon Tax on GDP and Environment." This study examines the impact of imposing carbon taxes to reduce greenhouse gas effects on eight energy and manufacturing sectors. As a result, by imposing a vehicle carbon tax of 5 percent, the GDP will decrease by 0.01 percent and effectively reduce carbon dioxide emissions by 0.06 percent. The difference between this research and mine is that, although both studies were conducted in Indonesia, this research focuses more on the impact of the carbon tax on the energy and energy-intensive manufacturing sectors. Meanwhile, this research examines the impact of the carbon tax on various regional economic structures in Indonesia.

II. Methods

2.1. Data Collecting

This research mainly uses the secondary data set from the Inter-Regional Input Output (IRIO) table. A more complete explanation is as follows:

1. The IRIO table is a table that contains the relationship between sectors in the form of input-output from one sector to another. It includes final requests in 17 sectors and 34 provinces. The linkages between these sectors will later be used as a policy impact simulation Gross Regional Domestic Product (GRDP) of 34 provinces in Indonesia 2020.
2. Economic structure (sectoral GRDP share) of 34 provinces in Indonesia 2020.
3. Gross Domestic Product (GDP) of Indonesia 2020.
4. Number of workers per economic sector and unemployment rate from the National Labour Force Survey (SAKERNAS) February 2020.

2.2. Method of Analysis

The IRIO Table Analysis is a general equilibrium approach and allows us to conduct inter-regional analysis. This method is used to analyze the impact of some scenario policies on economic sectors. IRIO is the development of the Input-Output (I-O) table, divided into 34 provincial I-O tables that are interconnected. Using the IRIO table, we calculate the accounting multiplier matrix. This matrix shows the endogenous change by Ma as a result of an exogenous account change by one unit. The equation can be written as:

$$T = A.\,T + X \quad (1)$$

$$T = (I\text{-}A)^{-1}X \quad (2)$$

$$T = Ma\ X \quad (3)$$

$$Ma = (I\text{-}A)^{-1}\text{: Accounting Multiplier} \quad (4)$$

The equation explains that the change in the exogenous account (X) will cause a change in the endogenous account (T) by $(I\text{-}A)^{-1}$. Accounting multiplier analysis shows the inter-relationship among economic sectors within a region as part of the economic analysis.

Tabel 1. Structure of the IRIO Table with 17 Sectors and 34 Provinces

			Intermediate demand								Final demand				Total Output
			Aceh (1)			...	Papua (34)				Aceh	...	Papua	Export	
			Sector 1	...	Sector 17	...	Sector 1	...	Sector 17						
Intermediate input	Aceh (1)	Sector 1	$X_{1,1}^{AA}$	...	$X_{1,17}^{AA}$	...	$X_{1,1}^{AP}$	...	$X_{1,17}^{AP}$		F_1^{AA}	...	F_1^{AP}	E_1^A	O_1^A
		...	...	...	...	...		...	...		...	...	...	...	...
		Sector 17	$X_{17,1}^{AA}$	...	$X_{17,17}^{AA}$	...	$X_{17,1}^{AP}$	...	$X_{17,17}^{AP}$		F_1^{AA}	...	F_1^{AP}	E_{17}^A	O_{17}^A
	...	...	...	...	...	...		...	...		...	...	...	...	...
	Papua (34)	Sector 1	$X_{1,1}^{PA}$		$X_{1,17}^{PA}$	...	$X_{1,1}^{PP}$	...	$X_{1,17}^{PP}$		F_{17}^{PA}	...	F_{17}^{PP}	E_1^P	O_1^P
		...	...	...	...	...		...	...		...	...	...	...	...
		Sector 17	$X_{17,1}^{PA}$	...	$X_{17,17}^{PA}$	...	$X_{17,1}^{PP}$	...	$X_{17,17}^{PP}$		F_{17}^{PA}	...	F_{17}^{PP}	E_{17}^P	O_{17}^P
Import			M_1^{IA}	...	M_{17}^{IA}	...	M_1^{IP}	...	M_{17}^{IP}		F^{IA}	...	F^{IP}		
Primary Input			I_1^{RA}	...	I_{17}^{RA}	...	I_1^{RP}	...	I_{17}^{RP}						
Total Input			T_1^{TA}	...	T_{17}^{TA}	...	T_1^{TP}	...	T_{17}^{TP}						

An exogenous shock can emerge with both direct and indirect effects. Indirect effects can, in turn, be separated into production and consumption linkages. Production linkages are determined by sectors' production technologies, which are contained in the input-output table. This research also analyzes the impact of the carbon tax on the economic sector and the unemployment rate. These two variables are used to analyze quality economic growth, one of which can create as many jobs as possible. The procedure is as follows:

Calculate the GRDP for each sector per worker using this formula:

$$\text{GRDPW}_{(i)} = \frac{GRDP_{(i)}}{NW_{(i)}} \tag{5}$$

$\text{GRDPW}_{(i)}$: GRDP per workers in sector (i)

$\text{GRDP}_{(i)}$: GRDP in sector (i)

$NW_{(i)}$: Number of workers in sector (i)

By linearity assumption, calculate additional workers (new jobs) using this formula:

$$AW_{(i)} = \frac{\Delta\ Produksi\ _{(i)}}{GRDPW_{(i)}} \quad (6)$$

AW(i) : Additional workers (new jobs) in sector (i)

Δ Produksi (i) : Additional production in sector (i)

GRDP/W(i) : GRDP per worker in sector (i)

The number of additional workers (new jobs) will directly reduce the unemployed. Therefore the unemployment rate will decline.

III. Result, Analysis, and Discussion

A carbon tax rate of IDR 30 Kg/CO2 will be simulated to determine the impact of implementing a carbon tax on the regional economy in 34 provinces in Indonesia. Therefore, in advance, it is estimated that the potential value of the carbon emissions (VCE) that the power plant must pay exceeds the limit. The first step, calculate the total energy produced by a coal-fired power plant (EPP):

EPP = CPP x CEF (7)

= 66.683.391,80 tons x 29.307,60 tons/megajoule

= 1.954.330.173.158 megajoule

= 1.954.330.173 terajoule

Where CPP : Total coal consumption for power plant (tons)

CEF : Coal energy factor (tons/megajoule)

Next step, calculate the total emission from coal-fired power plant (ECC):

ECC = EPP x CEF (8)

= 1.954.330.173 terajoule x 99,72 kilogram/terajoule

= 194.881.896.243 kilogram

Where CEF : Coal emission factor (kilogram/terajoule)

Finally, the value of carbon emission (VCE):

VCE = ECC x CTT (9)

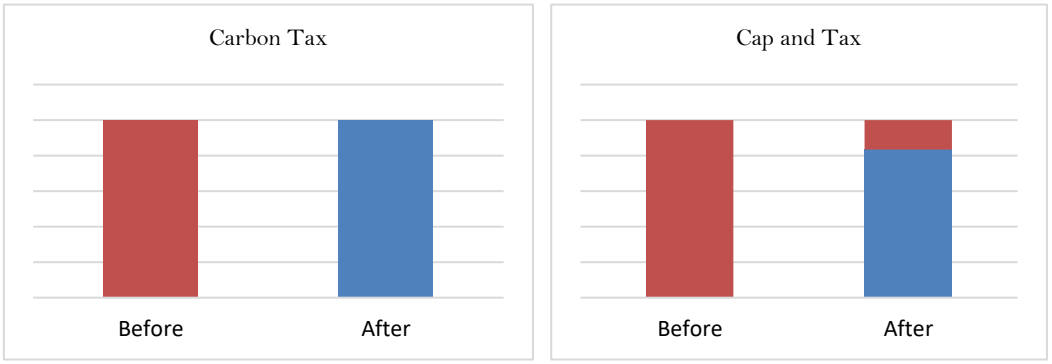
= 194.881.896.234 kilogram x IDR 30/kilogram

= IDR 5.846.456.887.285

= IDR 5.846 billions

Where CTT: Carbon tax tariff (IDR/kilogram)

Using the cap-and-tax scheme, not all carbon emissions will be taxed but only those exceeding the set limit (cap). As a result, a transaction of surplus and deficit carbon allocations from a power plant is possible. It can encourage PLTUs to innovate in order to reduce their carbon footprint.



Picture 2. Common Carbon Tax and Cap-and-Tax Scheme

In its implementation, the carbon tax in Indonesia will use three kinds of emission limits (caps), namely:

1. Power plant with a capacity above 400 MW: the emission limit value (cap) is set at 0.918 tons of CO2 per megawatt-hour (MWh).
2. The power plant has a 100–400 MW capacity with an emission limit value of 1,013 tons of CO2 per MWh.
3. Power Plant: 100–400 MW, with a cap value of 1.94 tons of CO2 per MWh.

Therefore, it is estimated that, of IDR 5.864 billion, only IDR 1.000 billion is subject to the carbon tax. Implementing the carbon tax will cause a decrease in electricity demand at the power plant by IDR 1,000 billion, equivalent to carbon tax revenue. This decline in demand of IDR 1,000 billion is used as a shock that will later be injected into the Indonesian economic system and distributed proportionally according to the GRDP value of each province.

From table 2, the most affected province by the implementation of the carbon tax is West Papua Province. If there is a decrease in electricity demand of IDR 2.5 billion, electricity production will decrease by IDR 5.3 billion. The elasticity of the carbon tax to total GDP is 13.49. It means that if electricity demand decreases by one currency unit due to the carbon tax policy, it will reduce the total GDP by 13.49 currency units. There will be a contraction of GDRP by IDR 33.76 billion.

West Papua Province becomes the most affected province because 43 % of GRDP comes from the coal processing and mining industry sector. Moreover, 90% of the manufacturing industry in this region is the coal industry and oil and gas refineries. It is because this industry is a carbon-intensive industry. As a result, this province is heavily reliant on coal, and the price of its processed products is high. Therefore, the carbon tax policy on coal-fired power plants will affect the economy of this province.

Tabel 2. The Impact of the Carbon Tax Shock (Simulation 1)

Rank	Province	Shock	Impact		Elasticity
			Electricity	Total	
(1)	(2)	(3)	(4)	(5)	(7)
The most affected provinces:					
1	Papua Barat	-2,50	-5,30	-33,76	13,49
2	Kalimantan Timur	-21,49	-42,06	-243,86	11,34
3	Sumatera Selatan	-34,00	-78,55	-271,27	7,97
The least affected provinces:					
32	Sumatera Barat	-14,04	-22,36	-27,62	1,96
33	Sumatera Utara	-36,05	-52,94	-67,20	1,86
34	Yogyakarta	-11,20	-16,55	-19,74	1,76
Others:					
16	Jakarta (Capital city)	-155,15	-302,94	-419,88	2,70
-	Average	-27,38	-53,75	-71,10	2,59

Source: IRIO Table, BPS – Statistics Indonesia

The second place is East Kalimantan province. This province is also quite dependent on coal. East Kalimantan's economy is dominated by the mining and quarrying sector by 45.05%, of which coal accounts for 76.01% of the total mining sector. The contribution of the East Kalimantan processing industry is also significant at 17.81%, where the coal processing industry and oil and gas refineries account for 56.35% of the total manufacturing sector in East Kalimantan. The province's dependence on coal causes its GRDP's elasticity to the carbon tax to remain very high, where every decrease in electricity demand due to the carbon tax by one currency unit will cause a decrease in GRDP by 11.34 currency units.

The third position as province most affected by the carbon tax policy is South Sumatra. Similar to the last two provinces, this one also depends on coal. The economy of South Sumatra is dominated by the mining and quarrying sector, which is 18.49%. Coal mining accounts for 29.47% of the total. The manufacturing sector accounts for 19.92%, and the coal processing industry and oil and gas refineries occupy the second-largest share in South Sumatra at 19.46% of the total processing industry in South Sumatra. The province's dependence on coal is relatively high, causing the province to be affected if the government implements a carbon tax. It can be seen from the elasticity level of the province's GRDP and the carbon tax of 7.79 that every decrease in electricity demand due to the carbon tax of 1 currency unit will cause a decrease in GRDP of 7.79 currency units.

Tabel 3. Economic Structure of Provinces in Indonesia 2021

Economic sector	Provinces						
	WP	EK	SS	SRY	NS	WS	CJ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Agriculture, Forestry & Fishing	10.98	8.48	15.12	10.19	21.33	22.38	0.08
Mining & Quarrying	17.69	45.05	18.92	0.49	1.28	4.27	0.16
Manufacturing	25.31	17.81	19.46	12.83	19.29	8.64	11.37
Electricity & Gas	0.06	0.06	0.15	0.14	0.11	0.10	0.33
Water supply, Sewerage, Waste Management & Remediation	0.11	0.05	0.12	0.10	0.10	0.09	0.03
Construction	14.80	8.95	12.00	9.63	13.59	10.19	11.27
Wholesales & Retail Trade	7.98	5.97	13.52	8.41	18.88	15.76	16.62
Transportation & Storage	2.56	3.34	2.14	4.57	4.48	10.44	3.49
Accommodation & Food Services	0.69	0.96	1.83	8.84	2.18	1.24	4.19
Information & Communication	2.00	1.46	3.22	9.72	2.28	6.44	9.41
Financial & Insurance	1.83	1.62	2.39	4.03	2.90	3.04	11.27
Real Estate	1.38	0.84	3.31	7.39	5.27	2.06	6.31
Business Activities	0.11	0.20	0.13	0.90	1.07	0.44	8.84
Public Administration, Defense & Social Security	10.88	1.90	2.79	8.44	3.73	6.71	5.30
Education	2.53	1.78	2.39	8.87	1.90	4.70	5.24
Health Service & Social Activities	0.96	0.89	0.71	3.18	1.03	1.62	2.12
Other Services	0.32	0.65	0.80	2.27	0.57	1.88	3.95
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: GDP Indonesia 2021, BPS – Statistics Indonesia

The provinces that were least affected included, among others, Yogyakarta Province, North Sumatra, and West Sumatra. In general, the economy of these provinces is still dominated

by the agricultural sector. From table 3, the economy of the Special Region of Yogyakarta is dominated by the industrial and agricultural sectors, which are 12.83% and 10.19%, respectively. The manufacturing sector in the Special Region of Yogyakarta is dominated by the food and beverage industry by 56.74%. Meanwhile, there is no coal processing and oil refining industry. In North Sumatra Province, the most significant economic sector is agriculture at 21.33%, followed by the manufacturing industry at 19.29%, which is dominated by the food and beverage subsector at 73.40%. Furthermore, there is no coal processing industry. Meanwhile, in West Sumatra Province, 22.38% of its economy is dominated by agriculture. The wholesale and retail sector holds the second position with 15.76%. Of course, these two sectors do not require significant coal inputs.

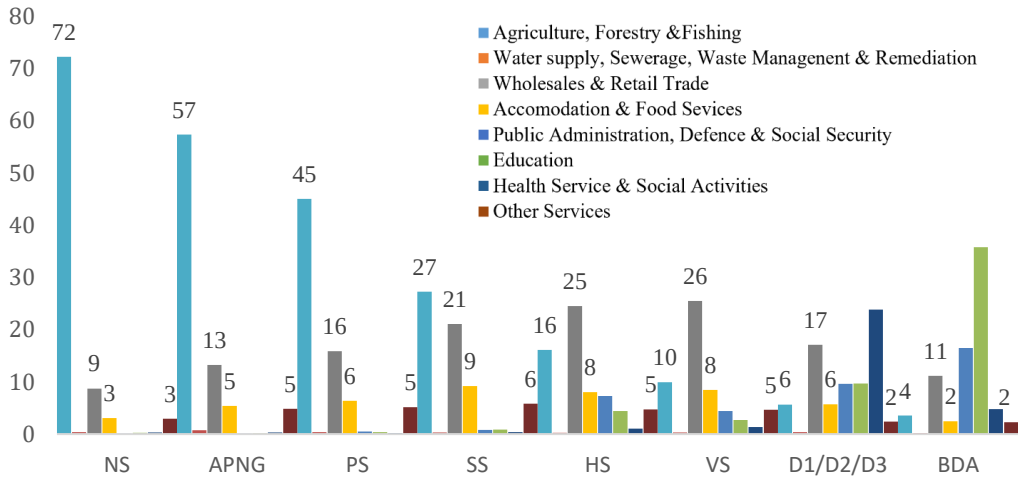
Tabel 4. Economic Structure of Provinces in Indonesia 2021

Economic sector	Percentage		Productivity
	GDP	Total labour	
(1)	(2)	(3)	(4)
Agriculture, Forestry & Fishing	2.115.086.100	38.224.371	55,33
Mining & Quarrying	993.541.900	1.352.236	734,74
Manufacturing	3.068.041.700	17.482.849	175,49
Electricity & Gas	179.741.600	303.551	592,13
Water supply, Sewerage, Waste Management & Remediation	11.302.800	490.984	23,02
Construction	1.652.659.600	8.066.497	204,88
Wholesales & Retail Trade	1.995.470.100	24.702.695	80,78
Transportation & Storage	689.700.700	5.591.941	123,34
Accommodation & Food Services	394.230.900	8.543.794	46,14
Information & Communication	695.839.100	933.273	745,59
Financial & Insurance	696.065.500	1.557.927	446,79
Real Estate	453.780.900	393.665	1.152,71
Business Activities	294.255.500	1.796.755	163,77
Public Administration, Defense & Social Security	580.175.200	5.031.438	115,31
Education	549.396.500	6.028.610	91,13
Health Service & Social Activities	201.149.000	2.005.522	100,30
Other Services	302.568.200	6.409.568	47,21
Total	14.873.005.300	128.454.184	115,78
Total	14.873.005.300	128.454.184	115,78

Source: Labour force survey (Sakernas), BPS – Statistics Indonesia

Therefore, the decline in electricity demand due to the carbon tax policy does not significantly affect the economy in the Special Region of Yogyakarta, North Sumatra, and West Sumatra provinces. It is indicated by the low total elasticity of these three provinces (table 2). Although the elasticities are still more than one, these values are the smallest among other provinces in Indonesia. For example, the total elasticity value of the Special Region of Yogyakarta is 1.76, which means that if due to the carbon tax implementation, electricity demand decreases by IDR 1, GRDP will be contracted by IDR 1.76.

Table 4 shows eight sectors whose productivity is below the average. This low productivity could be an early signal that this sector is labor-intensive. The next step is identifying which sector absorbs more labor from poor households. Picture 2 depicts the percentage of workers in the labor-intensive sector by education level. It can be seen that the agricultural sector significantly absorbs the most workers with low levels of education where this type of worker is identical to the poor. It is also confirmed by a pattern where the higher the level of education, the fewer people who work in the agriculture sector.



Picture 3. Sectoral Labour Per Education Level

Sumber: Labor force survey (Sakernas), BPS – Statistics Indonesia

Note : NS = Not attending school
APNG = Attending primary school but graduated
PS = Primary school
SS = Secondary school
HS = High school
VS = Vocational school
D1/D2/D3 = Certified pre-college from 1-3 years
BDA = Bachelor degree and above

Simulation II is carried out to analyze the impact of the carbon tax revenue being reallocated to the agricultural sector, which absorbs many poor people. Implementing a carbon tax on coal-fired power plants will likely cause electricity demand to decline. Therefore, a simulation is carried out by giving a shock in the form of a decrease in electricity demand worth IDR 1,000 billion. As a result, in Table 5, electricity production decreased by IDR 1,978.05 billion, and total GDP was contracted by IDR 3,029.57 billion, or 0.0196 percent of GDP. In addition, 5,116 people lost their jobs, which increased the unemployment rate by 0.0039%.

Tabel 4. Economic Structure of Provinces in Indonesia 2021

Policy	Shock (billion)	Sectoral Impact (billion)	Total Impact (billion)	Job creation (Unemployment rate)
(1)	(2)	(3)	(4)	(5)
Carbon Tax (Electricity)	-1.000,00	-1.978,05	-3.029,57 (0,0196% of GDP)	-5.116 0,0039%
Tax Revenue (Agriculture)	1.000,00	1.083,66	1.299,41 (0,0084% of GDP)	23.483 -0,0183%
Difference	-	-894,39	-1.730,16 (0,0112% of GDP)	18.367 0,0144%

Source: Labour force survey (Sakernas), BPS – Statistics Indonesia

Also, from Table 5, agriculture production increased by IDR 1,083.66 billion. GDP increased by IDR 1,299.41 billion, or 0.0084% of GDP. Furthermore, 23,483 new jobs decreased the unemployment rate by 0.0183%. However, this increase is still much smaller than the production decrease due to the carbon tax policy. There is still a difference of IDR 1,730.16 billion, equal to 0.0112% of GDP. Even though the economy continues to contract, the unemployment rate has decreased. The carbon tax has put 5,116 people out of work, mainly workers in the mining and coal processing sectors. Therefore, the unemployment rate increased by 0.0039%. However, the reallocation of tax revenues to the agricultural sector creates 23,483 new jobs, bringing unemployment down by 0.0183%. It is because the agricultural sector is one of the most labor-intensive sectors and absorbs most labor from the poor. Finally, economic growth is still slightly declining (-0.0112%), and unemployment, poverty, and inequality can improve.

IV. Conclusion and Recomendation

The conclusion and recommendation of the analysis of various economic structures at the provincial level in Indonesia can be summarized as follows:

1. A region whose economy is dominated by the coal mining sector and the coal processing industry is vulnerable to the application of the carbon tax policy on coal-fired power plants. Therefore, it is recommended that the government should pay attention to the possibility of increasing poor households in this sector, especially those of lower-level workers. Furthermore, a region whose economy is dominated by agriculture or other non-carbon-intensive sectors is resistant to the effects of implementing carbon tax policies. A region whose economic sector is dominated by the manufacturing sector (non-coal) or the service sector that uses significant electricity inputs is quite vulnerable to the impact of the carbon tax.
2. Carbon taxes lead to economic contraction and slow down the regional economy. In simulations I and II, the results show that the economy continues to slow down even though tax revenues have been reallocated to the agricultural sector. It, of course, returned to the government's priorities. If the government wants to curb poverty, it is recommended to reallocate tax revenues to the agricultural sector. However, if you

want to maintain high economic growth, it is recommended that the government reallocates tax revenue to sectors with a high multiplier effect.

3. In contrast to economic growth, unemployment, and poverty rates have decreased after the reallocation of tax revenues to sectors. The agricultural sector is labor-intensive and absorbs labor from people with low incomes. Therefore, inequality also tends to decrease. Therefore, it is recommended that the determination of the tax reallocation recipient sector must follow national development priorities.

References

BPS-Statistics Indonesia. (2021). Interregional Input-Output (IRIO) Table Indonesia 2021. Retrieved from https://www.bps.go.id

BPS-Statistics Indonesia Regional Office in Special Region of Yogyakarta. (2021). Jumlah pekerja usia 15-64 tahun per sektor ekonomi. Retrieved from https://www.bps.go.id

BPS-Statistics Indonesia Regional Office in Special Region of Yogyakarta. (2022). Produk Domestik Regional Bruto Indonesia Menurut Lapangan Usaha 2017-2021. Jakarta: BPS Republik Indonesia.

BPS-Statistics Indonesia Regional Office in West Papua. (2022). Produk Domestik Regional Bruto Indonesia Menurut Lapangan Usaha 2017-2021. Jakarta: BPS Republik Indonesia.

BPS-Statistics Indonesia Regional Office in South Sumatra. (2022). Produk Domestik Regional Bruto Indonesia Menurut Lapangan Usaha 2017-2021. Jakarta: BPS Republik Indonesia.

BPS-Statistics Indonesia Regional Office in East Kalimantan. (2022). Produk Domestik Regional Bruto Indonesia Menurut Lapangan Usaha 2017-2021. Jakarta: BPS Republik Indonesia.

di Cosmo, Valeria and Hyland, Marie, (2013). Carbon Tax Scenarios and their Effects on the Irish Energy Sector. Papers RB2013/2/7, Economic and Social Research Institute (ESRI)

Sutisna, Irwan. (2018) The Impact of Fossil Fuel Subsidy Removal on Economic Sector and Income Distribution. Master thesis at University Ca Foscari Venice Italy. Available on http://dspace.unive.it/bitstream/ handle/10579/13432/870896-1236356.pdf?sequence=2

Sutisna, Irwan (2021). Accelerating Post-COVID 19 Economic Growth: What is the Best Economic Recovery Policy? Presented on Regional Development Seminar of BAPPEDA D.I. Yogyakarta. Available on http://bappeda.jogjaprov.go.id/dataku/publikasi/detail/39-seminar-pembangunan-daerah-bappeda-diy-2021

Thomas Conefrey & John FitzGerald & Laura Malaguzzi Valeri & Richard S. J. Tol. (2008). The Impact of a Carbon Tax on Economic Growth and Carbon Dioxide Emissions in Ireland, Papers WP251, Economic and Social Research Institute (ESRI).

Khaerul Azis, Mohammad & Widodo, Tri, (2019). The Impact of Carbon Tax on GDP and Environment. MPRA Paper 91314, University Library of Munich, Germany.