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ASSESSMENT OF TRAIN'S COAL AND PETROLEUM EXCISE TAXES

Environmental Benefits and Impacts on Sectoral Employment and Household Welfare[1]

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ABSTRACT

This study assessed the impact of the first package of the Tax Reform for Acceleration and Inclusion (or TRAIN) Law, which includes an increase in petroleum and coal excise taxes, as passed by Congress in 2017. This study reviewed the context of the energy sector in the country given that petroleum and coal are the largest sources of energy in the country. Using a computable general equilibrium-microsimulation model, it mainly assessed the impact of this increase and of the whole TRAIN 1 package (which includes a reduction in the personal income tax and the broadening of the value added tax). The results from the simulations show that there is a slight adverse output effect for most industries under an increase in petroleum and coal taxes scenario, resulting in a lower level of carbon emissions. There is a slight decline

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in employment, and poverty incidence increased slightly as excise taxes have an adverse effect in terms of higher commodities prices among the poor.

KEYWORDS

tax reform; computable general equilibrium; microsimulation; excise tax; coal; petroleum

1. INTRODUCTION

In 2016, the Philippine government launched a series of tax reform schemes designed to broaden the base for revenue collection and increase public revenues to fund critical infrastructure projects and social services. Dubbed as the Tax Reform for Acceleration and Inclusion (TRAIN) Law, the tax proposals not only involve changes in tax rates across various government revenue sources but also aim to improve tax administration by mandating the use of electronic invoices and receipts as well as real-time sales reporting, among others.

The tax reform proposals were originally aimed to be undertaken through six packages which then evolved into the current four-package Comprehensive Tax Reform Program (CTRP). The first package—signed into law in December 2017 as Republic Act 10963 and now called the TRAIN Law—covers changes in personal income tax rates, the restructuring of the estate and donors' taxes, the broadening of the value added tax (VAT), and staggered increases in taxes on petroleum, sugar sweetened beverages, and motor vehicles. Of special concern to many, however, were the so-called carbon taxes included in the first package. The TRAIN Law 1) imposes excise taxes on diesel, fuel oil, liquid petroleum gas, and kerosene as well as upward adjustments on other types of fuel, including premium and regular gasoline, aviation fuel, and other types of gasoline, with yearly increases starting in January 2018 until 2020, and 2) mandates a PHP 50 (USD 1.10)[2] per metric ton excise tax on domestic or imported coal and coke in January 2018, PHP 100 (USD 2.20) per metric ton in January 2019, and PHP 150 (USD 3.30) per metric ton in January 2020. Before 2018, the tax imposed on coal and coke was PHP 10.00 (USD 0.22) per metric ton.

[2]All conversions to USD are based on exchange rates as of March 2021.

The tax was imposed at a time when the economy was enjoying rapid growth. As energy is an integral part of economic activities, fuel consumption inevitably increases as the economy grows. Over the last 45 years, total energy consumption had been increasing by an average of 2.4% per year, from 15 million tons of oil equivalent (MTOE) in 1970 to 43 MTOE in 2015.[3] Consequently, the Philippines's greenhouse gas (GHG) emissions also increased. In 1970, economic activities emitted 24.8 metric tons of CO_2 equivalent (mtCO_2e); by 2014, emission levels had reached 406.9 mtCO_2e, which is equivalent to an annual growth rate of 6.6%. Meanwhile, the Department of Energy (DOE, 2017) projects the energy use of the country to grow by 4.2% per year until 2030, when the country's total final energy consumption—excluding the consumption of the energy sector itself, losses during transformation (for example, from oil or gas into electricity), and the distribution of energy for non-energy purposes—will grow from 29.8 MTOE in 2015 to around 54.9 MTOE in 2030. Without substantial changes in the energy mix, increases in the consumption of fossil fuels will lead to increases in carbon emissions. Unless the tax reform succeeds in reducing GHG emissions significantly, the country is poised to miss its Intended Nationally Determined Contributions (INDC) commitments.

Taxes that regulate the consumption or production of certain commodities correct market failures. The increase in carbon taxes was an attempt to limit anthropogenic carbon emissions. In developing countries like the Philippines whose domestic industries rely heavily on fossil fuels, such tax policy reforms are a bold step toward low-carbon development. However, these may undermine growth.

Carbon taxes create a trade-off between growth and emissions. However, growth and emissions are only among some of the considerations in evaluating the soundness of tax policy. A full assessment of the economic impacts of tax reform would require a comprehensive approach. Thus, macroeconomy-wide models like computable general equilibrium (CGE) can be useful for analyzing the impacts of carbon taxes not only on economic growth and emissions but also on other socio-economic variables such prices, incomes, and household welfare.

This paper aims to evaluate the impacts of changes in carbon taxes as indicated in the TRAIN law by examining the macroeconomic impacts of carbon taxes using a CGE model, computing the impacts on household income and poverty through

[3]Based on data from the *Philippine Statistical Yearbook* (various years; Philippine Statistics Authority, n.d.).

microsimulation, and estimating changes in sectoral GHG emissions levels using output-emission ratios.

The paper is organized as follows: Section 2 discusses literature while Section 3 presents the methodology. Section 4 discusses the data and simulation scenarios used. Section 5 presents the simulation results. Section 6 discusses the implications of the results for government, business, and households.

2. THEORETICAL AND EMPIRICAL METHODOLOGY FOR ASSESSING COAL AND PETROLEUM TAX IMPACTS

In most cases of domestic price surges, the source of a fuel price hike is the increase in world prices that is transmitted to prices in domestic markets (Arndt, Benfica, Maximiano, Nucifora, & Thurlow, 2008). This is due to the fact that fuel products are usually imported commodities in developing countries. Owing to interindustry linkages, higher fuel prices are then transmitted to other sectors and end up influencing the prices in food and transport markets. Hence, fuel prices can also have substantial impacts on the poverty situation of the country owing to the network effects of the fuel industry. Furthermore, the discussion can then be extended to understanding who among the vulnerable sectors become most affected due to such fuel price surges.

2.1. Impacts on the Economy

It goes without saying that most industries depend on coal and petroleum for power generation and transportation fuel. Historical trends, however, show that fuel prices have been increasing over the past decades as a result of the growing global economy. Unfortunately, oil and gas rigs and refineries do not have the capacity to keep up with the growth in energy consumption (Van der Heijden & Tsedu, 2008).

Such a scenario of increasing fuel prices may thereby constrain the growth of manufacturing in the country. In the case of South Africa, Van der Heijden and Tsedu (2008) explain that the negative impacts of high fuel prices are substantial due to the country’s reliance on roads for transporting goods as well as people. Furthermore, the authors then remind us that the economic constraints associated with increasing fuel prices seem to fall on the micro and small enterprises (MSEs) that are without access to efficient logistics systems or even to just larger trucks. Instead, they are forced to contend with the available transport for hire.

Empirical studies from different countries, however, have failed to conclude that fuel price increases influence prices in other sectors. Chapa and Ortega (2017) used a SAM (Social Accounting Matrix)-based price model in Mexico to assess the impacts of carbon taxes on production cost, consumer prices, household consumption, and government revenue. The carbon tax had a direct impact on sectors like coke, refined petroleum, and nuclear fuel as these sectors showed the highest price increases. Furthermore, large indirect impacts on air and inland transport were found given that transportation sectors consume fuel.

In the U.S., the same conclusion was reached by Baumeister and Kilian (2013). Using a structural econometric framework, the authors report that there seems to be no evidence that higher corn ethanol prices led to higher prices in agricultural markets in the U.S. Rather, both markets are simply affected by the same macroeconomic determinants. Furthermore, there is also no evidence that higher fuel prices lead to higher costs along the value chain which in turn lead to higher retail food prices.

2.2 Impacts on Vulnerable Sectors

In the case of households, higher energy prices cause production costs to increase, pushing the prices of fossil fuel-intensive goods such as manufactured goods and transportation services to spike up. This also leads to higher costs in purchasing fuel, which is approximately 10% of total household consumption (Baker, 2008). According to Reyes, Sobrevinas, Bancolita, & de Jesus (2009), the impacts of higher fuel prices have two components: 1) the direct effect of higher prices of petroleum products consumed by households and 2) the indirect effect on the prices of other goods and services consumed by the household that use fuel as an intermediate input. Hence, increasing fuel prices also affects household groups in varying ways.

In the Philippines, Reyes et al. (2009) analyzed the impacts of price surges caused by the 2008 global financial crisis. Focusing on the demand side given that most households in the Philippines are consumers rather than producers, a nonparametric analysis of fuel consumption patterns across different groups of households was used to analyze the impact of fuel price increases.

Using data collected from the Family Income and Expenditure Survey (FIES; Philippine Statistics Authority, 2017b), the study observed that poorer households tend to have higher expenditures for fuel as compared to richer households. In terms of the vulnerability of sectors to fuel price changes, agriculture-related industries made it to the list, where the prices of pesticides/insecticides and fertilizer are expected to increase by about 6% and 4.9%, respectively, because of the fuel price increase. Based on the study's estimation, the fuel price increase would push total household spending up by 5.2%, resulting in a higher poverty threshold of 15,840 Philippine pesos per capita per year.

During the same period, Son (2008) checked whether inflation has hurt the poor. Using the price elasticity for the headcount ratio to predict the additional number of people who would be forced into poverty because of a 10% increase in the price of fuel, the study concluded that the increase in fuel prices would result in an additional 0.16 million poor people.

	Price elasticity with respect to				Additional number of poor due to 10 percent increase in price (in millions)
Expenditure Item	Average standard of living	Headcount	Poverty gap ratio	Severity of poverty	
Rice	-0.08	0.32	0.51	0.62	0.66
Fuel	-0.02	0.08	0.13	0.16	0.16
Transport and communication	-0.08	0.07	0.09	0.1	0.15

Table 1: Poverty impacts of changes in rice, fuel and transportation prices (Son, 2008)

2.3 Impacts on Environment

Fernandez (2018) mentioned that a tax increase on coal aims to slash the carbon emissions of the Philippines. She also mentioned that the Climate and Energy Program of the World Wildlife Fund (WWF)-Philippines stated that the passage of a coal tax hike is necessary to help protect the people and environment against the devastating impacts of coal consumption. La Viña (2017) added that an increase in the coal tax in the Philippines would allow the country to transition from coal to a cleaner, cheaper, and more sustainable energy system that is good for the environment. He also added that coal-fired power plants cannot function without using more natural resources (e.g., water) to operate their turbines and cool their thermoelectric plants. Mayuga (2017) quoted Renato Constantino, executive director of the Institute for Climate and Sustainable Cities, in saying that the carbon tax approach will help the country achieve its Conference of Parties (COP) 21 commitment, which is to reduce the country's carbon emissions by 70% between 2020 to 2030.

Shi, Tang, & Yu (2015) used a CGE model to understand the environmental effects of coal resource tax reform in China. The environmental influence of the coal resource tax reform would decrease total carbon emissions which could effectively improve China's environment. Dong et al. (2017) used a 30-Chinese province CGE model to conduct provincial evaluations of a carbon tax. They mentioned that a carbon tax can effectively reduce industrial carbon emissions after 2020 given the increase in the carbon price. Lin and Jia (2018) mentioned that while a medium carbon tax rate that meets a reasonable carbon tax coverage of industry would allow China to achieve certain emission reduction effects, the emission reduction effect would be very significant with a high carbon tax rate.

3. METHODOLOGY FOR ANALYSIS

The assessment of the impact of excise tax changes in the Philippines is undertaken using a CGE model. Such an approach has become useful in analyzing the economy-wide effects of policies like tax reforms because it can trace the reverberations of a policy shock throughout the economy. For instance, an increase in taxes on consumer goods may raise the prices of goods for households and reduce the demand for these goods depending on the price elasticity of demand. Changes in demand for goods and services would then have effects on firm production and also on the demand of firms for factors. On one hand, in the neoclassical sense, changes in wage rates affect employment and household incomes, which further affects the demand for goods; on the other, changes in returns to capital affect investment decisions.

3.1. Computable General Equilibrium Framework

In developing the CGE model for the current study, a standard Walrasian CGE model described in Rutherford (1999) was utilized. In this framework, consumer and firm behaviors are explicitly modeled: firms maximize their profits subject to their production function, consumers maximize their utility constrained by their income from labor and capital,[4] and supply equals demand in all markets. The levels of demand, supply, and prices settle to an equilibrium. The resource and economic transaction flows are illustrated in Figure 1. A shock perturbs the economy and brings markets to a new equilibrium.

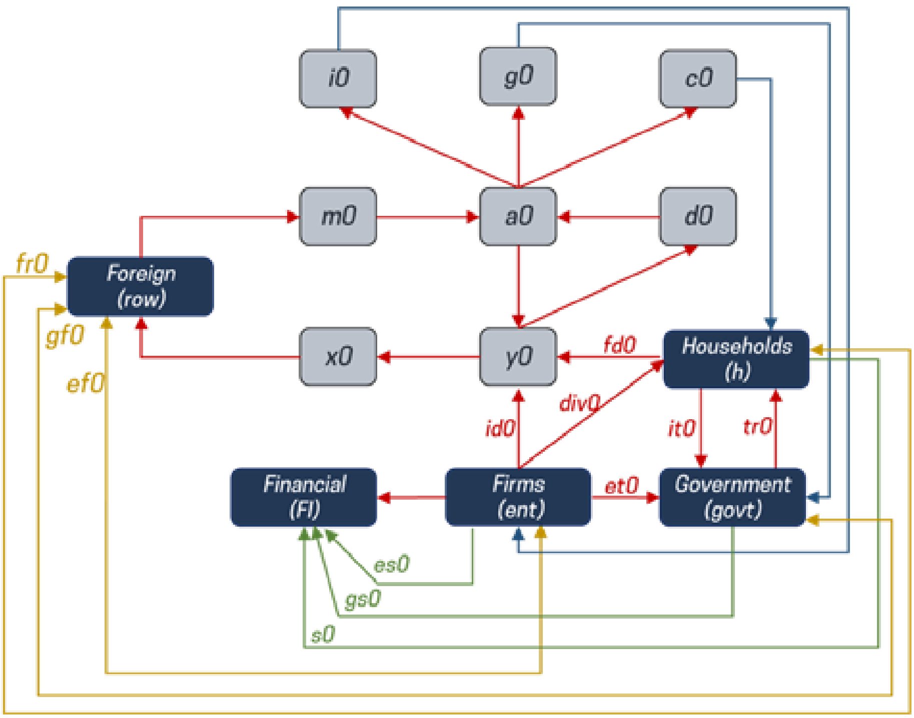

Figure 1: Economic flows in a computable general equilibrium model (modified from Markusen & Rutherford, 2004)

3.2. CGE Model for Coal and Petroleum Excise Taxes

The CGE model for the current study contains 44 production sectors, of which eight are agricultural activities, 20 are manufacturing/industrial activities, and eight are in services. In addition, there are seven other sectors that are utilized to specific types of energy sources specified in this model that, in turn, are utilized to create an “energy-composite”; these energy sources include coal, gas, hydroelectric, wind,

[4]Capital refers to buildings, durable equipment, breeding stocks and orchards, intellectual property products, and inventories.

oil, solar, and other electricity sources. There is also the electricity transmission sector, which provides the spread for the sources of energy in the composite sector. In addition, there are three production factors (skilled labor, unskilled labor, and capital), ten households (representing the ten income deciles), and several institutions (representing government, firms/enterprises, savings-investment, and the rest of the world). The data utilized for numerically specifying the economic stocks and flows of each of these sectors and institutions are specified in the succeeding section.

The production and consumption structure may be defined by showing the linkages between sectors and the elasticity of substitution in consumption and production; an illustration showing the nesting structure for production is shown in Figure 2. Furthermore, in order to feature the linkages in the energy sector, including the substitution of the different sources of energy (i.e., coal, hydroelectric, and geothermal), the CGE model in this study utilizes an "energy- composite" as the ability of firms to shift between the different sources of energy.

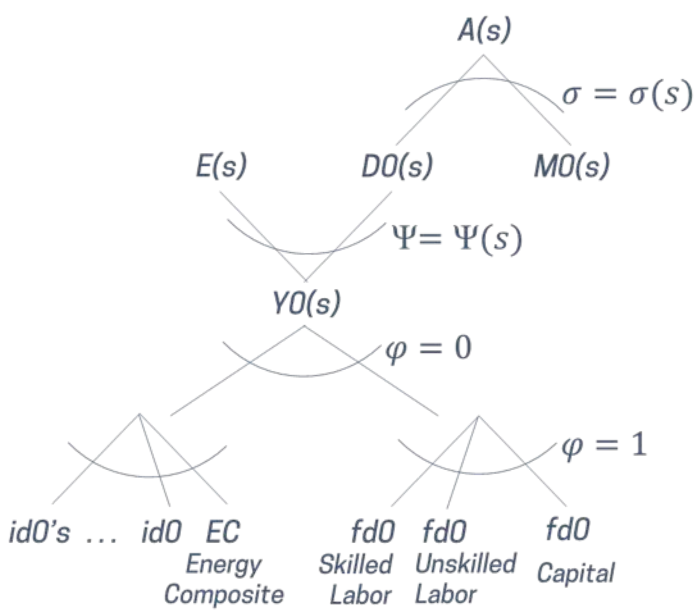

Figure 2: Production Nesting Structure of the Model (authors' illustration)

The use of this function simplifies the modelling system, which is based on the Mathematical Programming System for General Equilibrium

(MPSGE) (Rutherford, 1999). The price and quantity, marginal rate of substitution, and convexity of these functions characterize the production and consumption functions utilized in this system. This implies that the data requirements would be the share and elasticity parameters for all the consumers and production sectors.

3.3. Modeling Philippine Excise Taxes and other Taxes in the TRAIN

In a general equilibrium model, taxes are typically specified in an ad valorem manner. In this case, the tax at a given rate determines the fractional increase in the price level of the taxed commodity as in the case of excise and value added taxes. On the other hand, in terms of household income taxes, these are calculated as a reduction in return on both the capital and labor income of households.

In this model, the amount of the excise tax on domestic goods (*exct*) for each production sector (*s*) is calculated as the excise tax rate (*txrext*) multiplied by the domestic demand (*d*) minus the excise tax, other indirect tax (*oit*), percentage tax (*petx*), and road users tax (*rutx*), while the amount of excise tax on imported goods (*extm*) is calculated from the value added tax rate (*txrextm*) and the total value of the imported goods (*m*), and would thus be:

$$extd0(s) = txrext(s) * (d(s) - oit(s) - petx(s) - rut(s)$$
$$extm(s) = txrextm(s) * m(s$$

In addition, to assess the inflationary impact of the tax policy, another scenario is for calculating and assessing the impact of an endogenous price change on commodities from the petroleum industry and rice processing sector. This is calculated as a 20% change in the prices of these commodities in these sectors.

The model utilized in this study was computed numerically through MPSGE analysis (Rutherford, 1999) using Generalized Algebraic Modelling System (GAMS) software. As noted above, in the MPSGE system, the underlying algebraic formulation of the functional forms need not be programmed into the system; thus, only the general format of the underlying economic behavior and flows should be specified.

Using the results in the model, we analyzed the effects of the tax changes in two areas—household welfare and carbon dioxide (CO_2) emissions—through a microsimulation using the accounting approach. Prices and factor price changes were utilized to calculate the change in welfare while changes in output were used to calculate the change in emissions caused by production in the economy.

3.4. Calculation of the Poverty and Employment Impact

The study calculates for changes in poverty incidence in the economy utilizing a micro-accounting approach. The method utilizes the information on factor income and price changes in the CGE model and then applies these changes separately for each of the households in the 2015 FIES. Since the income and price information are available for each of the income deciles in the CGE model, each of the households in the FIES is identified by this income decile information and then the appropriate income and price changes are undertaken. The growth rates or changes are then applied separately to the per capita disposable income or consumption expenditure of each household in the household survey. This provides absolute income or consumption expenditure levels following the shock.

Then, using the new absolute nominal levels of income and consumption for each group, we can then calculate standard income distribution measures such as the headcount index, the poverty gap, and the Gini coefficient. Then, we can compare the post-policy poverty and income distribution indicators with the baseline values to assess the impact of the shock on the different households. The poverty indicator used is the headcount index, which can be derived from Foster, Greer, and Thorbecke's (2010) FGT poverty measure,

$$P_{\alpha t} = \frac{1}{N} \sum_{y_{it}}^{z_t} \left(\frac{z_t - y_{it}}{z_t} \right)^{\alpha}$$

where α is the poverty aversion parameter, N is the total number of individuals or households, y_{it} is the individual or household's income at time period t, z_t is the poverty line, and t is the time period (before and after the shock). The poverty headcount, in which $\alpha = 0$, is utilized in the calculation of poverty/welfare.

3.5. Calculation of the Environmental Impact

To calculate the trajectory of changes in emissions impact, emission multipliers are calculated from the Global Trade Analysis Project Energy (GTAP-E) information which has information on CO_2 emissions (see Global Trade Analysis Project, 2011a, 2011b).

Two sets of information were obtained from the GTAP-E database: the CO_2 emissions associated with a firm's usage of domestic commodities in sector *s* (also called the CODF in the database) and with a firm's usage of imported commodities in sector *s* (also called the COIF). CO_2 multipliers (defined as the impact of the CO_2 emission coefficient resulting from a specific value of output) in each industry were then calculated by using the information on the CO_2 emission coefficient from each industry multiplied by the total amount of carbon emissions in the base year.

4. DATA USED IN THE CGE MODEL AND SIMULATION SCENARIO

4.1 Social Accounting Matrix and Emissions Multipliers

The primary dataset used in numerically specifying the CGE model is the Social Accounting Matrix or SAM. The dataset traces the circular flow of incomes from producers/suppliers through factor payments to households and back to product markets through expenditures on final goods (or sales from activities). Additionally, income flows involving producers, government, financial intermediaries, and the rest of the world (*row*) are also accounted for in the SAM.

A national SAM was constructed for the year 2015 initially based on the 2012 65x65 Input-Output (IO) Table of the Philippines published by the Philippine Statistics Authority (PSA).[5] The 2012 values in this latest IO Table were simply inflated to reflect the 2015 level of the gross domestic economy in nominal terms. The various data required in the SAM were then collected from various sources while those data that were also available in the 2012 IO Table were validated using other sources (e.g., imports and exports). Table 2 below provides a list of production sectors utilized in the model.

[5]The procedure mostly follows that of Cororaton (2003), who assembled a 1994 Philippine SAM. Meanwhile, the 2012 65x65 Input-Output Table is the latest one available (Philippine Statistics Authority, 2017a).

SECTOR NO.		DESCRIPTION
AGRICULTURE		
1	rice	Paddy rice
2	corn	Corn
3	othcr	Other crops
4	sugr	Sugarcane
5	bana	Banana
6	live	Livestock and other animal products
7	fors	Forestry
8	fish	Fishery
INDUSTRY		
9	ming	Mining and quarrying
10	coal	Coal
11	crdo	Crude oil
12	ngas	Natural gas
13	food	Food manufacturing
14	sugm	Manufacture of sugar
15	beve	Beverage and tobacco
16	txtg	Textile and garments, tanneries and leatheries
17	wood	Wood and wood products
18	paper	Paper and printing
19	peta	Petroleum and other fuel products
20	chem	Chemicals, cosmetics, rubber, and plastic products
21	minl	Non-metallic mineral products
22	metl	Metals (except for iron and steel)
23	irst	Iron and steel
24	elec	Computer, electronic, and optical products
25	mach	Machineries and equipment (except for engine and turbines, etc.)
26	engines	Manufacture of engines and turbines, except aircraft, vehicle, and cycle engines
27	treq	Transport equipment
28	otmg	Other manufactured goods
ELECTRICITY AND POWER		
29	elet	Electric transmission
30	cole	Coal power generation

SECTOR NO.		DESCRIPTION
31	gas	Natural gas power generation
32	hydr	Hydroelectric power generation
33	wind	Wind power generation
34	oil	Oil power generation
35	solr	Solar power generation
36	othe	Other energy generation
SERVICES		
37	othu	Utilities, excluding electricity
38	cons	Construction
39	trde	Wholesale and retail trade and maintenance and repair of motor vehicles
40	trans	Transport services and storage
41	telc	Telephone and communications
42	otsr	Other services, including business services, and tourism
43	Puba	Public administration, education, and health

Table 2: Listing of the Production Sectors in the Model (authors' classification)

The change in emissions resulting from production activities is assessed using CO_2 emission multipliers computed as CO_2 emissions in kilograms per PHP 1 billion (USD 22 million) output in each sector. The CO_2 emissions data came from the Global Trade Analysis Project (GTAP) 9 database. The computed multipliers can be found in Appendix 2.

4.2 Simulation Scenario

To assess the impact of excise taxes on petroleum, the calculation of tax rates was undertaken. Table 3a shows the new specific tax rates following the tax reforms detailed in the TRAIN Law for coal and coke products. However, until the end of December 2018, the tax rate on coal and coke has remained at PHP 10 (USD 0.22) per metric ton. On the other hand, Table 3b shows the original and revised specific tax rates for petroleum products.

EFFECTIVE ON	TAX TO BE PAID IS
1-Jan-19	Php 100/metric ton
1-Jul-20	Php 150/metric ton

Table 3a: Revised Specific Taxes on Coal and Coke (TRAIN Law [RA 10963])

PETROLEUM PRODUCTS	NIRC 1997 RATES	PETROLEUM PRODUCTS	TRAIN LAW RATES		
			Effective on		
			Jan. 1, 2018	Jan. 1, 2019	Jan. 1, 2020
Lubricating oils (per liter) and greases (per kg)	Php 4.50	Lubricating oils (per liter) and greases (per kg)	Php 8.00	Php 9.00	Php 10.00
Processed gas (per liter)	0.05	Processed gas (per liter)	8	9	10
Waxes and petrolatum (per kg)	3.5	Waxes and petrolatum (per kg)	8	9	10
Denatured alcohol (per liter)	0.05	Denatured alcohol (per liter)	8	9	10
Naphtha, regular gasoline and other similar products of distillation (per liter)	4.35	Naphtha, regular gasoline, PYROLYSIS GASOLINE and other similar products of distillation and (per liter)	7	9	10
Leaded premium gasoline (per liter)	5.35	UNLEADED premium gasoline (per liter)	7	9	10
Aviation turbo jet fuel (per liter)	3.67	Aviation turbo jet fuel, AVIATION GAS (per liter)	4	4	4
Kerosene (per liter)		Kerosene (per liter)	3	4	5
Diesel fuel oil (per liter)		Diesel fuel oil (per liter)	2.5	4.5	6
Liquefied Petroleum Gas (per liter)		Liquefied Petroleum Gas (per kg)	1	2	3
Asphalt (per kg)	0.56	Asphalt (per kg)	8	9	10
Bunker fuel oil (per liter)		Bunker fuel oil (per liter)	2.5	4.5	6
		Petroleum coke (per metric ton)	2.5	4.5	6

Table 3b: Original and Revised Specific Taxes on Petroleum Products (National Internal Revenue Code of 1997 [RA 8424]; TRAIN Law [RA 10963]; Isla Lipana & Co./PwC Philippines, 2018)

The specific tax rates above are then transformed into their ad valorem counterparts. Hence, the baseline excise tax rates (ETR) in the CGE model are in ad valorem rates. The process of transformation into ad valorem rates involves knowing the actual volume of sales or consumption of the various production sectors and using the sectoral consumption to weight the specific tax rates. In the petroleum products sector, the weight comes from the consumption of petroleum products based on Department of Energy data.

We also include the revision in excise rates in the entire mining sector and not just in coal. For the coal mining sector, the excise tax on coal and coke will now be increased from PHP 10 (USD 0.22) per metric ton to PHP 150 (USD 3.30) per metric ton by 2020, which constitutes a 1,400% increase in the specific tax rate. On the other hand, all nonmetallic and metallic mineral products will now be subject to 4% from 2%, which is equivalent to a 100% rise in the ad valorem rate. Meanwhile, the mining of indigenous petroleum (i.e., crude oil), which was subject to 3% excise tax, is now subject to 6% excise tax, which also constitutes a 100% increase in the ad valorem rate. Table 3c shows the summary of the changes in excise taxes vis-à-vis the sectors of the model that have excise taxes.

SECTOR	ESTIMATED SHOCK (%)
Mining	100
Coal	1400
Crude Oil	100
Petroleum	281.0118

Table 3c: Summary of Changes in Effective Tax Rates, Excise Tax Rates, Petroleum and Coal (authors' calculations)

5. SIMULATION RESULTS AND DISCUSSION

The change in domestic output, domestic supply, and prices for each of the sectors and the change in each of the factors (i.e., skilled and unskilled labor and capital) were computed from the CGE model. Using these results, changes in welfare and emissions were calculated. The results are discussed below.

5.1. Sectoral Output

Table 4 shows the changes in production output. The results from the petroleum and coal excise tax simulation show that the sectors that are affected by the increased excise tax rates are the ones that suffer from a significant decline in output: petroleum and other fuel products (-4.3%), coal (-1.3%) and crude oil (-1.4%).

SECTOR	% CHANGE (in output)
AGRICULTURE	
Paddy rice	-0.2
Corn	-0.1
Other crops	-0.1
Sugarcane	-0.3
Banana	0
Livestock and other animal products	-0.3
Forestry	0.1
Fishery	-0.1
INDUSTRY	
Mining and quarrying	-0.1
Coal	-1.3
Crude oil	-1.4
Natural gas	0
Food manufactures	-0.3
Manufacture of sugar	-0.4
Beverage and tobacco	0
Textile and garments, tanneries and leather	-0.8
Wood and wood products	-0.4
Paper and printing	-0.3
Petroleum and other fuel products	-4.3
Chemicals, cosmetics, rubber and plastic products	-0.6
Non-metallic mineral products	-0.7
Metals (except for Iron and Steel)	-3.5
Iron and steel	-2.5
Computer, electronic and optical products	-0.9
Machineries and equipment (except for engine and turbines, etc.)	1

SECTOR	% CHANGE (in output)
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	-1.5
Transport equipment	-1.1
Other manufactured goods	-0.8
SERVICES	
Utilities, excluding electricity	0.2
Construction	-0.4
Wholesale and retail trade and maintenance and repair of motor vehicles	0.1
Transport services and storage	-1.8
Telephone and communications	1.6
Financial services	1.2
Other services, including business services, and tourism	0.1
Public administration, education and health	1.1
ENERGY AND POWER	
Electric transmission	-0.1
Coal power generation	-0.1
Natural gas power generation	-0.4
Hydroelectric power generation	0
Wind power generation	0
Oil power generation	-2.5
Solar power generation	0
Other energy generation	-0.5

Table 4: Changes in Production Output, % Change from Base (authors' calculations)

Manufacturing in general shows a decline in output as these activities are highly dependent on the energy inputs. Metals (-3.5%), iron and steel (-2.5%), engine manufacturing (-1.5%), transportation equipment (-1.1%), and other manufacturing (-0.8%) are the sectors that are adversely affected in this scenario. Similar to the industrial sectors, agricultural production shows a decline under higher excise taxes. Palay (-0.2%), corn (-0.1%), sugarcane (-0.3%), and other crops (-0.1%) show a decline in sectoral output. Forestry (+0.1%) shows a slight improvement.

Service sectors show mixed results in terms of output. There is a slight output increase in the sectors that are intensive in capital and skilled labor:

telecommunications (+1.6%) and finance (+1.2%). Service sectors that rely more on low-skilled workers, such as transport services (- 1.8%) and construction (-0.4%), showed a decline in output.

There is a slight output decline across all energy sectors: gas power (-0.4%), coal (-0.1%), and other energy sources (-0.5%). The biggest decline in output was recorded by the oil power generation sector (-2.5%).

5.2. Domestic Supply

Changes in domestic supply, which includes both domestic production and imports, are shown in Table 5. Changes in domestic supply follow the trend of changes in domestic production. However, there is a slight decrease in domestic supply under higher excise taxes resulting from a foreign exchange devaluation, which reduces imports for many of the industrial and service sectors. For example, the reduction in petroleum supply is more than 5% but the reduction in domestic output is only slightly above 4%.

SECTOR	% CHANGE (in supply)
AGRICULTURE	
Paddy rice	-0.2
Corn	-0.1
Other crops	0
Sugarcane	-0.2
Banana	0
Livestock and other animal products	-0.3
Forestry	0.1
Fishery	-0.1
INDUSTRY	
Mining and quarrying	-4.1
Coal	-1.2
Crude oil	-1.6
Natural gas	0
Food manufactures	-0.2
Manufacture of sugar	-0.2
Beverage and tobacco	0

SECTOR	% CHANGE (in supply)
Textile and garments, tanneries and leather	-0.3
Wood and wood products	-0.5
Paper and printing	0.1
Petroleum and other fuel products	-5.2
Chemicals, cosmetics, rubber and plastic products	-0.2
Non-metallic mineral products	-0.3
Metals (except for Iron and Steel)	-1
Iron and steel	-0.9
Computer, electronic and optical products	-0.3
Machineries and equipment (except for engine and turbines, etc.)	-0.3
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	-1.5
Transport equipment	-1.1
Other manufactured goods	-0.8
SERVICES	
Utilities, excluding electricity	0.2
Construction	-0.4
Wholesale and retail trade and maintenance and repair of motor vehicles	0.1
Transport services and storage	-1.3
Telephone and communications	1.6
Financial services	1.2
Other services, including business services, and tourism	0.2
Public administration, education and health	1.1
ENERGY	
Electric transmission	-0.3
Coal power generation	-0.5
Natural gas power generation	-1.4
Hydroelectric power generation	-0.1
Wind power generation	-0.2
Oil power generation	-5.7
Solar power generation	-0.1
Other energy generation	-1.2

Table 5: Changes in Domestic Supply, % Change from Base (authors' calculations)

5.3. Prices

Changes in prices are presented in Table 6. When excise taxes on fossil fuels increase, the coal price increases by 0.4% while the price of mining sector output increases by 5.2% and the petroleum price increases by 8.5%. Prices of agricultural products show a slight increase between 0.1% and 0.3%; these include rice (+0.2%), corn (+0.2%), sugar (+0.3%), and livestock (+0.2 %).

	% CHANGE (in prices)
Paddy rice	-0.2
Corn	-0.1
Other crops	0
Sugarcane	-0.2
Banana	0
Livestock and other animal products	-0.3
Forestry	0.1
Fishery	-0.1
Mining and quarrying	5.2
Coal	0.4
Crude oil	-0.1
Natural gas	2.1
Food manufactures	0.2
Manufacture of sugar	0.2
Beverage and tobacco	0.3
Textile and garments, tanneries and leather	0.3
Wood and wood products	0.8
Paper and printing	0.5
Petroleum and other fuel products	8.5
Chemicals, cosmetics, rubber and plastic products	0.3
Non-metallic mineral products	0.7
Metals (except for Iron and Steel)	1.9
Iron and steel	1.6
Computer, electronic and optical products	0.4
Machineries and equipment (except for engine and turbines, etc.)	0.2

	% CHANGE (in prices)
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	0
Transport equipment	0.3
Other manufactured goods	0.4
Utilities, excluding electricity	0.2
Construction	0.8
Wholesale and retail trade and maintenance and repair of motor vehicles	0.4
Transport services and storage	2
Telephone and communications	0.4
Financial services	0.2
Other services, including business services, and tourism	0.3
Public administration, education and health	0.4
Electric transmission	0.1
Coal power generation	0.1
Natural gas power generation	0.8
Hydroelectric power generation	-0.1
Wind power generation	0
Oil power generation	6.4
Solar power generation	-0.1
Other energy generation	1.3

Table 6: Changes in Sectoral Prices, % Change from Base (authors' calculations)

The prices of the transportation sector show a 2.0% increase, the highest among the service sectors. Together with the price of construction, which increased by 0.8%, the prices of other service sectors show an increase of less than 0.5%; these include trade (+0.4%), telecommunications (+0.4%), financial services (+0.2%), and other services (+0.3%).

The prices of the electricity generation industries also show only a slight increase, except for the prices of oil generating plants which increased by 6.4%. The price of solar energy shows a slight decline of 0.1%.

5.4 Factor Returns, Employment, and Welfare

Table 7 shows the changes in wage rates and rates of return to capital. With higher excise taxes on coal and petroleum, wages of low skilled laborers and income from capital declined slightly by 0.1% and 0.2%, respectively. Capital returns suffered the most among factors of production because capital-intensive sectors are also fossil fuel intensive.

FACTOR	% CHANGE (in Factor Returns)
Unskilled	-0.1%
Skilled	0.3%
Capital	-0.2%

Table 7: Change in Factor Returns (authors' calculations)

Table 8 shows the changes in employment based on the simulated changes in output by sector. With an excise tax increase, the biggest drop in employment is experienced by the transport services and storage sector, which loses more than 50,000 workers—greater than the net employment loss of more than 36,000 workers. Construction and metal industries show a decline in employment while public administration, education, and health show gains.

SECTOR	% CHANGE (in thousands of workers)
Paddy rice	-5,061
Corn	-1,421
Other crops	-2,388
Sugarcane	-1,231
Banana	-
Livestock and other animal products	-2,538
Forestry	223
Fishery	-1,331
Mining and quarrying	-217
Oil and gas	-13
Food manufactures	-2,396
Manufacture of sugar	-74
Beverage and tobacco	-
Textile and garments, tanneries and leather	-4,872

SECTOR	% CHANGE (in thousands of workers)
Wood and wood products	-1,377
Paper and printing	-1,545
Petroleum and other fuel products	-392
Chemicals, cosmetics, rubber and plastic products	-920
Non-metallic mineral products	-638
Metals (except for Iron and Steel)	-7,039
Iron and steel	-129
Computer, electronic and optical products	-3,463
Machineries and equipment (except for engine and turbines, etc.)	762
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	-121
Transport equipment	-1,146
Other manufactured goods	-1,779
Utilities	-341
Construction	-12,186
Wholesale and retail trade and maintenance and repair of motor vehicles	7,686
Transport services and storage	-52,949
Telephone and communications	597
Financial services	5,845
Public administration, education and health	45,578
Other services, including business services, and tourism	8,619
Total	-36,256

Table 8: Change in Employment, Various Scenarios (basic data from the 2015 Labor Force Survey [Philippine Statistics Authority, 2015]). Note: Coal, natural gas, and crude oil have been integrated into the oil and gas sector while electricity transmission, the electricity generation sectors (coal, hydroelectric, geothermal, etc.), and other utilities have been integrated into the utilities sector as the Labor Force Survey does not have disaggregated information in the different industrial and service sub-sectors.

Changes in welfare are measured by the change in poverty incidence, which is affected by the change in incomes (through the changes in factor returns) and the change in commodity prices. Impact on poverty incidence is provided in Table 9. Given that increases in commodity prices are higher than increases in returns to labor and capital (which proxy for the change in income), there is a slight decline in real income and therefore an increase in poverty incidence.

SECTOR	BASELINE	PERCENTAGE POINT CHANGE FROM BASELINE
Households	16.5	0.16
Individuals	21.6	0.2
Women	21.2	0.19
Fisherfolks	38.9	0.17
Transport workers	10.5	0.26
Farmers	42.2	0.32

Table 9: Poverty Incidence by Scenarios (authors' calculations)

5.5. Emissions

Table 10 shows the changes in emissions. Across all sectors, the increase in excise taxes resulted in CO_2 emissions declining by 0.8% and this is due primarily to the decline in transport service activities and electricity generating sectors, particularly oil and coal. The net decline is small because, despite declines in emissions from transportation and electricity generation, there are sectors that had increases in production and hence emissions.

SECTOR	BASELINE	COUNTERFACTUAL
CO2 emissions	97670.3	96904.5
Change from baseline	0	-0.78%

Table 10: Changes in CO2 Emissions, Various Scenarios (authors' calculations)

6. SUMMARY AND IMPLICATIONS FOR GOVERNMENT, BUSINESS, AND HOUSEHOLDS

This study analyzed the impacts of increased taxes on petroleum and coal in the country in the midst of increasing energy utilization. The initial results show that the excise tax component in the TRAIN 1 would have a slight impact in terms of sectoral output and prices, and therefore on household welfare through incomes and employment and on carbon emissions in the country. Sectors that are energy-intensive would see a slight decline in output, and there would be a slight increase in poverty given heightened prices.

This leads to two considerations that policymakers have to undertake when designing tax policies. While the ultimate goal of the TRAIN as a tax reform and its impact on environmental sustainability are very commendable—raising public revenues to improve the delivery of basic services and improve social and economic outcomes in the future while, at the same time, indirectly mitigating negative externalities on the climate and the environment—there are short-term considerations that the government should make. One would be the impact of the policy reform on sectors; another would be the impact on the targets that the Philippines must observe in terms of emissions.

Regarding the first, complementary measures are necessary to mitigate the negative effects of the tax reform on marginalized groups especially in the short-term. Besides the unconditional cash transfer program, which the government provided to the lowest seven income deciles, the government also undertook an assistance program for jeepney drivers called the Pantawid Pasada program, which provided a fuel subsidy amounting to PHP 5,000 (USD 110) in 2018 and PHP 20,500 (USD 451) in 2019 and is managed by the Land Transportation Franchising and Regulatory Board, the government agency in charge of jeepney transfers.

It is thus important to make sure that the poorest households continue to be supported by additional measures that may reduce the impact of the indirect taxes. These may include an additional cash transfer subsidy beyond the subsidy that is being provided under the unconditional cash transfer program. In addition, Mapa (2018) suggested that the poor households can also be provided with additional assistance in the form of discounted rice prices from the National Food Authority, which is promised under the TRAIN Law.

Besides the impact on incomes and therefore on poverty as noted above, increases in prices also have other effects such as those on children. This is a very important consideration especially in the context of the high incidence of child malnutrition and stunting in the country. Given that under the TRAIN Law there is a slight increase in prices, it would also be good to consider mitigating mechanisms for reducing the impact on one of the most vulnerable socio-economic groups.

For the second consideration, the design of measures to raise revenue may also consider how these would lead to the improved use of alternative energy policies that would lead to greater sustainable development outcomes. The results in this simulation had shown that while the increase in excise taxes slightly reduced the use of fossil fuels, increased economic production due to the impact of the other TRAIN components increased, ironically, the use of these types of energy sources only due to the fact that these types of plants have a higher generating capacity. Greater mitigation efforts in the use of energy by businesses and households would also allow for a reduction in emissions while minimizing the impact on the overall output of the economy.

The implication here is that measures that improve public revenue, while having a positive impact on the environment, have an adverse impact on welfare. Businesses and communities should also strive to help mitigate these negative impacts by contributing to development efforts and programs that raise the incomes of marginalized households.

Given that the simulation exercise focused only on changes in excise tax rates, there may also be intertemporal effects of the tax reform on output, employment, and welfare. In this case, a dynamic, i.e., multi-period, model would be more appropriate. Another scenario where dynamic simulation would be useful is in modeling the transition into low carbon development pathways and whether such a transition leads to the creation of an adequate number of green jobs—those that contribute to a reduction in carbon emissions—to offset job losses in fossil fuel-intensive sectors. Future work in this area may also explore the appropriate interventions from government to support low-carbon development that also reduces poverty through green jobs.

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APPENDICES

Appendices 1a–1e: Macro-SAM for 2015 (sourced from authors' calculations on PSA and Bangko Sentral ng Pilipinas [BSP] data).

ACTIVITIES				
	Agriculture	Industry	Service	Energy
Agriculture				
Industry				
Service				
Energy				
Agriculture	217,277.22	900,842.57	243,752.25	2,378.52
Industry	186,056.97	2,988,767.55	2,450,995.28	103,777.15
Service	542,650.31	1,900,394.15	5,237,136.94	139,943.11
Energy	3,330.98	108,604.65	323,759.11	40,404.49
Low skilled	540,286.58	300,102.26	1,008,735.63	9,072.89
High skilled	364,322.85	702,540.38	3,456,685.60	68,104.69
Capital	726,559.09	1,987,433.08	3,643,554.54	436,313.75
Tax collection	2,370.58	242,320.27	327,074.98	23,972.04
Household				
Enterprises				
Government				
Savings-Investment				
Rest of the World				
Total	2,582,854.58	9,131,004.91	16,691,694.33	823,966.64

Appendix 1a: Macro-SAM for Activities

COMMODITIES				
	Agriculture	Industry	Service	Energy
Agriculture	2,428,891.21			
Industry		7,281,918.56		
Service			15,406,815.86	
Energy				823,966.64
Agriculture				
Industry				
Service				
Energy				
Low skilled				
High skilled				
Capital				
Tax collection	7,479.80	186,704.70	159,345.50	-
Household				
Enterprises				
Government				
Savings-Investment				
Rest of the World	131,190.23	2,900,298.70	1,074,264.57	-
Total	2,567,561.24	10,368,921.96	16,640,425.93	823,966.64

Appendix 1b: Macro-SAM for Commodities

FACTORS				
	Low skilled	High skilled	Capital	Tax collection
Agriculture				
Industry				
Service				
Energy				
Agriculture				
Industry				
Service				
Energy				
Low skilled				
High skilled				
Capital				
Tax collection	-	-	-	
Household	1,858,197.36	4,591,653.52	3,515,619.72	
Enterprises			3,278,240.74	
Government				2,679,594.33
Savings-Investment				
Rest of the World				
Total	1,858,197.36	4,591,653.52	6,793,860.46	2,679,594.33

Appendix 1c: Macro-SAM for Factors

INSTITUTIONS					
	Household	Enterprises	Government	Savings-Investment	Rest of the World
Agriculture					153,963.37
Industry					1,849,086.35
Service					1,284,878.47
Energy					-
Agriculture	944,371.74		15,094.29	243,844.65	
Industry	3,329,563.61		119,220.49	1,190,540.91	
Service	5,204,131.32		1,742,947.20	1,873,222.90	
Energy	347,816.32		51.09	-	
Low skilled					
High skilled					
Capital					
Tax collection	847,224.92	870,048.50	-	-	13,053.04
Household			254,747.00		1,095,911.38
Enterprises			89,619.00		437,818.83
Government					
Savings-Investment	605,580.68	2,587,754.05	455,967.98	-	104,674.67
Rest of the World	37,440.39	347,876.02	1,947.28	446,368.92	-
Total	11,316,128.98	3,805,678.57	2,679,594.33	3,753,977.38	4,939,386.11

Appendix 1d: Macro-SAM for Institutions

	Total
Agriculture	2,582,854.58
Industry	9,131,004.91
Service	16,691,694.33
Energy	823,966.64
Agriculture	2,567,561.24
Industry	10,368,921.96
Service	16,640,425.93
Energy	823,966.64
Low skilled	1,858,197.36
High skilled	4,591,653.52
Capital	6,793,860.46
Tax collection	2,679,594.33
Household	11,316,128.98
Enterprises	3,805,678.57
Government	2,679,594.33
Savings-Investment	3,753,977.38
Rest of the World	4,939,386.11

Appendix 1e: Totals for Activities, Commodities, Factors, and Institutions

	Sector	Domestic Inputs	Imported Inputs	All Inputs
1	rice	0.0995	0.0734	0.1729
2	corn	0.2268	0.1701	0.3968
3	othcrops	0.0295	0.0241	0.0536
4	sugarcane	0.7294	0.5835	1.3129
5	banana	0.1149	0.0919	0.2068
6	livestock	0.0065	0.0043	0.0108
7	forestry	1.5354	1.1811	2.7165
8	fishery	0.6107	0.4852	1.0958
9	mining	3.7287	2.6747	6.4035
10	Coal	2.2315		-
11	Oil	1.7502	0.1795	1.9297
12	Gas	1.2696	- 1.2696	-
13	foodmfg	0.2704	0.1502	0.4206
14	sugarmilling	0.5126	0.2278	0.7404
15	othbeverages	0.5354	0.3189	0.8542
16	textile	0.1199	0.0658	0.1857
17	wood	0.2999	0.1941	0.4940
18	paper	1.0021	0.1462	1.1483
19	petroleum	0.4484	1.4666	1.9150
20	chemicals	0.9293	0.4772	1.4065
21	minerals	15.3602	26.1491	41.5093
22	metals	0.2780	0.1192	0.3972
23	ironsteel	1.4393	1.5249	2.9641
24	electronics	0.0911	0.0674	0.1585
25	machineries	0.7298	0.4320	1.1618
26	engines	4.8802	0.9760	5.8563
27	transequip	0.0060	-	0.0060
28	othmfg	0.1316	0.0351	0.1667
29	Electrans	-	-	-
30	coal	127.8474	179.3900	307.2374
31	Gas	43.5736	0.0280	43.6016
32	Hydro	-	-	-
33	Wind	-	-	-
34	Oil	31.5297		-

	Sector	Domestic Inputs	Imported Inputs	All Inputs
35	Solar	-	-	-
36	OtherSource	-	-	-
37	otherutil	1.0785	0.0200	1.0985
38	construction	0.2045	0.1091	0.3137
39	trade	0.2174	0.1696	0.3870
40	transport	13.4029	10.1514	23.5543
41	comms	0.3033	0.2406	0.5439
42	finance	0.1678	0.1324	0.3001
43	othservice	0.0896	-	0.0896
44	publicadmin	0.1610	0.1235	0.2846

Appendix 2: CO2 Emission Multipliers for 2014 (authors' calculations)

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