The Impact of the Low-cost Green Car (LCGC) Program on the Domestic Market and Export of Passenger Cars in Indonesia

By

RASYAD, Kemal

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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ABSTRACT

Concerns over greenhouse gases (GHG) and energy security have led countries to create automotive development policies that promote green development, sustainable growth, and industrial upgrading. In 2013, the Indonesian Government introduced the Low-Cost Green Cars (LCGC) program as a fiscal incentive policy targeting the development of fuel-efficient and low-emission small passenger cars with an internal combustion engine (ICE). This research exploits the LCGC program incentive to a particular car model as an instrument to find the program's effect on the domestic market, production, and export. The difference in difference (DD) model is used to study the effect by comparing the similar vehicle segment in the control group that is not covered by tax incentives. The combination of the DD method with the initial matching design is intended to minimize bias. The monthly and annual panel data of sales, production, export, and other variables are used from 2011 to 2015 to examine pre and postintervention effects. The result shows that the LCGC program significantly increases domestic market sales and production in all models. Meantime, its impact on export is also shown to positive but it is relatively small compared to those on domestic sales and production. The analytic results generally indicate that the LCGC program with fiscal incentive policy succeeded in boosting the domestic market, production, and export of eco-friendly and low-cost small passenger vehicles.

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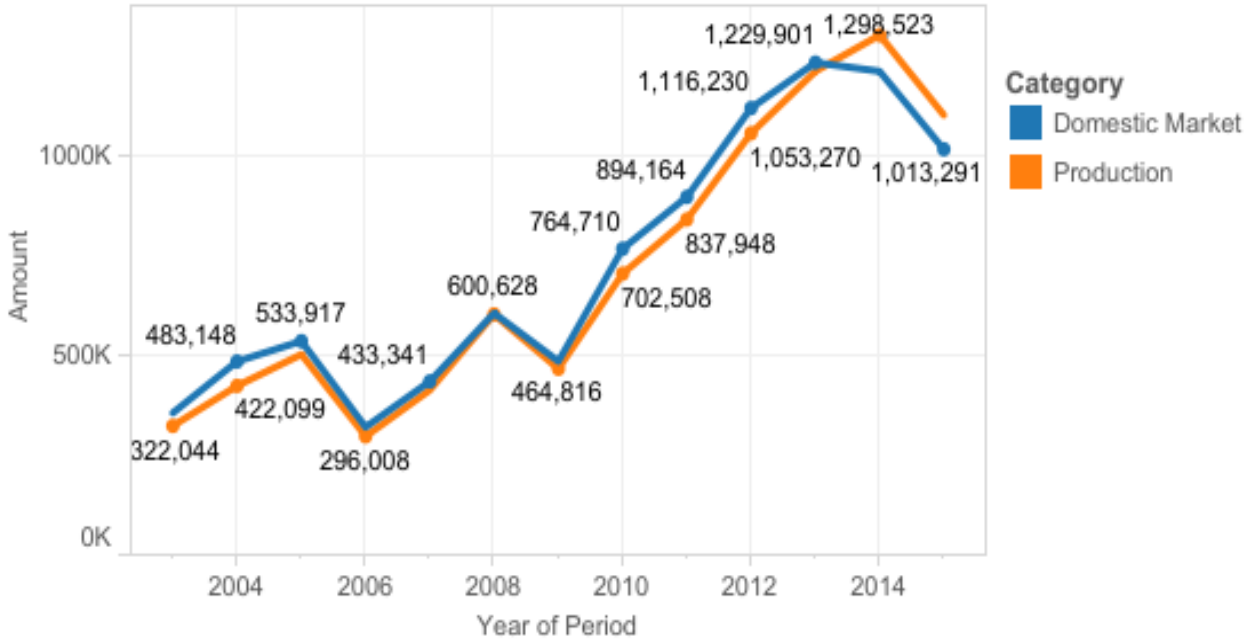
I. Introduction

Indonesia has emerged as a new player in the global automotive market and industry in the last decade. In 2012, Indonesia cemented its milestone with total vehicle domestic sales and production passing one million units in one year for the first time in its history (Natsuda et al., 2015). Advanced economies lost some of their automotive production shares due to potentially emerging new markets in developing countries such as Brazil, China, India, and later Indonesia (OICA, 2013; Pavlinek & Zenka, 2011). From the country development stage perspective, Indonesia enjoys a 'demographic dividend' that significantly increases consumer goods demand, especially passenger cars (Basri, 2012; Negara & Hidayat, 2021). In addition, the growth of middle-income in Indonesia is crucial for expanding the potential domestic car market and the automotive industry (Negara & Hidayat, 2021). Figure 1 shows recent trends in the Indonesian auto industry.

Industrial policy is an essential means for the government to stimulate industrial structure development and boost economic growth (Wei et al., 2018). The policy facilitates an increase in the national income of the country and provides easy entry of multinational companies, privatization, removal of gregarious industrial rules and regulation, easy licensing, and liberal taxation/or tax exemption. Therefore, industrial policy play an important role in fostering the industrial development of the automotive industry, as well as contributing to economic growth (Natsuda et al., 2015; Negara & Hidayat, 2021). In 2013, after a long process of public-private consultation, the Indonesian Government introduced a policy called the "Low-Cost Green Cars" (LCGC hereinafter) program, which intended to develop a new car segment: the compact and environmentally friendly car.

Figure 1. Indonesia's domestic auto market and production 2003-2015 (GAIKINDO)



Source: GAIKINDO (2016)

Industrial policy is an essential means for the government to stimulate industrial structure development and boost economic growth (Wei et al., 2018). The policy facilitates an increase in the national income of the country and provides easy entry of multinational companies, privatization, removal of gregarious industrial rules and regulation, easy licensing, and liberal taxation/or tax exemption. Therefore, industrial policy has a vital role in fostering the industrial development of the automotive industry, as well as contributing to economic growth (Natsuda et al., 2015; Negara & Hidayat, 2021). In 2013, after a long process of public-private consultation, the Indonesian Government introduced a policy called the "Low-Cost Green Cars" (LCGC hereinafter) program, which intended to develop a new car segment: the compact and environmentally friendly car.

The LCGC program began the initiatives for the low carbon emission vehicles project in Indonesia. This was an effort to fulfill the commitment in the G-20 meeting to reduce greenhouse gas (GHG) by 26 percent in 2020 (Sugiyono, 2010). Meanwhile, developed countries, such as the United States, France, Norway, Germany, England, Japan, and South Korea, have become the global role model for initiating policies to promote the use of electric and hybrid vehicles in their market to reduce GHG significantly (Urrutia-Mosquera & Fábrega, 2021). However, in the case of developing countries, the diffusion of advanced new technologies was still too costly, and the domestic industry did not ready to adopt electric and hybrid vehicles. Therefore, the decarbonization strategy of the LCGC program was started with conventional cars using internal combustion engines (ICE) with several specifications and standards that ensure the vehicle has relatively low emissions.

The domestic car manufacturer must produce or assemble an affordable and energy-saving vehicle that meets particular technical specifications to be registered in the LCGC program (Ministry of Industry, 2013). In addition, the vehicle's model registered in this program will get a fiscal incentive of luxury tax exemption, which is 10 percent equivalent to the total car price (The Fiscal Policy Agency, 2013). Negara and Hidayat (2021) explain that "[t]he majority of these vehicles were sold in the domestic market, with around 10–15 percent reserved for exports. In retrospect, these tax incentives were very successful in boosting the demand and production of low-priced cars" (p. 176). The LCGC program is believed to be a successful program because, in the first year, not less than 53.000 units were produced, and the number tripled in just the second year of implementation. (GAIKINDO, 2021).

One of the goals of the LCGC policy issuance is to boost Indonesia's automotive industry, encourage the manufacturing of more affordable cars for domestic consumers, and support the

independence of the national automotive industry. Moreover, the main target is the four-wheel motor vehicle component industry to create a competitive automotive components industry structure in line with the increasing demand for energy-efficient and affordable motor vehicles (Natsuda et al., 2015; Negara & Hidayat, 2021). The regulation states that the automotive manufacturers who want to produce LCGC cars must meet various technical specifications including vehicle fuel consumption. Furthermore, to attract multiple auto manufacturers into this program, the government grants fiscal incentives in the form of luxury tax exemption (Rukmi & Almamalik, 2019).

Several previous studies about the LCGC program primarily focused on consumer behavior such as green goods (Olson, 2013), price effect (Komaladewi & Indika, 2017), brand image quality (Hudrasyah, 2015;Suhud & Willson, 2019), and value perception (Windasari, 2019). Therefore, to fill the gap, this study will focus on the causal effect relationship of an LCGC program on domestic car sales, production, and export with firm-level data evidence. The data is collected and examined from the association of Indonesia automotive industries (GAIKINDO) and the Ministry of industry. This study focuses on five years duration before and after policy implementation from 2011 to 2015. The result of this impact evaluation will be used to improve or formulate policy to develop the automotive industry in Indonesia. Therefore, the following research question will be used in this paper:

1) Does the low-cost green car (LCGC) program have an impact on increasing the domestic market sales of a small passenger cars?
2) Does the low-cost green car (LCGC) program have an impact on increasing the production of a small passenger cars?

3) Does the low-cost green car (LCGC) program have an impact on boosting the export of small passenger cars?

This research paper consists of six sections. Section I provide an introduction, program intervention, context, and research question of the study. Section II provides the literature review and the content of the program intervention. Section III provides the basis of the hypotheses development. Section IV presents the research method of the study with data, methodology, and identification strategy. Section V focuses on the empirical result and the effect of the program. Finally, Section VI closes this research project with a conclusion.

II. Literature review

2.1. Indonesia automotive industry policy

2.1.1 Joint venture and Import substitution policy

According to the regulation of the government decree in 1969 about the automotive industry, business entities must separate their operation between assembly and distribution activities. This regulation induces multiple cooperation in the joint venture scheme between a foreign company or multinational company (MNC) with a local company that will create two business entities at minimum in manufacturing and distribution operations. According to Chalmers (1994), in 1967, there was a strategic shift from socialism to liberalization in economic policy, which promoted and opened investment and trade opportunities with foreign entities. In general, the MNC automotive manufacturer will focus on production management, product development, and the auto parts supply chain. In contrast, the local company will focus on distribution operation, sales, forecast, marketing, and regional representative. This policy is intended to create knowledge

sharing, local participation, and national interest of government due to the high potential automotive industry in Indonesia.

Localization policy through import substitution was the measure the government chose to develop the automotive industry. Aswicahyono (2000) noted that in 1969 there was a ban on imported Completely Built Units (CBUs) for commercial vehicles to promote Completely Knocked Down (CKD) activity. The measure was intended to increase national added value through CKD activity and force manufacturers to build their assembly plants for production. The localization policy directly targeted the component industry to gradually increase the local content ratio of the vehicle. Among the manufacturers, the one that had a production plant and invested in their supply chain supports this measure, meanwhile, the manufacturer who had not prepared their production plant lags behind. The protectionism was maintained till 1993 when the government prepared for a new approach to automotive policy.

2.1.2 The national car program and WTO dispute

In the 1990s, the Indonesian government attempted to create an ambitious automotive development program with Program Mobil Nasional or National car program, because the joint venture scheme didn't show the expected result since they only focused on the domestic market and were restricted to the global market or export strategy. The national manufacturer was initially allowed to create a joint venture with MNC but with a clause that there is no restriction for global market access and export strategy. The local content ratio becomes the pressure point at which national cars should achieve 20%, 40%, and 60% in the first three years of production (Aswicahyono et al., 2000). The manufacturer who was eligible to be the national car program should have to own its brand and national company, produce domestically and use local components. According to Hale (2001), since the national producer had not owned a production

plant, the government allowed them to import CBU vehicles with a national brand and exempted them from import tax and luxury tax.

As a result, the other foreign manufacturer that had invested in production plants protested against the government because the price of the national car program was lower by about 50% in the market (Hale, 2001). Regarding this issue, Japan, the European Union, and the USA brought and filed this case to the dispute settlement body of WTO and accused Indonesia of violating several WTO measures and regulations. After a long process, in 1998, WTO found that Indonesia's national car program violated the provision on agreement-related investment measures (TRIM) due to the local content prerequisite for several tax exemptions (WTO, 1998). Moreover, several aspects of this program also contravened with the WTO agreement on subsidies and countervailing measures that were raised by the European Union. The WTO ordered the abolishment of the program and the incentive tax system, which marked the end of the government's attempt to create its national car.

2.1.3 Liberalization policy

The Asian financial crisis in 1998 impacted Indonesia's economy severely, which pushed the government to reform trade and industry regulation, especially in the automotive industry. According to Hale (2001), the IMF asked the Indonesian government to implement a liberalization policy in the automotive industry, including adjusting import tariffs, abolishing subsidies and incentives, and committing to WTO regulations. In 1999, a new automotive industry policy was introduced for the importation scheme of CKD vehicles depending on engine size, type, and gross weight of the vehicle. Although the import tariff of CBU vehicles had been greatly reduced, the CKD scheme still had a lower tariff which would lead to increased domestic added value for the country.

After liberalization, vehicle production and sales increased significantly not because of the automotive development policy but due to stabilizing economy and politics after the Asian financial crisis. Natsuda and Thoburn (2015) noted that the increase in local content ratio becomes the next priority, therefore an incentive for the new model incomplete knocked down (IKD) system has been introduced. The government targeted several key car components that are not produced locally in the IKD system, meanwhile gradually expanding the car component list that could produce locally with sharing and cooperation between foreign producers and local entities. The IKD scheme also supported the auto part producer to invest and build their production facility, which would be integrated with car manufacturer assemblers that use the IKD system. However, after years of implementation, the auto part local industry didn't develop as expected, so the government came up with the next automotive development policy.

2.2. The low-cost green car (LCGC) program

In 2013 the Indonesian government launched the LCGC program, which targeted the domestic car manufacturer to produce compact, affordable, fuel-efficient, low-emission passenger vehicles. One of the goals of the LCGC policy issuance was to boost Indonesia's automotive industry and support the independence of the national automotive industry. Moreover, the main target was the four-wheel motor vehicle component industry to create a competitive automotive components industry structure in line with the increasing demand for energy-efficient and affordable motor vehicles (Natsuda et al., 2015; Negara & Hidayat, 2021). This program was projected to boost market demand and expand the economies of scale for production and auto parts, reducing overall costs.

The fiscal incentives facility was prepared to encourage manufacturers to join the program and stimulate a new car market segment. In addition, the vehicle's model registered in this program would get a fiscal incentive of luxury tax exemption, equivalent to 10 percent of the total car price (The Fiscal Policy Agency, 2013). The regulation also has set the maximum price for the most basic model of the car with an estimated IDR 95 million or USD 9,000. The affordable price is projected to shift middle-income demand from motorbikes into LCGC cars as their first car. The growth of the middle-income class in Indonesia is crucial for expanding the potential domestic car market and the automotive industry (Negara & Hidayat, 2021).

The LCGC program stated several technical requirements for auto manufacturers to certify the intended car model under this program. First, the engine displacement capacity should be 980-1,200 cc for the petrol engine. Indonesia's car segment is categorized by its type and engine capacity, this is the fundamental information for the identification of the treatment and control group of this paper. The treatment group under the scope LCGC program will be categorized by cars with an engine capacity lower than 1,200 cc. On the other hand, the control group will cover the car segment with an engine capacity of 1,200-1,500 cc, which is the market segment leader with a 50% market share of total passenger cars. Second, the fuel economy of the car should not be lower than 20 km/L, which emphasizes the energy efficiency and low emission in the development of the car.

Negara and Hidayat (2021) note that "[t]he majority of these vehicles were sold in the domestic market, with around 10–15 percent reserved for exports. In retrospect, these tax incentives were very successful in boosting the demand and production of low-priced cars" (p. 176). LCGC program is believed to be a successful program because, in the first year, not less than

53.000 units were produced, and the number increased tripled in just the second year of implementation to more than 185,000 units (GAIKINDO, 2021).

III. Hypotheses development

There has been a vast number of studies on government policy to promote the diffusion of new technologies, low emission, and energy-saving vehicles (Chandra et al., 2010; Diamond, 2009; Jenn et al., 2020; Kwon et al., 2018; Wang et al., 2018). Fiscal policies are the most common instruments used by the government because the nature of the incentives can shift the behavior toward particular government objectives with incentives as compensation (Cuervo-Cazurra et al., 2022). However, the form and coverage level of incentives vary significantly among the countries that have become the most exciting research area for scholars. According to Lévay (2017), the design of policy and implementation depends on government targets and objectives, for example, GHG reduction, alternative energy promotion, climate change mitigation, or industrial structure competitiveness.

From a policy context perspective, the LCGC program provided the fiscal incentive in the form of a 10% tax exemption of purchase price to stimulate the creation of a new car market segment and encourage car manufacturers to join this program. Furthermore, the LCGC program targeted the fuel-efficient and low-emission small passenger cars with an internal combustion engine (ICE). Even though some research used low-emission vehicles as the observed sample, most of the research about the impact of fiscal incentives on market penetration is based on the new technology diffusion, such as battery electric vehicles (BEV) and hybrid electric vehicles (HEV) (Alhulail, 2014; Bardal et al., 2020; Diamond, 2009; Jenn et al., 2020; Kwon et al., 2018;

Wang et al., 2018). Therefore, this research develops a hypothesis of the LCGC program on the domestic market, production, and export based on previous research in a similar area.

3.1. Effect of LCGC program on domestic sales

Fiscal incentives are a potent instrument of the government to stimulate new market demand by shifting consumer preferences into the targeting sector. According to Urrutia-Mosquera and Fabrega (2021), several studies indicate that monetary incentives and fiscal policy directly correlate with car ownership. The potential buyer of low-emission vehicles is significantly affected by purchase subsidies and tax reductions that positively impact the demand. Fiscal incentives in the form of tax-exempt successfully offset the cost difference between LCGC program vehicles with another car segment in the control group (Lévay, 2017).

Based on previous research on policy and fiscal incentives on the domestic market, this study develops the first hypothesis as follows:

H0: LCGC program has no effect on increasing small passenger car domestic sales.

H1: LCGC program increases small passenger car domestic sales.

3.2. Effect of LCGC program on production

The LCGC program stated several technical requirements to be considered affordable and energy-saving for auto manufacturers to certify the intended car model acquired fiscal incentives. The automotive industry in Indonesia is dominated by the global production network (GPN) framework that incorporates activities such as R&D, production, sales, distribution, and marketing (Martins et al., 2019). Therefore, the fiscal incentives for the mid to long term could support the industry's lower production cost of new low-emission vehicles and cut the parity with the market leader. From the perspective of policy design and coverage, promoting industrial structure and

nurturing production efficiency is a side effect supporting the diffusion and development of low-emission vehicles (Jenn et al., 2020).

Based on previous research on policy and fiscal incentives for manufacturing production, this study develops the second hypothesis as follows:

H0: LCGC program has no effect on increasing small passenger car production.

H1: LCGC program increases small passenger car production.

3.3. Effect of LCGC program on export

The implementation of the LCGC program is intended to increase the productivity of domestic manufacturers. According to Melitz (2003), the openness of international trade affected the aggregate productivity that benefited the industry to be more productive and more engaged in export activity. The automotive development program confirmed that it has a significant and positive impact on export, even though there is a delay from policy adaptation to the improvement of international trade (Dorsati & Guix, 2011).

Based on previous research on policy and fiscal incentives for export, this study develops the third hypothesis as follows:

H0: LCGC program has no effect on boosting small passenger car export.

H1: LCGC program boosts small passenger car exports.

IV. Research method

This research examines the effect of the LCGC program on domestic sales, production, and export of vehicles in Indonesia. However, the intervention of the LCGC program is not given by randomization because the government decides the technical specification of the vehicle that

would receive the tax exemption incentives. The lack of randomization could threaten the credibility of this research project's causal effect relationship because the treatment and control group may not be orthogonal. This paper addresses this issue with a particular combination of methodology that leads to a causal effect relationship between the LCGC program on domestic sales, production, and export of vehicles.

The difference in difference or DID/DD method is used in the absence of randomization. The treatment and control groups are assumed to have similar trends or behavior in the absence of the program. This research will expose the parallel trend assumption with two methods to fulfill the prerequisite requirement for the DD methodology. First, the counterfactual gap between the treatment and control group will be examined as a causal effect relationship. Second, the interaction between the LCGC program and treatment in the post-intervention period after 2013 will match the instrument of the equation. Therefore, the individual fixed effect will be deployed as a base of the regression analysis of this paper.

The baseline characteristic of the treatment and control group are observable and show an opportunity to combine the DD method with baseline characteristics control with mean comparison. Manufacturer-level data that produced vehicles for treatment and control groups will be observed to compare with several variables. Controlling for initial characteristics can solve the non-random selection to minimize bias in this research.

4.1. Data and Variables

The data used in this research project come from the report by the Association of Indonesia automotive industries (GAIKINDO), which is a non-profit organization comprising 16 manufacturer companies, 21 distributor agencies, and 11 automotive parts companies. The active

member of the association must publish a report of their business activity annually with monthly details. The report contains various pieces of information such as cars model, production, domestic sales, export, imports, and technical specification of the cars. Initially, the report from GAIKINDO is annual cross-sectional data with monthly details, which is transformed into panel data as a prerequisite for DD analysis examination.

Table 1. Summary Statistic

Variable	Obs.	Mean	Std. Dev.	Min	Max
Panel A: Log of dependent variables					
Log of domestic sales	1800	4.986	3.155	0	9.967
Log of Export	1800	1.274	2.458	0	8.389
Log of Production	1800	5.203	3.102	0	10.089
Panel B: Individual car model specification					
Gross Vehicle Weight (Kg)	1800	1229.333	217.485	800	1750
Engine horsepower (HP)	1800	100.3	18.803	68	160
Wheelbase (mm)	1800	2547.287	191.275	1970	2740
Length (mm)	1800	4076.433	264.917	3565	4485
Width (mm)	1800	1685.7	61.434	1475	1799
Height (mm)	1800	1650.7	154.067	1425	1915
Panel C: Manufacturer (producer) baseline characteristics in 2011					
Log of Plant's total capacity	15	11.218	0.853	9.903	12.429
Log of total assets in (IDR)	15	28.240	0.764	25.865	29.135
Log total workforce	15	7.698	1.172	5.704	8.961
Total factory plant	15	3.087	2.006	1	5
Astra group (=1)	15	0.498	0.518	0	1
Indomobil group (=1)	15	0.425	0.517	0	1

Sources: GAIKINDO (2022)

This research project will focus on passenger car non-sedan with a maximum engine capacity of 1,500 cc. The LCGC program is intended for a low-end or entry-level car with a 1200 cc maximum engine capacity with minimum fuel economy not less than 20 L/Km. The multi-purpose vehicle (MPV) and sub-compact car are Indonesia's favorite car segments, responsible for more than 50% of passenger cars in Indonesia in 2011.

The high population in this car segment is expected to enhance the result of the regression analysis due to consistency with the law of the large number (LLN). The panel data is acquired by combining the annual data from 2011 to 2015. The LCGC program was published in 2013. The five years of observation are expected to catch the parallel trend of two years pre and postintervention. The summary statistic is shown in Table 1.

4.1.1 Choice of car models: Treatment and Control groups

The LCGC program was intended to stimulate auto manufacturers to develop a low-end or entry-level car with a 1200 cc maximum engine capacity with a minimum fuel economy of not less than 20 L/Km. This paper tries to examine the impact of the LCGC program with tax exemption on the domestic market and the export of small passenger cars. Therefore, the engine capacity of the car models will determine their position in the treatment or control group. The choices of the treatment group are clear with a small car with a maximum 1200 cc engine capacity. Meanwhile, for selection of the treatment group need several adjustments. It is reasonable to compare the treatment group with car models in similar segments with an engine capacity maximum of 1500 cc. The close or similar car segment comparison will minimize biased because they both have almost similar market characteristics. In contrast, if the treatment group is selected from a totally different car segment, such as a luxury sedan car, this will not create an orthogonal comparison because they have totally different characteristics or selection bias.

Table 2. Observed Car Models by Treatment Group

Control group			Treatment group		
Car Model	**Manufacturer**	**Engine Capacity**	**Car Model**	**Manufacturer**	**Engine Capacity**
Avega	Hyundai	1500	Xenia1.0	Daihatsu	989
Mk2	Geely	1500	Karimun	Suzuki	998
Spin1.5	Chevrolet	1500	Agya	Toyota	1000
Yaris	Toyota	1500	Ayla	Daihatsu	1000
Evalia	Nissan	1498	i10	Hyundai	1100
Juke	Nissan	1498	Brio	Honda	1198
Livina	Nissan	1498	Datsun	Datsun	1198
Freed	Honda	1497	March	Nissan	1198
Hrv	Honda	1497	Etios	Toyota	1200
Jazz	Honda	1497	Golf1.0	Volkswagen	1200
Mobilio	Honda	1497	Spin1.2	Chevrolet	1200
Apv	Suzuki	1495			
Luxio	Daihatsu	1495			
Rush	Toyota	1495			
Terios	Daihatsu	1495			
Sx4	Suzuki	1490			
i20	Hyundai	1400			
Tiguan	Volkswagen	1400			
Golf1.3	Volkswagen	1390			
Touran	Volkswagen	1390			
Ertiga	Suzuki	1372			
Swift	Suzuki	1372			
Avanza	Toyota	1300			
Granmax	Daihatsu	1298			
Xenia1.3	Daihatsu	1298			

Table 2 shows a total of 36 car models divided into groups, with 11 car models included in the treatment group while the remaining 25 car models were selected for the control group. This paper focuses on the engine capacity of the car model in its placement into the treatment and control groups. All car models observed in table 2 are car models sold in the domestic market and

assembled in Indonesia. But due to business strategy and market response, several manufacturers stopped and added new car models in 2013 to respond to the LCGC program. The examination will be focused on how the post-intervention of the LCGC program affects the amount of domestic market and export of the treatment group compared to the control group.

4.1.2 Dependent variables

Table 1, panel A shows the dependent variable for this research project. There are three outcomes of this paper, log of domestic sales, log of production, and log of export. Initially, those outcomes have units of vehicles as their unit that are transformed into log form to simplify examination. This research tries to observe the effect of the LCGC program on domestic sales, production, and export of vehicles in Indonesia.

4.1.3 Independent and control variables

Table 1 panel C, and Table 2 show the individual car specification as an essential aspect of independent variables. Since the tax exemption of the LCGC program is granted to specific car models with an engine capacity lower than 1,200 cc, treatment with a dummy variable equal to 1 is given. Meanwhile, cars with engine capacity higher than 1,200 to 1,500 cc are 0. The time variant of post-intervention is listed as equal to 1 after 2013 when the LCGC program was published. The control variables or covariates are also included in the equation from vehicle technical specifications such as Gross Vehicle Weight (Kg), Engine horsepower (HP), Wheelbase (mm), Length (mm), Width (mm), and Height (mm).

4.1.4 Manufacturer (firm-level) variables

Table 1**,** Panel C shows the manufacturer-level data variables of the vehicles. In the absence of a randomized trial, this research tries to check if the treatment and control group are balanced

with several variables. This includes any pre-intervention of manufacturer characteristics such as a log of the Plant's total capacity, log of total assets in (IDR), total log workforce, total factory plant, and dummy variable that cooperation with a local company.

4.2. Empirical Strategy

This research project will use the difference in difference (DD) method that combines with the mean comparison of baseline characteristics to eliminate the potential of selection bias. By the DD framework, this research will cover DD estimation mean comparison, fixed-effect regression model, and two methods of parallel assumption. Meanwhile, controlling for baseline characteristics from firm-level data can also resolve nonrandom programs that might bias the effect of examination.

4.2.1 Matching Design: Comparison of means

After the selection process of the treatment and control groups, this paper proposes a statistical comparison between groups with observed characteristics. This paper assumes that car manufacturer ability and characteristics will affect the treatment effect of vehicles on the LCGC program compared to car producers for the control group. Even though both groups come from the same segmentation of the car with an engine capacity lower than 1,500cc, this approach attempts to control preprogram characteristics that can affect the outcome and minimize selection bias.

This research includes a set of car manufacturer-level characteristics in 2011 as the first year of the observation. Five car manufacturers produce vehicles in the treatment group. Meanwhile, the control group has more participant manufacturers, with ten total. Several manufacturer characteristics included in this matching method are car manufacturers' total

capacity in a year, total assets, total workforce, total factory plant, and their affiliation with the domestic company for distribution.

4.2.2 Difference in Difference (DD) Estimation

Before running a DD regression with a fixed effect model, DD estimation calculation with a simple two-by-two method will be conducted. (Card & Krueger, 1993) presented this method while answering the classic economic question of how minimum wage policies will affect the labor market. This method compared the means of the outcomes by treatment and control group before and after the treatment. DD estimation (δ_{DD}) will catch the change in outcomes in treatment and control groups over a specific period. This version of fixed-effect estimation use means of outcome with the following.

Y_{1t} = The average of the outcome in year *t* for car model *c* on the treatment group or LCGC program

Y_{0t} = The average of the outcome in year *t* for car model *c* on control group or non-LCGC program

(1) $$\delta_{DD} = (Y_{0,\,2015} - Y_{0,2011}) - (Y_{1,2015} - Y_{1,2011})$$

Domestic sales and total production are the outcomes compared to this DD estimation. This version of the calculation subtracts pre- and post-treatment between groups. Therefore, it shows that the adjustment of the outcome of the LCGC program and the non-LCGC program is not the same initially. The comparison uses the initial and the end of observation years, 2011 and 2015, respectively. This DD estimation will be presented using a two-by-two table.

4.2.3 Parallel (common) trend assumption

The primary assumption of this research paper is that in the absence of the LCGC program, the increase in domestic sales, production, and export vehicles would not have been significantly different for vehicles in the treatment and control groups. According to Angrist & Pischke (2015), when treatment and control outcomes have parallel moves in the absence of the treatment, the deviation of post-treatment from the trend by comparing two groups may signal a treatment effect. Meanwhile, the counterfactual is defined as what would happen in the treatment group in the absence of the LCGC program. Since the counterfactual cannot be observed, it assumes the treatment group will follow the common trend assumption of the control group.

First, as one of the outcomes, domestic sales will be used to identify parallel trend assumptions between treatment and control groups in five years of observation. In those years, the log mean of domestic sales for both groups will be plotted respectively. According to the parallel trend assumption, it is expected that the LCGC group and the non-LCGC group will have similar trends between 2011 and 2012. The big difference occurred when the LCGC program was published in 2013. After that, it will be expected to have a similar trend between 2014 and 2015.

$$(2) \qquad \text{Log } Y_{ct} = \alpha + \beta_t \sum_{t=2011}^{2015} (LCGC_c \text{ x } Post_t) + \varepsilon_{ct}$$

Where:

Y_{ct}	The log of domestic sales of car model *c* in year *t*
$LCGC_c \text{ x } Post_t$	The interaction between group fixed effect and time fixed effect
β_t	Can be interpreted as the impact of the LCGC program in that year

Second, this paper tries to find another way to identify parallel trends between treatment and control groups. In equation (2), I try to estimate the exposure of the LCGC program in each observed year. This equation only included the treatment group in the LCGC program, while the control group was omitted. Therefore, coefficient β_t can be interpreted as the effect of the LCGC program on each year. Since the program started in 2013, The result between 2011 and 2012 are expected not to be significant, and meanwhile, after 2013, the result should be statistically significant.

4.2.4 Fixed-Effects model

A panel data study with fixed effects will be taken to exploit the effect of the LCGC program with the difference in difference method. The difference between the outcome in the treatment and control group in pre and postintervention of the LCGC program shows the impact of the program intervention. If the LCGC program led to an increase in sales, production, and export, then the difference will positively relate to each car model's treatment status.

This strategy suggests running the regression with the following equation:

$$(3) \quad \ln Y_{ct} = \alpha + \beta 1\ LCGC_c \text{ x } Post_t + \beta 2\ LCGC_c + \beta 3\ Post_t + \delta\ X_{ct} + \varepsilon_{ct}$$

Where:

Y_{ct}	The log of outcome variables i.e., the domestic sales, production, and export of car model *c* in year or month *t*
$LCGC_c$	The group fixed the effect of a dummy variable whether the car model in the scope of the LCGC program
$Post_t$	The time fixed effect of a dummy variable after program intervention in 2013
α	Constant

X_{ct}	The vector of the control variable that varies in car model *c* technical specification in time *t*
$\beta 1$	The main coefficient of interest denotes the effect of the LCGC program on the outcomes i.e., the domestic sales, production, and exports of the vehicle
$LCGC_c$ x $Post_t$	The interaction between group fixed effect and time fixed effect
$LCGC_c$ x $Post_t = 1$	If the car model *c* in the LCGC program where the program was implemented when year *t* is 2013 and afterward
$LCGC_c$ x $Post_t = 0$	If the car model *c* not in the LCGC or when the year *t* is before 2013

The empirical analysis will be conducted using the STATA program. The specific command used for the analysis is *reghdfe* which stands for linear regression with multiple fixed effects. This calculation will directly consider the interaction between the group and the time-fixed effect as the main parameter. Thus, equation (3) will be modified into equation (4).

$$\ln Y_{ct} = \alpha + \beta 1\, LCGC_c \text{ x } Post_t + \delta\, X_{ct} + \varepsilon_{ct} \quad (4)$$

V. Empirical Results

5.1. Matching Design: Comparison of means of manufacturer characteristics

This paper assumes that car manufacturer ability and characteristics will affect the treatment effect of vehicles on the LCGC program compared to car producers for the control group. Furthermore, the DD method assumes that differencing will cancel out unobserved heterogeneity, which is time-invariant. However, this paper will do the orthogonal check to ensure that treatment and control groups are equal, which minimalizes selection bias. The treatment group is the car

model covered by the LCGC program, cars below 1200 cc engine capacity. Meanwhile, the control group is the car model that does not cover the LCGC program, which has an engine capacity higher than 1200 cc to 1500 cc. Table 3 show the manufacturer characteristic with firm-level mean between the two groups.

Table 3. The Comparison of means of manufacturer characteristics by LCGC program

	Treatment (LCGC) (1)	Control (Non-LCGC) (2)	Difference (3)
Log of Plant's total capacity	10.780	11.128	-0.348
	[1.021]	[0.889]	(0.541)
Log of Manufacturer's total assets in IDR	27.614	27.788	-0.174
	[0.841]	[1.104]	(0.497)
Log Manufacturer's total workforce	6.951	7.418	-0.467
	[1.230]	[1.227]	(0.689)
Manufacturer's total factory plant	1.911	2.677	-0.766
	[1.876]	[1.784]	(1.054)
Astra group (=1)	0.228	0.333	-0.106
	[0.469]	[0.497]	(0.275)
Indomobil group (=1)	0.630	0.341	0.290
	[0.540]	[0.500]	(0.286)

Standard deviation in bracket [] standard errors in parentheses ()
*** p<0.01, ** p<0.05, * p<0.1

This method includes a set of car manufacturer-level characteristics in 2011 as the first year of the observation The characteristic used for comparison is the plant's total capacity, total assets, total workforce, total factory plant, and local business group affiliation. Column 1 shows

the means of the treatment group manufacturer characteristic, and column 2 shows the control group manufacturer characteristics. Column 3 shows the differences between characteristics means of treatment and control group with standard error, respectively. Out of the six manufacturer characteristics, no single characteristic is shown to be statistically significant.

5.2. The Difference in difference (DD) estimation

This paper will examine the impact of the LCGC program on the car's domestic sales, production, and export in Indonesia. The difference in difference (DD) method will be used to analyze the causal effect relationship. The difference between car segments that benefited from the LCGC program will be compared to the control group. The identification strategy will be shown on the simple two-by-two table to calculate the difference in difference estimation (Table 4).

Table 4. Means of domestic sales and production by LCGC program and year

	Average Log of sales			Average Log of production		
	Non-LCGC	LCGC	Difference	Non-LCGC	LCGC	Difference
Year	(1)	(2)	(3)	(4)	(5)	(6)
2011	10.318	7.984	2.334	10.359	7.994	2.365
	(0.143)	(0.225)	(0.267)	(0.142)	(0.194)	(0.241)
2015	10.116	10.319	-0.203	10.446	9.710	0.735
	(0.158)	(0.255)	(0.300)	(0.273)	(0.170)	(0.321)
Difference	0.202	-2.335	2.537	-0.087	-1.716	1.630
	(0.213)	(0.340)	(0.402)	(0.308)	(0.258)	(0.402)

Notes: The treatment group is LCGC. The Control group is non-LCGC. Standard errors are in parentheses.

Table 4 shows the mean of sales and production for different years and treatment status. The main observation of this paper is within the period 2011 to 2015. The year 2011 is chosen to compare the initial position between the LCGC and non-LCGC segments. Since the program started in 2013 and 2011, both groups have not been affected, but it shows that the non-LCGC car segment has higher means of sales and production. After comparison with 2015, it shows that the LCGC segment has a significant increase both in sales and production.

The difference in difference can be interpreted as the causal effect of the LCGC program. The main assumption that will be used in this method is that in the absence of the program, the increase in sales and production would not have been systematically different between LCGC and non-LCGC. Thus, the initial difference between the treatment and control group are not the main issue, but the difference between those in column (3) and (4) is the main takeaway.

According to column (3), The estimation of the effect of the LCGC program is very high, with 2.537 higher than the non-LCGC program. Meanwhile, from column (4), the difference between the group is not as high, with 1.630 higher. These two differences show statistically significant results if compared to the standard error.

5.3. Parallel (common) trend

The difference in difference logic also can be depicted from visual interpretation from graphics that compare treatment and control groups on the outcome. Domestic sales figures will be observed as representative of the three outcomes. 1 shows the level and similar trends of domestic sales between the LCGC car segment and the non-LCGC car segment. Before the LCGC program was published in 2013, the cars with lower than 1,200 cc engine capacity, which will be the LCGC car segment, had smaller sales figures than cars with engine capacity between 1,200-

1500 cc or the control group. After the LCGC program implementation in 2013, There was a significant change in LCGC car sales compared to non-LCGC car sales.

The difference in difference counterfactual is the change in domestic sales of LCGC cars without policy intervention in 2013. This counterfactual would explain the actual effect of the LCGC program if compared to the actual higher sales figures after the intervention. However, this number cannot be observed. Thus, under the common trends assumption, the non-LCGC car (control group) trend is what happened to LCGC car sales without policy intervention in 2013. The fact that there's a similar trend between the treatment and control groups unless in 2013 to 2014 at the time of intervention, significantly increased the sales number for LCGC cars and then slowed down the trend in 2015 for both groups.

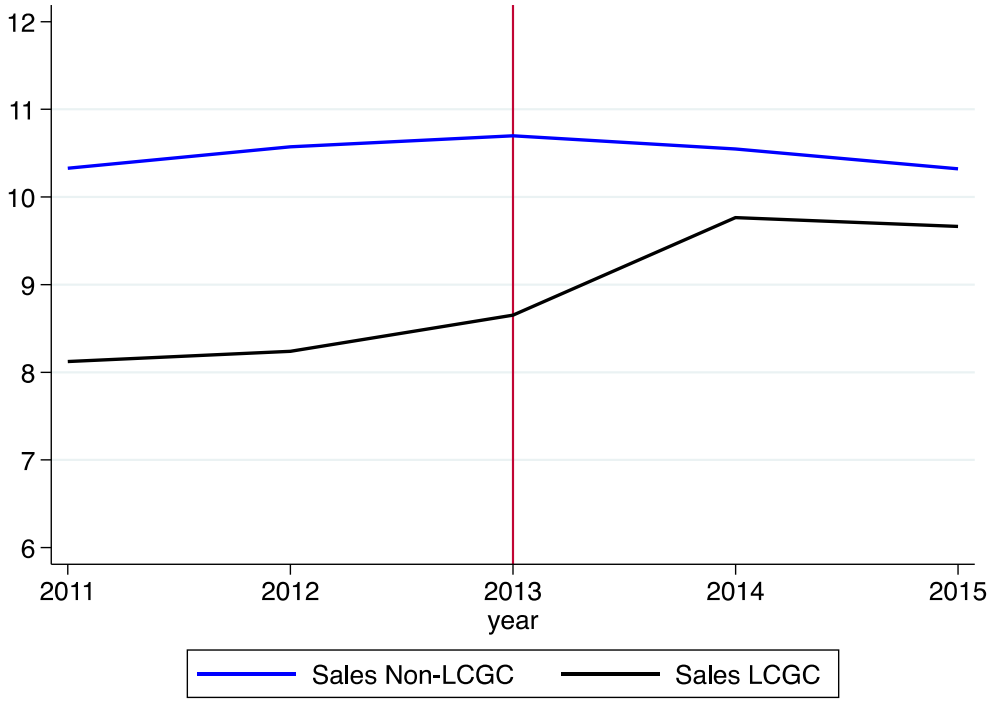


Figure 2. Log means of annual domestic sales mean for LCGC and non-LCGC

5.4. Parallel (common) trend: coefficient interaction

Figure 2 uses descriptive statistics to indicate that the level and trends in domestic car sales in the treatment and control cars segments were similar before the publication of the LCGC program. Empirical analysis to find evidence of parallel trends also can be conducted by using equation (2). Figure 3 plots the β_t in five years span, each dot means coefficient interaction, and solid lines mean the standard error of the coefficient. In 2011 and 2012, even though the β_t is positive but the standard error in these years is high enough to make this coefficient interaction not statistically significant. This result is expected because, before the intervention in 2013, the LCGC program should not affecting the outcomes yet. Since the program was launched in 2013, this year will be used as a pivot of equation (2), showing zero coefficient and standard error.

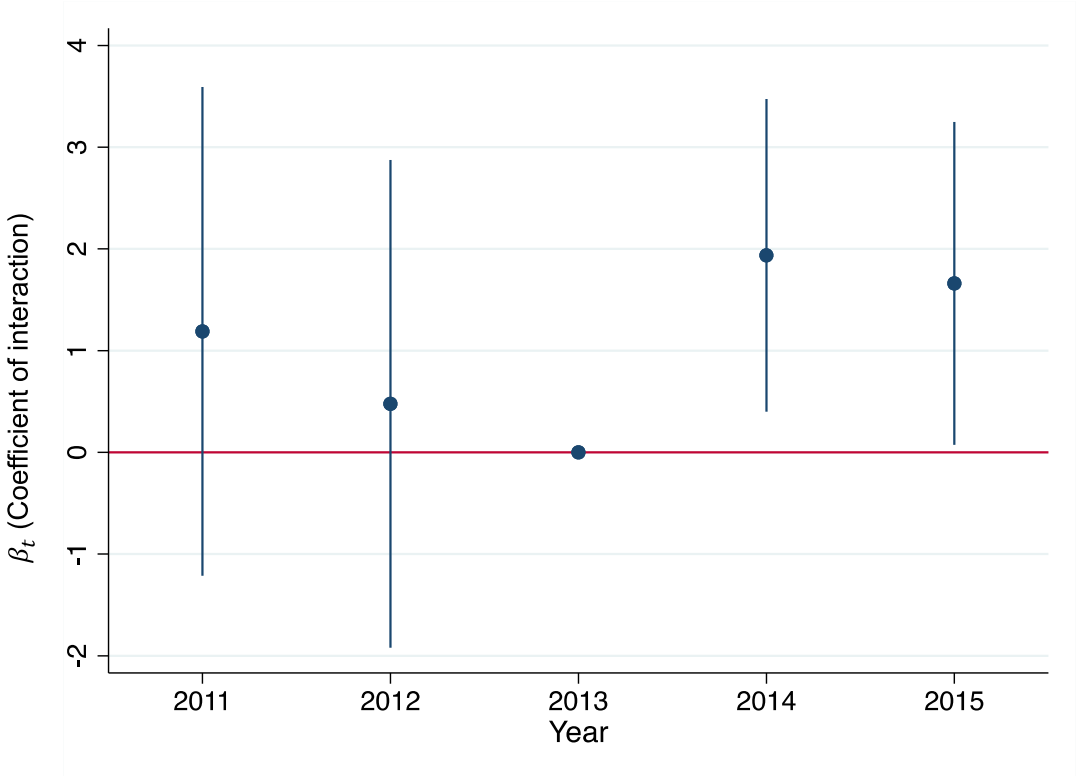


Figure 3. Coefficient of the interaction Year * LCGC Program in the domestic sales
Note: each dot is the coefficient of interaction (β_t) and solid lines are standard error

Furthermore, after the LCGC program implementation, the interaction coefficient is expected to be positive and significant. This means there is an impact of the LCGC program on domestic car sales. Figure 3, in 2014 and 2015, shows that it has a positive value which indicates there is a positive effect. It also has a small enough standard error to make these interaction coefficients statistically significant.

5.5. The Effect of the LCGC program on domestic sales

Table 5 uses equation (4) to estimate the effect of the LCGC program on domestic sales for two subsamples. In columns 1 and column 2, the annual data is used to estimate the effect. Meanwhile, in columns 3 and column 4, the monthly data is used to estimate the effect. In columns 1 and 3, the suggested effect is that the LCGC program increased the domestic sales of cars with an engine capacity lower than 1,200 cc or cars with LCGC program incentive by 2.46 for the annual sample and by 2.03 for the monthly sample.

The fiscal incentive is proven to boost domestic sales of a small passenger car in the treatment group. Even though car manufacturers that produced cars in treatment and control groups have been controlled, as seen in section 5.1, columns 2 and 4 use equation (4) with the control variable included in the regression analysis. This interpretation is meant to avoid omitted variables that will affect domestic sales. The car model specifications will determine the market to buy the car as their preference. In columns 2 and 3, the suggested effect is that the LCGC program increased the domestic sales of cars with engine capacity equal to less than 1,200 cc or cars with LCGC program incentive by 2.53 for the annual sample and by 2.13 for the monthly sample. These results show an even higher suggested effect if the control variable is included in the regression analysis equation.

Table 5. The Effect of the LCGC program on domestic sales (Y1)

	Dependent variable: Log domestic sales			
VARIABLES	(1)	(2)	(3)	(4)
β1 (LCGC x Post)	2.4604***	2.5292***	2.0299***	2.1329***
	(0.7110)	(0.6930)	(0.2034)	(0.2186)
Control variables:				
Gross Vehicle Weight		0.0314**		-0.0019
		(0.0146)		(0.0029)
Car Performance		-0.3165**		-0.0116
		(0.1347)		(0.0281)
Dimensions		0.0019		-0.0007
		(0.0066)		(0.0014)
Constant	6.7164***	-3.8118	4.6164***	9.9841*
	(0.2297)	(26.4786)	(0.0554)	(5.8564)
Observations	159	159	1,800	1,800
R-squared	0.7493	0.7692	0.7206	0.7208
Time FE	Year	Year	Month	Month
Control variables	No	Yes	No	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The result in domestic sales can be interpreted as the LCGC program succeeding in increasing demand for the LCGC car segment. The fiscal incentive of a 10% tax exemption for the car price effectively boosts domestic demand. The growing lower middle income can finally afford their first car because the LCGC car price is reasonable for the entry-level car market.

5.6. The Effect of the LCGC program on production

Table 6 6 uses equation (4) to estimate the effect of the LCGC program on car production for two subsamples. In columns 1 and column 2, the annual data is used to estimate the effect.

Meanwhile, in columns 3 and column 4, the monthly data is used to estimate the effect. In columns 1 and 3, the suggested effect is that the LCGC program increased the production of cars with an engine capacity lower than 1,200 cc or cars with LCGC program incentive by 1.69 for the annual sample and by 1.77 for the monthly sample.

Table 6. The Effect of the LCGC program on production (Y2)

	Dependent variable: Log production			
VARIABLES	(1)	(2)	(3)	(4)
β1 (LCGC x Post)	1.6908***	1.7566***	1.7708***	1.7843***
	(0.6325)	(0.6112)	(0.2140)	(0.2260)
Control variables:				
Gross Vehicle Weight		0.0323**		-0.0032
		(0.0128)		(0.0030)
Car Performance		-0.2852**		-0.0189
		(0.1188)		(0.0290)
Dimensions		0.0038		-0.0027*
		(0.0058)		(0.0015)
Constant	7.3088***	-12.5043	4.8963***	17.6828***
	(0.2044)	(23.3528)	(0.0574)	(6.0544)
Observations	159	159	1,800	1,800
R-squared	0.7580	0.7809	0.6905	0.6914
Time FE	Year	Year	Month	Month
Control variables	No	Yes	No	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Even though car manufacturers that produced cars in treatment and control groups have been controlled, as seen in section 5.1, columns 2 and 4 use equation (4) with the control variable included in the regression analysis. This interpretation is meant to avoid omitted variables that will affect car production. The car model specifications will determine the market to buy the car as their preference and later will affect the supply for production. In columns 2 and 3, the suggested

effect is that the LCGC program increased the production of cars with engine capacity equal to less than 1,200 cc or cars with LCGC program incentive by 1.76 for the annual sample and by 1.78 for the monthly sample. These results show an even higher suggested effect if the control variable is included in the regression analysis equation.

The result in car production can be interpreted as the LCGC program succeeding in increasing the supply side for the LCGC car segment. The fiscal incentive of a 10% tax exemption for the car price effectively boosts domestic demand and then supply from a domestic manufacturer. The growing lower middle income can finally afford their first car because the LCGC car price is reasonable for the entry-level car market and boost domestic production.

5.7. The Effect of the LCGC program on exports

Table 7 uses equation (4) to estimate the effect of the LCGC program on car export for two subsamples. In columns 1 and column 2, the annual data is used to estimate the effect. Meanwhile, in columns 3 and column 4, the monthly data is used to estimate the effect. In columns 1 and 2, even though the estimated effect shows a positive result, the standard error is high enough to make these results not statistically significant. From the annual data, it suggested there is no effect of the LCGC program on the export of cars with an engine capacity lower than 1,200 cc or cars covered by the LCGC program.

The different results are acquired from monthly data as a subsample. First, even though car manufacturers that produced cars both in treatment and control groups have been controlled, as we have seen in section 5.1, Column 4 uses equation (2) with the control variable included in the regression analysis. This interpretation is meant to avoid omitted variables that will affect car production. The car model specifications will determine the market to buy the car as their

preference and later will affect the export. In columns 3 and 4, the suggested effect is that the LCGC program increased the export of cars with engine capacity equal to less than 1,200 cc or cars with LCGC program incentive by 0.55 and by 0.57 for the monthly sample which was added with the control variable in regression analysis.

Table 7. The Effect of the LCGC program on export (Y3)

	Dependent variable: Log Export			
VARIABLES	(1)	(2)	(3)	(4)
β1 (LCGC x Post)	0.2518	0.3433	0.5508***	0.5691***
	(0.7404)	(0.7392)	(0.1448)	(0.1845)
Control variables:				
Gross Vehicle Weight		0.0265*		-0.0033
		(0.0155)		(0.0025)
Car Performance		0.1100		-0.0171
		(0.1436)		(0.0237)
Dimensions		-0.0040		-0.0018
		(0.0070)		(0.0012)
Constant	2.1417***	-31.3583	1.1767***	11.6013**
	(0.2392)	(28.2448)	(0.0468)	(4.9422)
Observations	159	159	1,800	1,800
R-squared	0.6995	0.7097	0.6716	0.6725
Time FE	Year	Year	Month	Month
Control variables	No	Yes	No	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The result in car export can be interpreted as the LCGC program succeeding in increasing the export for the LCGC car segment. The high demand from the domestic market also attracted foreign demand to purchase LCGC cars. The increasing production of this car push production

costs more efficiently. Furthermore, the low-segment or entry-level car is suitable for other developing countries' market demand.

VI. Conclusion and Policy Implication

This paper estimated the impact of the LCGC program policy on the sales, production, and export of the low-cost and energy-saving vehicle segment in Indonesia. Several developed countries introduce tax incentives and subsidies to increase eco-friendly vehicle domestic sales in their respective country. The LCGC program, published in 2013, targeted an internal combustion engine (ICE) vehicle which has an engine capacity lower than 1200 cc and gas mileage not less than 20 Km per liter. The regulation also has set the maximum price for the most basic model of the car with an estimated IDR 95 million or USD 9,000. The difference in difference method is used to estimate this effect with a comparison or control group vehicle in a similar segment but did not get tax exemption or incentive. This study shows that the LCGC program policy has increased sales, production, and export of small passenger cars with an engine capacity lower than 1200 cc in Indonesia.

The result on domestic sales shows that the policy increases domestic sales by up to 252%. The fiscal incentive of a 10% tax exemption for the car price effectively boosts domestic demand because consumers can afford this vehicle at a lower price. The affordable price was projected to shift middle-income demand from motorbikes to LCGC cars as their first car. The growth of middle-income earners in Indonesia is crucial for expanding the potential domestic car market and the automotive industry (Negara & Hidayat, 2021). The growing lower middle income can finally afford their first car because the LCGC car price is reasonable for the entry-level car market.

Fiscal incentives are a potent instrument of the government to stimulate new market demand by shifting consumer preferences into the targeting sector. Fiscal incentives in the form of tax-exempt successfully offset the cost difference between LCGC program vehicles with another car segment in the control group. According to Urrutia-Mosquera and Fabrega (2021), several studies indicate that monetary incentives and fiscal policy directly correlate with car ownership. The potential buyer of low-emission vehicles is significantly affected by purchase subsidies and tax reductions that positively impact the demand.

The result on production shows that the policy increases vehicle production by up to 176%. One of the LCGC policy issuance goals was to boost Indonesia's automotive industry and support the independence of the national automotive industry. The comprehensive cooperation between car manufacturers and the local supporting industry was anticipated. However, the local component industries were still experiencing difficulties meeting car assemblers' standards. The IKD and CKD scheme incentive policies, which have been in place since 2009, were intended to improve the quality and efficiency of local industries. The cooperation arising from the LCGC program was expected to strengthen the structure of the automotive industry. Moreover, the target is the four-wheel motor vehicle component industry to create a competitive automotive components industry structure in line with the increasing demand for energy-efficient and affordable motor vehicles. The high-added value car's components that used to be imported finally started assembly in a domestic plant because it had achieved economies of scale.

The manufacturers also invested more in their in-house plant as their commitment to fulfill the growing demand for LCGC program. From 2013 to 2019, the total investment from manufacturers that joined the LCGC program was more than US$ 1.3 Billion. Due to extending production capacity, the newly built plant affected the employment market in that area. Therefore,

job creation became one of the indirect benefits of the LCGC program. The quality of human resources should become the concern of the government to prepare highly skilled manufacturing labor to support the private sector.

Research and development (R&D) by automotive manufacturers is the backbone of developing car component manufacturing. The tax exemption of the LCGC program is targeted to reduce purchase value for the customer in order to promote fuel-efficient small car passenger cars. The other form of incentive directly targeted the manufacturer to promote local R&D. The development of automotive components created independence, especially in the component that met economic of scale to produce locally. However, research and development activity would cause additional expenses, reducing their profits. In 2020, the Indonesian government launched a tax holiday policy for the company that conducted in-house research and development. The incentive will be equal to the research and development expense and reduce company tax up to 150-200%. From the perspective of policy design and coverage, promoting industrial structure and nurturing production efficiency is a side effect supporting the diffusion and development of low-emission vehicles (Jenn et al., 2020).

The result on export shows that the policy increased vehicle export by more than 57%. The high demand from the domestic market also attracted foreign demand to purchase LCGC cars. The impact on the export is not high as the outcome of domestic sales and production. It shows that the LCGC program mainly targeted the domestic market because only 10-15% of the production was for export. According to a lesson from developed countries, export orientation is the key to promoting the competitiveness of industries. The increasing production of this car pushed production costs to become more efficient. Furthermore, the low-segment or entry-level car is

suitable for other developing countries' market demand. Therefore, the promotion of LCGC cars should be a priority in the potential market, especially in developing countries.

The success of the LCGC program encouraged the government to prepare the next automotive industry development program with another fiscal incentive. As a result, in 2021, the Indonesian government published a low-carbon emission vehicle (LCEV) program to support zero-carbon emission technology efforts. The LCEV program is broader in scope than the LCGC program. Besides covering affordable and fuel-efficient vehicles, this regulation also encourages the diffusion of new technologies such as electric vehicles, hybrid vehicles, fuel cell vehicles, and flexy engine vehicles with 100% biofuels. Furthermore, the issue of climate change triggers the transformation of the motor vehicle industry towards zero-emission technology, the increasing growth of the middle class, demographic bonuses, penetration of digital technology, and increasing trends in the use of new and renewable energy.

VII. Limitations and Future study

This research paper's limitation is that the observed datasets focus only from 2011 to 2015. The LCGC program launched in 2013, so the research focuses on monitoring the program's two years of pre and postintervention. The tax exemption incentive of the program had given until 2021. More comprehensive results would be obtained if the observation period were extended from 2011 to 2021. This is the foundation for future research to comprehensively determine the LCGC program's impact on the domestic and export markets.

This research has three outcomes or independent variables: domestic sales, production, and export. There are other parameters that can be added to measure the impact of the LCGC program, namely the import value of vehicles with the same segment. Future research could incorporate

import values into program outcomes. Moreover, the new low carbon emission vehicle (LCEV) policy is a new policy that has a broader scope, especially on the diffusion of new technologies such as electric vehicles and flexy engines. The future study could use a similar method using the difference in difference using the LCEV policy as an instrument to see the impact of the policy on the domestic market, production, export, and import of electric or hybrid cars in the Indonesian market.

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