Economic Analysis and Policy 71 (2021) 279–290

Contents lists available at ScienceDirect

Economic Analysis and Policy

journal homepage: www.elsevier.com/locate/eap

Modelling economic policy issues

Does the US–China trade war increase poverty in a developing country? A dynamic general equilibrium analysis for Indonesia

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ARTICLE INFO

Article history:
Received 18 January 2021
Received in revised form 25 April 2021
Accepted 18 May 2021
Available online 21 May 2021

JEL classification:
F14
I32
D33
C68

Keywords:
Poverty
Income distribution
Trade war
Indonesia
Multi-household general equilibrium model

ABSTRACT

In contrast to previous studies that mostly focused on the winners and losers of the US–China trade war, this study investigates the poverty and income distribution impact of the trade dispute in a developing country, using Indonesia as a case study. Employing a dynamic, computable general equilibrium model that is multi-region and multi-household, this study found that the trade war increases households' real income and reduces poverty in Indonesia. The impact of the trade war, which is channeled into the Indonesian economy via trade diversion, improves the country's terms of trade and eventually increases the returns of primary factors owned by households. However, Indonesia's income inequality might increase as the rise in real income of upper-income households exceeds the rise in real income of lower-income households. The policy measures introduced by Indonesia to take advantage of the trade war might lower poverty incidence further and alter the impact of negative income distribution from the trade war.

1. Introduction

The trade tensions between the world's two biggest economies have drawn much attention in recent literature. To date, research on the global trade war has mostly focused on the winners and losers of the dispute (see Carvalho et al., 2019; Cui et al., 2019; Dong and Whalley, 2012; Guo et al., 2018; Itakura, 2020; Li et al., 2018, 2020; Rosyadi and Widodo, 2018; Shagdar and Nakajima, 2018). By conducting multi-country analysis, the literature has shown that the trade war will not only directly affect the US and China but also indirectly affect other countries. This is mainly because the contribution of these two big economies constituted 40% of the global GDP and 25% of global trade in 2019. Although the trade war does indirectly affect economies of developing countries, and it is argued that trade is one contributor to poverty reduction (see Anderson, 2020; Bhagwati and Srinivasan, 2002; Dollar and Kraay, 2004; Maertens and Swinnen, 2009), the specific impact of the trade war on poverty has never been investigated, particularly in a developing country.

This study, however, considers the impact of the trade dispute on poverty in developing countries, with Indonesia as a case study. Thus, this study will contribute to the existing literature as follows. First, this study provides a trade war analysis from the point of view of developing countries. Although developing countries are not directly involved in the

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https://doi.org/10.1016/j.eap.2021.05.008
0313-5926/

trade dispute, they often enjoy extensive trade with the US and China. This is true in the case of Indonesia: regarding exports, China and the US are the first and third-largest trading partners for the country, respectively; regarding imports, China is its largest trading partner. More interestingly, developing countries often make substantial efforts to capture opportunities from any trade war. Indonesia, for example, has undertaken talks with the US to secure a bilateral trade deal. The country also has lowered its corporate tax rate in an attempt to capture any investment spillover from the trade war. These efforts to maximize gain from the trade war by the developing country is unnoticed in any literature. Here, the efforts are simulated and discussed.

Second, this study fills the gap in the literature by specifically examining the poverty impact of trade war. Although the literature heavily scrutinizes the impact of trade policy on poverty, it can be divided into two broad categories: studies that focused on the poverty effect of trade liberalization (such as Anderson, 2020; Maertens and Swinnen, 2009; Bhagwati and Srinivasan, 2002; Dollar and Kraay, 2004) and studies that focused on poverty effect of trade protectionism (such as Mahadevan et al., 2017). Thus, the poverty effect that specifically arises from the trade war has not been addressed in the literature. The poverty effects of a trade war are different from those effects that arise from trade liberalization and trade protectionism. The poverty impact of a trade war is not straightforwardly channeled but transmitted through trade diversion and investment spillover from disputing countries.

Poverty is also a persistent problem for a developing country such as Indonesia. In 2019, of the Indonesian population of approximately 268.8 million, 24.8 million (9.2%) were classed as poor. Recently, the speed of poverty slowed. Between 2000 and 2015, the poverty rate declined at the average annual rate of 0.76%, but from 2015 to 2019 the declining rate was only 0.37% annually. Consequently, the country missed the 2015–2019 poverty target set by the government in the national medium-term development plan (see Ministry of National Development Planning, 2017). This problem means that achieving the first goal of the Sustainable Development Goals of poverty eradication became harder. Hence, the government's trade policies are expected to boost economic development and accelerate poverty reduction in the country.

The third contribution of this study concerns the methodological aspect. The model used in this study integrates a module, poverty analysis of Indonesia, into the multi-region, Global Trade Analysis Project-Recursive Dynamic (GTAP-RD) model. Within the module, we augment a single representative, private household from the original GTAP database into 100 representative households based on the distribution of income and expenditure. Thus, the income distribution and poverty impact analysis can be performed with the upgraded model. In addition, the retaliation scenario of the trade war tariff was generated from a detailed tariff line of levels published from 2018 to 2020 (see Appendices A and B). Thus this study provides a more realistic simulation than previous studies, such as those by Dong and Whalley (2012), Li et al. (2018), Noland (2018) and Shagdar and Nakajima (2018), which all used conjectures about tariff reductions on US–China trade war.

It is also worth noting that the trade war, which was previously seen as a relatively short-lived tension, will very likely not end soon. The trade dispute that is a legacy of the Trump presidency is likely to continue in the era of newly elected US President, Joe Biden (Barret, 2020). Biden hints that he will not immediately remove tariffs imposed on China (Lee and Kimball, 2020).

2. Literature review

2.1. Studies on the trade war

While several studies have quantitatively estimated the impact of the trade war, their results are most likely affected by the choice of modeling framework and economic assumptions underlies. Cui et al. (2019), Li et al. (2020), Rosyadi and Widodo (2018), and Shagdar and Nakajima (2018) tried to capture the impact of China's tariffs retaliation on US policy using the standard static GTAP model. By and large, those four studies found identical results: that the trade retaliation led to a decrease in welfare and/or GDP for both the US and China, with a greater reduction for China compared to the US. In addition, Shagdar and Nakajima (2018) highlighted that the results are similar whether the international capital mobility is allowed for or not. With regards to the aforementioned four studies, Li et al. (2020) arrived at the most realistic scenario, because they calculate the shocks employed in their study from the 8-digit-level, harmonized system (HS6) level of tariffs database.

The study conducted by Bellora and Fontagne (2020) showed that the trade war is having a serious economic impact on China while causing loss of competitiveness on the part of US producers due to increasing production costs. This result was found from the imperfect competition-CGE modeling, with the feature of differentiating demand of goods according to their use. In contrast to most studies that predicted economic loss for China, Dong and Whalley (2012) predicted that China and the rest of the world would gain a welfare surplus, while the US and the European Union (EU) were expected to experience welfare losses. This result was obtained under the endogenous trade surplus model. Under the cooperative and non-cooperative Nash equilibrium method, Li et al. (2018) estimated that the US can gain more than China in trade war negotiations due its stronger bargaining power. Another study from Mahadevan and Nugroho (2019) attempted to relate the trade war issue with a regional trade agreement. They measured whether the regional comprehensive economic partnership (RCEP), as the mega-regional free trade area (FTA), is able to minimize the losses from the US–China trade war. The study found that although the RCEP provides benefits to its members, it is unable to negate the global effect of the trade war.

The impacts of the US–China trade war on emerging countries was the focus of Carvalho et al. (2019). By utilizing the GTAP model, the study demonstrated that emerging countries benefit due to shifting demand, which in turn depends on the comparative advantage of each country. However, Pangestu (2019) noted that not all developing countries might benefit from the trade war. Indonesia, for example, is unlikely to benefit due to low integration with the global value chain and its current structure of exports, which heavily serves domestic markets of China and the US (ibid). Hence, to maintain its trade competitiveness during the US–China trade war era, Indonesia must harmonize conflicting domestic economic regulations and promote inclusive export policies as well as encourage the diversification of export markets (Wangke, 2020).

Although aforementioned studies have already attempted to provide empirical evidence on the impact of the US–China trade war, generally their focus has been the winners and losers of the trade dispute. In contrast to the previous studies, the present study fills the gap in the literature by focusing on the poverty and income distribution impacts of trade wars, particularly in developing countries. This study will use the recursive dynamic model, in contrast to studies such as those conducted by Carvalho et al. (2019), Cui et al. (2019), Dong and Whalley (2012), Guo et al. (2018), Li et al. (2020), Rosyadi and Widodo (2018), and Shagdar and Nakajima (2018), which used only a static model. The dynamic feature in the model for the present study allows endogenous adjustment in supply of factors and technology as responses to price changes (Anderson, 2020). It is therefore able to capture market reactions and structural adjustments to the trade war more comprehensively.

2.2. Observations on trade and poverty

Trade has long been characterized as the engine of growth (see Robertson, 1940). Until now, most literature still supports the idea that freer trade will promote economic growth (see Dollar and Kraay, 2004; Frankel and Romer, 1999; Broda et al., 2017). However, the effect of trade on poverty still lacks consensus. Several studies supported the idea that trade liberalization tends to reduce poverty (Bhagwati and Srinivasan, 2002; Dollar and Kraay, 2004; Maertens and Swinnen, 2009). From the computable general equilibrium (CGE) point of view, Anderson (2020) also found that trade liberalization tends to reduce poverty. This conclusion was made after performing a literature review of 66 studies that used the CGE model. However, Winters et al. (2004) mentioned that no simple, broad conclusion about the relationship between trade liberalization and poverty can be made. For instance, the link depends on what trade policies are liberalized and how a poor household earns its living (Winters and Martuscelli, 2014). By using firm-level data analysis, Topalova (2007), also found no significant relationship between trade liberalization and poverty for the average district in rural or urban India.

Drawing from previous literature, the trade war could affect the economy of a developing country through a trade diversion from or to that developing country (Carvalho et al., 2019; Dong and Whalley, 2012; Li et al., 2018; Mahadevan and Nugroho, 2019; Rosyadi and Widodo, 2018). A diversion would most likely lead to output expansion (contraction) and alter the price of domestic commodities in the developing country. Hence, the poverty impact would most likely be transmitted via household income and/or commodity prices. For instance, according to the Stolper–Samuelson theorem, if a developing country manages to benefit by its comparative advantages of cheap, low-skilled labor, then the income will flow to low-income households (Bhagwati and Srinivasan, 2002). This flow should help to reduce poverty in the country. On the other hand, the trade policy could also indirectly assist poor populations with cheaper commodity prices, especially food. For instance, poor households in Indonesia direct a greater part of their expenditure towards necessities such as food, while richer households direct a smaller part of their expenditure towards food (Misdawita et al., 2019). Thus if, for example, the price of food commodities falls, poverty will be reduced.

2.3. Indonesia's policy measures regarding the trade war

Although not directly involved in the trade war, Indonesia takes the state of affairs seriously. The President of Indonesia, Joko Widodo, has pushed his ministers to take advantage of the trade war situation (Yuniar, 2020). They have launched several initiatives, including proposing a bilateral trade agreement with the US (the US–Indonesia limited trade deal). The deal is set to boost trade between the US and Indonesia. It will cover the agenda of trade cooperation and investment in information communication and technology (Cabinet Secretary of Indonesia, 2020). The deal is expected to boost the trade between the US and Indonesia from US$ 28.6 billion in 2018 to US$ 60 billion in 2024 (ibid). Given that the bilateral trade agreement is still under negotiation (Yuniar, 2020), little information is available about the agreement.

Indonesia's other policy measure regarding the trade war is cuts in corporate income tax rates (see DDTC, 2020; Government of Indonesia, 2020), which is an attempt to attract trade war investment spillover to Indonesia. The policy is also set to improve Indonesia's long-term tax reforms (see Nugraha and Lewis, 2013; Amir et al., 2013; Arnold, 2012). Prior to 1998, corporate income was taxed at a progressive rate. The tax rate for small and micro firms (firms with income below IDR 50 million) was 10%, while the tax rate for medium-sized firms (firms with income between IDR 50 million and IDR 100 million) was 15%. Large-sized corporations with a net income of more than IDR 100 million were taxed at 30%. As a policy measure during the global financial crisis, the corporate income tax rate was set at a single rate of 28% in early 2009. In 2010, the Indonesian government further lowered the corporate income tax rate to 25%.

Another corporate income tax cut was set in 2020, ten years after the previous tax reform. In this reform, the government cut the corporate income tax rate from 25% to 22%. Although the policy was mainly designed as a tax relief

measure during the COVID-19 pandemic, this arrangement was also intended as a permanent tax reduction to attract foreign direct investment to the country and to take advantage of the ongoing US–China trade war (see DDTC, 2020; Government of Indonesia, 2020).

3. General Equilibrium Modeling Framework

3.1. General structure of the model

The empirical tool used in this study is the Computable General Equilibrium (CGE) model: Arrow (2005) acknowledged that "in all cases where the repercussions of proposed policies are widespread, there is no real alternative to CGE". The tool is a reasonable choice given the CGE approach has the ability to model the interrelation between industries and between regions while taking into account the impacts on a range of macroeconomic variables, such as wages and employment, which are important in the trade analysis (Hertel and Reimer, 2005; Naranpanawa et al., 2011; Rege, 2018).

This study uses GTAP-RD, a dynamic multi-region model that is described in detail by Aguiar et al. (2019).[1] Within the model, each region has their own economy, and the regions are linked through inter-regional trade flows. In each region, firms perform production activity using a multi-level, nesting production structure. For the top-level nesting, the intermediate input composite and primary factor (or endowment) composite are combined using a fixed proportion to produce output. For the lower-level nesting structure, the primary factor composite is composed from the combination of various types of primary factor, including skilled labor, unskilled labor, capital, land, and natural resources. Using the constant elasticity substitution (CES) function, producers substitute the more expensive type of primary factor with the lower cost in order to minimize the cost of primary factor composite. Still in the same level of nesting, the intermediate composite is composed from various inputs of commodity using a fixed proportion function. For the bottom-level nesting, each commodity used for intermediate inputs is composed using the Armington function (Armington, 1969), which allows for imperfect substitution between domestic and imported commodities.

The outputs of production are sold for domestic and export markets, generating income to regional households from their endowment (including skilled labor, unskilled labor, capital, land, and natural resources). The income is then outlaid on private household expenditure and government spending, and some of the income is directed to savings. The savings would be allocated for investment spending. The final demand (including private household, government, and investment spending) and intermediate input purchases comprise domestic and imported products. The products are to be provided by domestic and foreign firms, respectively.

3.2. The dynamic and closure settings

The recursive dynamic feature of GTAP-RD works by sequentially solving static equilibrium problems in each period (within-period module), with updates in some areas when switching between periods (between-period module). The within-period module is the static CGE analysis, given the level of capital stock in the particular period, while the between-period module links each period by updating some aspects, including capital stocks and exogenous endowments. The capital stock is endogenously driven by the capital accumulation mechanism using the stock-flow relation, where the end-of-period capital stock is equal to the beginning-of-period capital stock, less depreciation, and added to the investment in the current period. The regional investment, the other hand, is allocated using the default GTAP-RD closure, in which it is endogenously driven by the regional expected rate of return. This assumes that capital will flow into regions that have above-the-average expected rates of return, and that the region's trade balance will endogenously adjust accordingly. Last, the exogenous endowments, such as population and labor force for each region, are updated using external data.

Running a simulation in a dynamic CGE model requires two main steps. We perform the first step, that is, running the baseline or business-as-usual simulation, which projects the growth path of the region's economy without any policy changes. To establish this simulation, the model requires inputs for the year-on-year projection on GDP, population, and the labor force growth of each region up to 2030. These data were obtained from the International Institute for Applied Systems Analysis (IIASA, 2020). Following the baseline simulation, we perform the second step of policy simulation. This simulation represents the policy changes and is performed by adding shock(s) to the model. The policy simulations performed in this study are described in more detail in the following section. Finally, we perform a counterfactual analysis by measuring the difference between the outputs of baseline simulation and the outputs of policy simulation.

[1] GTAP-RD model offers similar features to the pre-existing dynamic multi-region model of GTAPDyn (Ianchovichina and Walmsley, 2012), including product differentiation by origin, capital accumulation, and international capital/investment mobility. However, GTAP-RD was built on the latest GTAP 7 framework (Corong, 2017) as opposed to GTAPDyn, which was built based on GTAP 6.2 framework (Mcdougall, 2003). In addition, GTAP-RD offers greater flexibility in terms of the choice of the closures as well as offering a more convenient way to perform a modification to the model due to a more consistent variable, coefficient, and equation-naming convention.

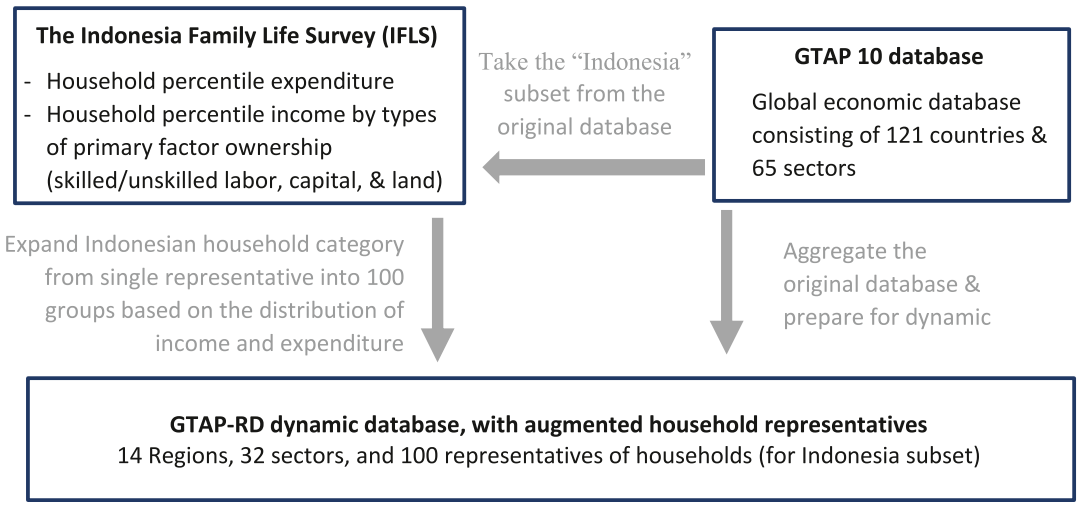

Fig. 1. Development of the CGE model's database.

3.3. Model database development

For the database, this study employs the GTAP version 10 database, which covers 141 regions/countries, 65 sectors/commodities, and eight factors of production. The original database is aggregated to 14 regions and 32 sectors for our analysis. However, the standard GTAP database cannot be directly used to perform poverty and income distribution analysis because it uses only a single representative household for each region, which is insufficient for examining distributional impacts on poverty and income distribution. Therefore, for our analysis, the single private household representative is augmented into 100 groups based on the distribution of income and expenditure. This disaggregation is illustrated in Fig. 1.

The household disaggregation is carried out only for the subset of the Indonesia region, which is our subject of analysis. It is performed by incorporating information from the Indonesia Family Life Survey (IFLS) 2014 into the original GTAP data. The survey is Indonesia's large-scale, national socioeconomic analysis, and it includes a sample of 16,204 households and 50,148 individuals, which represent 83% of the Indonesian population (Strauss et al., 2016). For this study, the following data are extracted from the IFLS: (i) income of skilled and unskilled labor at the individual level, (ii) return to capital and land at the household level, and (iii) expenditure at the household level. This information is then employed to disaggregate the household categories into percentiles, which are 100 representatives of households based on the distribution of income and expenditure. To maintain consistency between macro (GTAP) and micro data (IFLS), we follow the mutually inclusive-bridging reconciliation method introduced by Corong (2014). Using this rule, variables are reconciled using their macro value flows but disaggregated using the share derived from the survey. Thus, all income and expenditures data from the survey are proportionally adjusted to match the aggregate macro value. Using this technique, the total flows of household income and expenditure in the original GTAP database are unchanged.

3.4. Poverty calculation

The percentile income and expenditure data from the survey are then linked into the model using the micro-accounting method. Using this approach, the impact of the policy for each percentile of representative household is calculated by applying the change in the consumer price and primary factor income to the particular household group (see Anderson, 2020; Annabi et al., 2006). The real income of the household representatives is then used to calculate poverty impact by using the poverty headcount ratio method employed by Warr and Yusuf (2014). Using this method, we arrange households by real income per capita and then measure poverty incidence by the headcount ratio for each subcategory by applying the following formula:

$$P\left(\{y_c\}, y_p\right) = \max\left\{c \,|y_c \geq y_p\right\} + \frac{y_p - \max\left\{y_c \,|y_c \leq y_p\right\}}{\min\left\{y_c \,|y_c \geq y_p\right\} - \max\left\{y_c \,|y_c \geq y_p\right\}} \tag{1}$$

where, $c = 1, \ldots..$, 100 percentiles of household, arranged by real income per capita;
y_p = poverty line;
y_c = real income per capita of household in the cth percentile; and
$\{y_c\}$ = a set containing all y_i;

Table 1
Macroeconomic impacts of trade war on US, China, and developing countries performance (percentage change).
Source: Authors' calculation.

Variable	Year	US	China	Indonesia	Vietnam	Thailand
GDP	2025	−0.23	−0.55	0.14	0.80	0.37
	2030	−0.29	−0.71	0.17	1.09	0.56
Export	2025	−4.32	−1.48	0.31	1.08	0.88
	2030	−4.96	−1.81	0.55	1.70	1.22
Import	2025	−4.23	−5.30	0.96	2.34	1.59
	2030	−4.33	−5.32	0.97	2.64	1.83

We then perform the following method to calculate the change in the poverty incidence from the simulations:

$$\Delta P = P\left(\left\{y_i'\right\}, y_p\right) - P\left(\{y_i\}, y_p\right) \tag{2}$$

where y_i' is then policy simulation's real income per capita calculated as $y_i' = \left(1 + \frac{\hat{y}_i}{100}\right) y_i$, and $\hat{y}_i$ is the percentage change in real income per capita of household in the percentile c produced from the policy simulation of the CGE model.

4. Result and discussion

4.1. Simulation setting

Considering the discussion in the previous sections, the following simulation is undertaken for this study:
Scenario 1: US–China trade war implemented in 2018 and 2019
Scenario 2: US–Indonesia limited trade deal implemented in 2021
Scenario 3: Indonesia tax rate cut for corporate income from 25% to 22% in 2020
Scenario 4: Combined simulations (Scenarios 1, 2, and 3)

In Scenario 1, this study simulates the US–China tariffs retaliation in numerous waves during 2018–2019, as listed in Appendix A. For this simulation, the 8 digits tariffs data regarding the US and China 2018–2020 are weighted and aggregated into GTAP sectors classification (See Appendix B for tariff escalation by sectoral classification of GTAP). The information on the detailed tariffs line for the US and China are compiled from Li (2020).

The next two simulations (Scenarios 2 and 3) exercise Indonesia's policy measures in order to take advantage of the ongoing trade war. In Scenario 2, this study simulates the implementation of the US–Indonesia limited trade deal in 2021. Given that the bilateral trade deal is still under negotiation (Yuniar, 2020), little information is available about the technical aspects. Thus, in this simulation, we reduce the tariffs of the top 20 commodities most heavily traded by the two countries by a maximum of 5%. The tariff reduction is implemented in the model from 2021. Next, in Scenario 3, this study simulates a tax cut of the Indonesian corporate income rate from 25% to 22% in 2020. This simulation is part of domestic reforms designed to capture investment spillover, as described in the previous section. Last, Scenario 4 combines the policy simulation of Scenarios 1, 2, and 3.

4.2. Macro results

We begin the analysis by describing macroeconomic and sectoral impacts of the policy simulation and then describe poverty impact.

Table 1 shows the macroeconomic impacts of the trade war on the US, China, and some representatives of developing countries, such as Indonesia, Vietnam, and Thailand. At the macroeconomic level, the Chinese and US economies are expected to significantly contract by 0.71% and 0.29%, respectively. China suffers a greater reduction because the US is its largest export destination; for the US, China is only their third-largest export destination. For the US, if the goal of tariffs retaliation is to weaken China's economy, then it will be achieved, but at the cost of its US domestic economy. These results are in line with other studies even though the magnitude of the US–China economic contraction is weaker than reported by Itakura (2020) and slightly stronger than reported by Mahadevan and Nugroho (2019). Our estimation of the US–China GDP contraction is closest to those estimated by Bellora and Fontagne (2020).

The GDP contraction for the US and China displayed in the scenario 1 is mainly contributed to by the decreases in trade, because tariffs are escalating for both countries. US total export declines by 4.96%, while China's export declines by 1.81% in 2030. On the other side, total imports for the US and China decline by 4.33% and 5.32%, respectively. This decline, in turn, will caused trade diversion from the US and China to other countries, including developing countries.

The trade diversion affects developing countries via the following mechanism. First, the excess supply from the US and China reduces the global price index of commodities heavily traded by both countries, such as textiles, electronic products, metal products, machinery and equipment, wood products, and non-food crops. Due to lower global commodity prices, the import demand from developing countries increases. As seen in Table 1, imports of Indonesia, Vietnam, and Thailand

Table 2
Impacts of trade war on Indonesian macroeconomic performance (percentage change).
Source: Authors' calculation.

		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
		US–China trade war		US–Indonesia limited trade deal		Indonesian corporate income tax cut		SIM1 + SIM2 + SIM3 combined	
		2025	2030	2025	2030	2025	2030	2025	2030
1	Real GDP	0.14	0.17	0.02	0.05	0.03	0.06	0.19	0.28
2	Aggregate import	0.96	0.97	0.58	0.59	0.11	0.12	1.69	1.73
3	Aggregate export	0.31	0.55	0.26	0.29	−0.09	−0.04	0.49	0.81
4	Aggregate private consumption	0.17	0.19	0.05	0.07	0.03	0.05	0.26	0.31
5	Aggregate investment	0.51	0.38	0.17	0.19	0.20	0.22	0.90	0.81
6	Import price	−0.21	−0.24	0.00	0.00	0.00	0.00	−0.21	−0.25
7	Export price	0.10	0.03	0.14	0.12	0.02	0.01	0.28	0.18
8	Terms of trade	0.32	0.28	0.14	0.12	0.02	0.01	0.49	0.42
9	Consumer price index	0.18	0.12	0.18	0.17	0.06	0.05	0.43	0.36
10	Average payments to unskilled labor	0.36	0.33	0.34	0.35	0.12	0.12	0.84	0.83
11	Average payments to skilled labor	0.35	0.32	0.34	0.34	0.11	0.12	0.83	0.81
12	Average payments to capital	0.38	0.36	0.24	0.25	0.19	0.20	0.77	0.78
13	Lowest 20% income household	0.18	0.19	0.13	0.14	0.07	0.08	0.39	0.42
14	Highest 20% income household	0.19	0.20	0.04	0.05	0.09	0.10	0.32	0.36
15	Lowest 40% income household	0.18	0.19	0.12	0.13	0.08	0.09	0.39	0.42
16	Highest 40% income household	0.19	0.20	0.05	0.07	0.09	0.10	0.33	0.37

increase by 0.97%, 2.64%, and 1.83%, respectively, in 2030. Lower import prices benefit developing countries because they will increase the competitiveness of developing economies due to lower production costs.

Second, the trade diversion creates excess demand effect from the US and China to developing economies. Given import tariffs escalate for these two countries, importers in both would try to find alternative sources for imports. This situation creates demand from developing countries and boosts their exports. Table 1 shows that exports from Indonesia, Vietnam, and Thailand increase by 0.55%, 1.70%, and 1.22%, respectively, in 2030. However, third, the trade war may also indirectly reduce exports from developing countries due to lower demand from the US and China.

Compared to other developing countries, Indonesia suffers smaller trade war impacts on its exports, imports, and GDP (see Table 1). This difference is due to the following points. First, manufacturers in Vietnam and Thailand produce close substitute products for those that are heavily traded by the US and China, such as textiles, machinery and equipment, electronic products, and metal products. Sectoral results show that both countries' exports are increasing significantly in the sectors[2]. Second, each developing country has a different level of trade openness index. The index indicates the country's exposure to international trade, and it is measured by dividing total trade by GDP. The trade openness index for Vietnam, Thailand, and Indonesia, was 210%, 110%, and 37% respectively in 2018. With greater trade openness, the Vietnam and Thailand economies are also able to source cheaper intermediate inputs for production, which has seen an expansion. Not surprisingly, Vietnam and Thailand will receive a larger boost in GDP compared to Indonesia.

For Indonesia, the impact of the trade war is reflected in the 0.24% decline in import prices and 0.03% increase in export prices in 2030, and these changes are due to trade diversion from the US and China (Table 2). Thus, the terms of trade are improved by 0.32%. This result benefits the developing country because it somewhat reflects welfare gains for Indonesia, given the country can import more than previously for a given unit of exported goods/services. Subsequently, imports and exports will increase by 0.97%, and 0.55%, respectively, in 2030.

In the sectoral level, effects of the trade dispute are mixed, particularly because the US and China are among Indonesia's largest trading partners. First, it can be seen from Table 3 that the excess supply from the US and China cause an increase in imports of several commodities, including rice (9.22%), textiles (2.23%), wood products (2.23%), fruit and vegetables (1.70%), rubber & plastic products (2.13%), and metal products (1.83%). Second, excess demand from US and China importers who struggle to find alternative suppliers causes some of Indonesia's exports to increase, including paper products (0.61%), electronic products (8.1%), and other manufacturing product (6.48%). Third, lower output of China's economy indirectly creates lower demand for Indonesian exports of coal (−0.52%), and fish and livestock (−0.58%).

2 Sectoral results for the specific country available upon request.

Table 3
Effect on selected industries in 2030 (percentage change).
Source: Authors' calculation.

Industries	Output				Export				Import			
	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 1	Simulation 2	Simulation 3	Simulation 4
Rice	0.10	−0.10	0.02	0.02	1.67	−1.51	−0.89	−0.93	9.24	0.74	0.49	10.68
Other food crops	0.04	−0.34	−0.05	−0.38	0.26	−0.38	−0.34	−0.51	0.07	1.11	0.12	1.37
Fruit & vegetable	−0.09	−0.11	0.00	−0.20	−0.71	−0.58	−0.30	−1.65	1.70	1.18	0.16	3.07
Livestock	0.07	−0.02	0.02	0.07	−1.82	−0.67	−0.33	−2.90	0.37	1.34	0.19	1.99
Forestry	0.12	0.26	0.11	0.51	0.13	−1.27	−0.47	−1.72	−0.14	0.40	0.37	0.67
Fisheries	0.08	−0.01	0.01	0.08	−0.58	−0.45	−0.18	−1.25	0.23	0.29	0.13	0.68
Coal	−0.44	−0.20	−0.07	−0.73	−0.52	−0.23	−0.09	−0.87	−0.05	0.00	0.16	0.12
Oil & gas	0.22	−0.25	−0.08	−0.14	0.30	−0.36	−0.19	−0.28	0.04	0.09	0.15	0.30
Minerals	−0.02	−0.13	0.11	−0.05	−0.79	−0.35	−0.17	−1.34	0.39	0.29	0.27	0.97
Meats	0.09	−0.01	0.03	0.12	−0.49	−1.76	−0.18	−2.59	0.60	3.03	0.12	3.82
CPO & vegetable oils	0.00	−0.56	−0.06	−0.68	−0.08	−0.81	−0.10	−1.07	−0.13	0.19	0.04	0.11
Processed foods	0.10	−0.09	0.02	0.02	0.19	−0.50	−0.11	−0.50	0.40	1.49	0.08	1.99
Sugar	0.03	−0.16	−0.01	−0.15	−0.04	−0.60	−0.20	−0.91	0.23	0.36	0.08	0.69
Textile products	−0.51	4.32	0.10	4.23	−0.11	9.02	0.12	9.73	2.23	3.56	0.04	6.17
Wood products	−0.02	−0.43	0.09	−0.40	−0.64	−1.49	−0.04	−2.30	2.23	0.79	0.16	3.28
Paper products	0.37	−0.39	0.08	0.02	0.60	−0.89	0.10	−0.28	0.49	0.02	0.03	0.55
Refinery products	0.11	−0.05	0.08	0.14	−0.08	−0.14	0.02	−0.20	0.18	0.11	0.05	0.35
Chemical & pharmaceutical	−0.30	−0.32	0.10	−0.56	−0.77	−0.68	0.09	−1.45	0.68	0.82	0.06	1.63
Rubber & plastic products	−0.14	0.18	0.07	0.11	−0.74	0.83	−0.05	0.01	2.13	0.73	0.13	3.07
Metal products	0.03	−0.19	0.16	−0.01	−0.61	−1.08	0.06	−1.72	1.84	0.42	0.14	2.47
Electronic	4.51	−0.61	0.07	3.99	8.10	−0.76	0.03	7.43	1.98	0.14	0.15	2.31
Machines & equipment	−0.43	−0.72	0.17	−1.05	−0.15	−1.23	0.18	−1.33	0.86	0.25	0.18	1.31
Cars & motorcycles	0.07	−0.47	0.16	−0.28	0.13	−1.22	0.24	−0.97	0.77	0.40	0.08	1.29
Other manuf. products	2.12	0.21	0.10	2.55	6.48	0.70	0.05	7.53	3.22	0.66	0.15	4.10

The net effect of the trade war is reflected in the output of each industry. Industries that register higher outputs include the paper, electronic, and other manufacturing industries. The magnitude of expansion is strong for electronic (4.5%) and other manufacturing industries (2.12%) but relatively modest for paper (0.37%). On the other hand, some industries also experience a modest contraction, including coal (−0,44%), machines and equipment (−0.43%), textile products (−0.51%), and pharmaceuticals (−0.3%).

To maximize the benefits of the trade war, Indonesia has taken several policy measures, including proposing a US–Indonesia limited trade deal and cutting the corporate income tax rate. These measures are simulated in Scenarios 2 and 3, respectively. The policy measure of a US–Indonesia limited trade deal (Scenario 2) increases Indonesia's GDP by 0.02% in 2025 before expanding to 0.05% in 2030 (see Table 2). For the US economy, the impacts of this policy are positive although small, given that trade with Indonesia only represents a minute share of their total trade. The policy measure also significantly boosts Indonesia's textile industry, with its exports and output expanding by 9.02% and 4.32%, respectively. This outcome is not surprising, since the US is traditionally the largest export market for Indonesian textiles.

The next policy measure, a tax rate cut for corporate income (Scenario 3), adds a further boost to the Indonesian economy. Due to this policy, the country's GDP expands by 0.03% in 2025 before expanding further to 0.06% in 2030 (Table 2). This expansion results from a 0.22% increase in investment due to corporate income tax cuts in Indonesia. Scenario 3, however, demonstrates that this policy has a negligible, indirect impact on other countries.

The last scenario (Scenario 4) shows that the introduction of a domestic policy measure to the trade war significantly improves benefits for Indonesia. With the policy measure (Scenario 4), the Indonesian GDP expands by 0.28%, far greater than the 0.18% expansion without any policy measures (Scenario 1). Under this scenario, Indonesia's exports (imports) also improve by 0.812% (1.729%), almost double that found in Scenario 1.

4.3. Poverty and income distribution effects

As we have learned from the previous subsection, trade diversion emerging from the US–China trade war brings improvement in terms of trade for Indonesia. This situation alters the competitiveness of domestic industry and eventually changes the output of these industries. Under the general equilibrium framework, the effects on the economy are not ended here. For the household, welfare is affected on both the income and consumption sides. When the output of certain industries increases (decreases), the demand for labor and capital required for production also increases (decreases). It will change the factor prices, reflected in real wages (for skilled and unskilled labor) and real returns to capital. This in turn alters the distribution of income households across income groups. Eventually, the poverty incidence will also be changed.

In the case of Scenario 1, the sectoral output impact of the US–China trade war favors capital-intensive industries, such as electronic, paper, and other manufacturing products, but not labor-intensive industries, such as textile products (Table 3). Thus, it can be seen in Table 1 (rows 10–12) that the return to capital is slightly higher than payment to labor. In this case, a larger gain flows to upper-income-level households compared to those in the lower-income level. This result is reflected in Fig. 2 (Scenario 1), in which real income effect is slightly progressive. However, since the real income of all households increases, the US–China trade war as simulated in Scenario 1 lowers the poverty incidence in Indonesia by 0.06% in 2040 (Fig. 3).

In contrast to Scenario 1, Scenario 2 brings regressive effect to the income distribution (Fig. 2). Under the scenario, the gains for lower-income households outweigh those in the upper income level. The US–Indonesia limited trade deal means

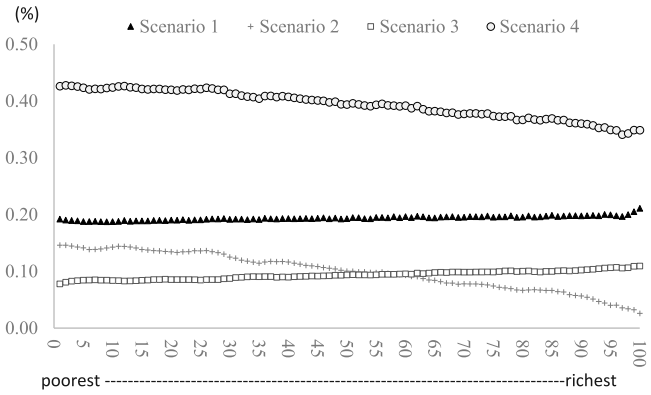

Fig. 2. Impact on household real income by income percentile in 2030 (percentage change). Note: The horizontal axis denotes the household income percentile and vertical axis indicates percentage change in real income.

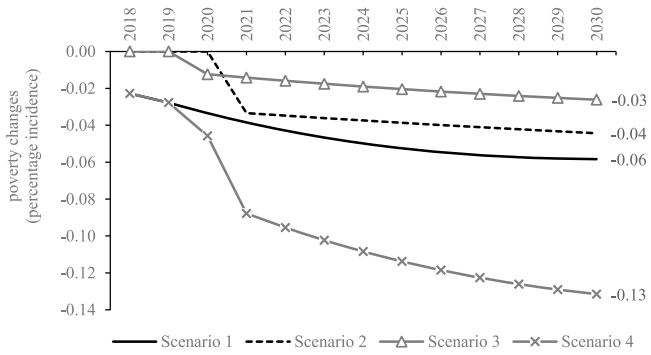

Fig. 3. Poverty impact.

an increase in output for textile industries where the industry itself is labor intensive. Thus, labor income increases more than capital income (see Table 2, rows 10–12). In this scenario, Indonesia's poverty incidence reduces by 0.04% in 2030 (Fig. 3).

The policy measure of corporate income tax cuts as introduced in Scenario 3 increases return to capital at a much higher level than payments to skilled and unskilled labor (see Table 2, rows 10–12). Thus, in Fig. 2 we can see that the income distribution effect of this simulation is progressive. Under Scenario 3, the poverty incidence lowers by 0.03% in 2030 (Fig. 3). It is interesting to compare this simulation with Scenario 2. Although the GDP impact is slightly lower in Scenario 3, the poverty reduction shown in Scenario 2 is preferable. This result is due to differences in the income distribution impact of both scenarios.

With the introduction of policy measures for the trade war (Scenario 4), a positive impact on household real income and poverty reduction results. Household real income increases for all income levels. The effect on income distribution is altered from progressive, in Scenario 1 (without policy measures), to regressive in Scenario 4 (with policy measures), which benefits the developing economy. Under the combined simulation of Scenario 4, the lowest 20 percentile of household real income increases by 0.42%, outweighing the highest 20 percentile that expands by 0.36% in 2030. Poverty reduction is also nearly doubles compared to Scenario 1. Scenario 4 lowers the poverty reduction incidence further to 0.13%, from a 0.06% reduction in Scenario 1. While the magnitude is relatively small in all simulations, the good news is poverty changes show a downward trend over time for all simulations.

5. Conclusion

While literature has warned about the severe economic consequences of the trade war, it is mostly focused on the winners and losers of the trade dispute. This study, however, places a strong focus on the poverty and income distribution impact of the trade war for a developing country such as Indonesia. Using a multi-region and multi-household dynamic CGE model, this study unveils the dynamic relationship between the trade war, its macroeconomic impact on the developing country, and eventually its impact on poverty and income distribution among all household groups in Indonesia.

The US–China trade war affects the Indonesian economy through trade diversion, which improves the country's terms of trade. This event, in turn, will positively affect the returns of primary factors owned by households and reduce poverty. However, given the heterogeneity in household primary factors endowment, each household would be affected to a different magnitude. The US–China trade war's impact on Indonesia's industries favors capital-intensive industries rather than labor-intensive industries, so capital will earn a higher return than labor. In that case, a larger gain will flow to upper-income-level households that endow more capital than to those on the lower-income levels that endow more unskilled labor.

The empirical evidence from this study warns policymakers that, although the trade war might reduce poverty, it might also increase inequality. The empirical evidence also supports the notion that policy measure is important for maximizing the trade war gain and altering the negative impact on income distribution. For example, the policy measure of the US–Indonesia trade deal can alter the negative income distribution impact while benefiting both countries. Thus, the design of a policy measure is important. For instance, a policy that promotes labor-intensive industries such as textiles can improve income distribution.

Due to the study limitations, the empirical results need to be considered with caution. The simulations in the study do not account for an ongoing COVID-19 pandemic. It is hard to effect that due to technical complexities. Baldwin and Tomiura (2020) already mentioned that the pandemic could affect the economy in many ways, such as via direct labor supply disruption, supply chain changes, and demand-side shocks. Besides, an impact assessment of the COVID-19 health crisis is beyond the scope of this study.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

This work was supported by the Bank Indonesia Institute [grant numbers 22/PKS/BINS/2020]

Appendix A. Measures implemented in trade war scenario (scenario 1)

No	Tariff measures	Date started	Description
1	US aluminum	2018/03/23	US increases tariffs on aluminum (10%) and steel (25%) imports
2	China 3b	2018/04/02	China's imposes tariffs on 128 US products, worth US$ 3 billion
3	US wave 1	2018/07/06	US increases tariffs on China's products (worth US$ 34 billion)
4	China wave 1	2018/07/06	China increases tariffs on US's products (worth US$ 34 billion)
5	US wave 2	2018/08/23	US increases tariffs on China's products (worth US$ 16 billion, or US$ 50 billion cumulative)
6	China wave 2	2018/08/23	China increases tariffs on US's products (worth US$ 16 billion, or US$ 50 billion cumulative)
7	US wave 3	2018/09/24	US implements tariffs on US$ 200 billion worth of Chinese products
8	China wave 3a	2018/09/24	China implements tariffs on US$ 60 billion worth of US's products
11	China wave 3b	2019/05/13	China's increases tariff rates on 60 billion worth of US goods (second increase)
9	US wave 4	2019/09/01	US increases tariffs on Chinese goods, worth US$ 300 billion
10	China wave 4	2019/09/01	China increases tariffs on US goods, worth US$ 75 billion

Source: Li (2020).

Appendix B. Shocks in trade war scenario (percentage change)

No.	Commodities	Tariffs shock imposed for China			Tariff shock imposed for US		
		2018	2019	2020	2018	2019	2020
1	Rice	0,00	0,00	0,00	0,00	0,00	0,00
2	Other food crops	20,18	−13,74	0,00	9,82	−2,41	0,00
3	Fruit & Vegetable	13,42	−15,10	0,00	4,07	5,89	0,00
4	Livestock	−1,37	4,54	0,00	0,00	4,94	0,00
5	Forestry	9,96	3,77	0,00	13,57	−1,45	0,00
6	Fishery	16,04	−14,96	0,00	0,00	8,45	0,00
7	Coal	20,49	−19,62	0,00	15,00	0,00	0,00
8	Oil & gas	1,67	5,00	0,00	15,00	−10,00	0,00
9	Minerals	7,88	3,15	0,00	14,96	−8,61	0,00
10	Meats	12,58	−14,98	0,00	0,05	9,95	0,00
11	CPO & vegetable oils	−1,07	3,52	0,00	11,68	1,35	0,00
12	Processed foods	7,12	−5,32	0,00	5,02	1,84	0,00
13	Sugar	−5,40	0,12	0,00	10,68	−1,22	0,00
14	Textile products	−1,15	2,50	0,00	3,33	0,78	0,00
15	Wood products	11,77	0,50	0,00	0,00	6,42	0,00
16	Paper products	13,68	0,24	0,00	0,00	10,00	0,00
17	Refinery products	21,01	−3,85	0,00	22,63	−2,35	0,00
18	Chemical & Pharmaceutical	4,29	−0,16	0,00	10,58	−1,84	0,00
19	Rubber & plastic products	0,60	1,78	0,00	10,58	−6,40	0,00
20	Metal products	7,16	−0,35	0,00	13,02	2,37	0,00
21	Electronic	5,24	0,78	0,00	18,28	1,69	0,00
22	Machin & Equipment	1,77	1,78	0,00	24,46	−0,63	0,00
23	Car & motorcycle	0,65	0,27	0,00	24,00	−0,40	0,00
24	Other manuf. products	4,57	−3,17	0,00	13,78	0,27	0,00

Source: Compiled from Li (2020).

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