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Do inward looking trade policies affect poverty and income inequality? Evidence from Indonesia's recent wave of rising protectionism☆

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ABSTRACT

Unlike previous studies which often focus on trade liberalisation, this paper examines the impact of protectionism in the form of import tariffs and mineral export taxes on rural and urban poverty and income inequality for the first time. Using a dynamic computable general equilibrium model on Indonesia, mineral export taxes were found to adversely affect urban and rural poverty but income inequality hardly changed as the decline in income in the higher income group is not significantly different to the decline in low income groups. However, if smelters for mineral ore are developed, then there is not only a fall in poverty, more so for the rural than urban, but there is some decline in income inequality. On the other hand, although the current imposed import tariffs do not affect poverty or income inequality, any further increases from the current low average MFN applied rates, will see a rise in rural and urban poverty and income inequality. By and large, any small improvements in the trade balance brought upon by the mineral tax and import tariffs are more than outweighed by the substantial decline in real household consumption expenditure due to falls in employment and wages, thereby leading to a fall in GDP growth.

1. Introduction

While the macroeconomic and sectoral effects of trade reforms and trade liberalisation have long generated research interest, the analysis of the impacts of these trade scenarios on the welfare of the people is however relatively recent. To date, the literature on the potential of trade liberalisation to reduce poverty has grown substantially with divided views (McCulloch et al., 2001; Thirlwall and Pacheco-Lopez, 2008; Winters et al., 2004). More recently, some studies have gone on to also include the impact on income inequality (Acharya et al., 2012; Liyanaarachchi et al., 2016, Santos-Paulino, 2012; Zhou et al., 2011). But according to Anderson et al., (2011), the need for undertaking poverty and inequality analysis remains strong, notwithstanding the contributions of trade policy reforms. In fact, income inequality remains a global concern (OECD, 2015) and the worsening trend of it in developing countries is worrisome as noted by Alvaredo and Gasparini (2015).

This paper however considers the impacts of rising protectionism instead of trade liberalisation (as is often considered by previous studies) on poverty and income inequality. By doing so, it contributes to the existing literature in the following ways. First, the analysis on protectionism (as opposed to trade liberalisation) will provide a direct view as to whether poverty and income inequality will necessarily worsen if countries were to take on inward looking trade policies. To date, although Chauvin and Ramos (2012) is one of the few studies to examine the welfare impacts of a rise in protectionism in four Latin American countries, their national welfare impact is an aggregate measure that does not consider poverty incidence or income distributional impacts. In addition, their use of a multiregional model circumvents detailed analysis on the impacts on various industries or regional rural/urban effects, both of which this paper does.

The second contribution of this paper is that it is reflective of Indonesia's recent spate of trade strategies involving import tariffs and an export tax on minerals, which makes this a realistic case study. Also, Indonesia is a lower middle income country and the impacts may be different compared to the high income and upper middle income economies examined by Chauvin and Ramos (2012). Although the present goals of these trade strategies of the Indonesian government is not to address poverty or income inequality, it is nevertheless important to examine if the consequences of these policies have any adverse effects on the welfare of its citizens. Considering the current trade protectionism measures has future implications as the re-

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introduction of trade protectionist measures remain a policy option for the Indonesian government given its past historical record.

Third, although export taxes have been previously examined (see Anderson and Strutt (2015), Bussiere et al. (2010), Piermartini (2004), Soelleder (2013), Waschik and Fraser (2007)), none of these studies explicitly focussed on the impact on poverty or income distribution. To our knowledge, only Warr (2001, 2002) has examined an export tax on coconuts for the Philippines, and on rice for Thailand, to conclude that export taxes harm the poor in both rural and urban areas. Our study however focuses on mineral exports and is the first comparative analysis on the distributional impacts on poverty and income inequality arising from import tariffs and an export mineral tax.

Fourth, our study extends well beyond Indonesia to contribute to wider policy debates elsewhere given that import tariffs have seen a rise after the 2008/09 financial crisis (Bussiere et al., 2010) and with current economic conditions and the unstable financial markets, this trend may not abate anytime soon. Export taxes in particular remain an important policy instrument for many other developing countries, especially for large exporters of primary products, such as several mineral rich African countries and agricultural economies in South Asia and South East Asia.

For the case study on Indonesia, the empirical tool used is the computable general equilibrium (CGE) model as Arrow (2005) argues that, '….in all cases where the repercussions of proposed policies are widespread, there is no real alternative to CGE.' The major advantage of the CGE approach is its ability to incorporate interactions and consider the impacts on a range of macroeconomic variables that are important in an economy-wide analysis (Rege, 2003). In fact, Amiti and Cameron (2012) lament that the theoretical predictions of trade models such as the Hecksher-Olin and Stolper-Samuelson are in practice difficult to use to establish links between tariffs and wages because of confounding macroeconomic shocks. But such interrelated shocks and impacts make the CGE model all the more amenable as an appropriate analytical tool. There are several variations in the literature on the type of CGE models used to examine trade liberalisation on poverty and income inequality. For instance, Acharya et al. (2012) applies the CGE model to the Social Accounting Matrix (SAM); Liyanaarachchi et al. (2016) uses the 'top down' approach where a separately developed microsimulation model is used to feed changes predicted by a CGE model; Savard (2003) developed the 'top down bottom up' approach which is similar to the top down approach with the addition of the bi-directional link between the CGE and micro-simulation models. The problem with the microsimulation model in these studies is however, the choice of the functional form assumed/used for the poverty and income distribution models (Boccanfuso et al., 2008).

Our approach is broadly similar to that of Acharya et al. (2012) where the SAM is integrated into the CGE model. But the integrated multi-household method used in this study has a strong methodological advantage of internal model consistency (Balasko and Tourinho, 2014; Warr and Yusuf, 2014). In addition, all previous studies relied on static CGE models and the use of a dynamic CGE model in this study is an improvement as Anderson et al. (2011) warns that absence of dynamics in CGE models could provide very misleading results. Unlike the static model which provides impacts on broadly-categorised 'short-run' and 'long-run' based on time periods not clearly specified, the dynamic model provides the impacts for every year after the simulation shock, thus enabling one to examine the changes in magnitude over time with a clear specification of the length of time period needed for analysis.

The poverty and inequality analyses undertaken in this study considers rural and urban regions separately, which is another aspect often not considered in previous trade-poverty CGE analyses. Examining the urban/rural aspect is important for two reasons. While Taplov (2007) finds regionally disparate trade effects on poverty and inequality, Anderson et al. (2011) explains that trade strategies can result in a mixture of winners and losers within rural and urban regions. Thus careful consideration must be given to its impacts using disaggregated household data in both regions. Second, regional analysis such as the urban/rural divide is important as it is in line with the concept of inclusive growth in the development literature (see Commission on Growth and Development (2008)) which emphasises the need to ensure that benefits and opportunities are shared widely across the populations for balanced and sustainable growth. The relevance of this issue for Indonesia in particular has been highlighted by the World Bank (2014) concern that growth in Indonesia may not be inclusive even if Indonesia manages to avoid a prolonged growth slowdown.

The rest of this paper is organised as follows. The next section reviews the literature on trade protectionism, poverty, and income inequality followed by the situation in Indonesia on these issues. Section four sets out the framework underlying the CGE model while section five explains the results obtained. The last section concludes.

2. Literature review on the impact of trade protectionism on poverty and income inequality

Protectionism, at its root, is a political tool used by the government to enact policies that interfere in the market economy. Import tariffs are one prevalent form of protectionism where a tax on imports is levied such that foreign goods cost more than they otherwise would. Other measures include quotas, surcharges, quantitative restrictions, licensing and mixing arrangements affecting imports, rules of origin, custom valuation, variable levies, technical barriers, safeguard actions, and anti-dumping actions. Export restrictions are also another common practice as seen during the 2007–2008 global food crisis when Thailand, Vietnam, Bolivia, Russia, Brazil, India, Egypt, and Indonesia implemented export taxes and restrictions on agricultural and food commodities such as cereals and rice.

Several justifications for protectionism have been identified in the literature. By implementing an import tariff (or an export subsidy), a country can decrease (increase) its demand for imports (exports) and this could lead to an improvement in its terms of trade. Some countries may use tariffs to raise revenue, especially if they have limited capacity to rely on domestic taxation. On the other hand, developing countries such as Papua New Guinea have used export taxes and subsidies to stabilize domestic prices for their producers exporting cocoa, coffee, copra and palm oil (Piermartini, 2004). Others argue that domestic industries need to be protected and higher value processing industries need to be nurtured domestically. This was the case with the export tax on palm oil by Malaysia to support the development of the biodiesel industry; Indonesia on lumber for its domestic wood processing industry in 1994; and Pakistan in 1988 on raw cotton to stimulate its yarn cotton industry. Export taxes are popular as they are not subject to Article XI of the GATT 1994 which states that, "No prohibitions or restrictions other than duties, taxes or other charges … shall be instituted or maintained …".

Although governments do not typically levy export taxes to improve the welfare of the nation (Santis, 2000), an export tax can however redistribute income from domestic producers of the taxed commodity to domestic consumers who enjoy lower prices (Warr, 2001). On the other hand, import tariffs may raise the relative domestic price to consumers and encourage inefficient domestic producers who may be unable to lower costs to continue production, and hence consumers end up paying more. This leads to a redistribution of wealth from consumers to producers of the protected industry. And since the poor spend a larger proportion of their income on necessary goods, import taxes which are similar to consumption taxes, may be regressive when imposed on the lower income bracket. While Rodriguez and Rodrik (2000) maintain that imposing tariffs do not increase welfare, they however admit that results in the empirical literature are not robust when subjected to a variety of tests.

In fact, history shows that trade protection played a positive role in the development of post-war South Korea and Taiwan as well as the United States and Britain during the nineteenth century (Thirlwall and Pacheco-Lopez, 2008). For instance, trade liberalisation which may be a necessary condition for development and poverty reduction, has been argued to not be a sufficient condition as the bad experiences of Peru, Mali and Nepal showed (Panagariya, 2003). Goldberg and Pavcnik (2007) and Winters et al. (2004) note that Mexico, Colombia, Brazil, Argentina, India, and China saw wage inequality rise when they opened up their economies. Milanovic (2005) on the other hand argues that it cannot be strongly asserted that for any given country, openness makes income distribution worse before making it better, but it can be argued that the poor in poor countries do not seem to be beneficiaries from greater trade. Harrison et al. (2003) too reached a similar conclusion that the poorest households could lose even if trade liberalization results in aggregate welfare gains. By and large, trade liberalisation or protectionism is expected to affect GDP growth and this can be related to the wider literature on whether and how GDP growth affects the poor as discussed by studies such as Basu and Mallick (2008), and Mallick (2014).

Recent advances in trade theory at a firm level suggest that trade liberalization may be more unequalizing between skilled and unskilled workers than previously thought and this raises the possibility of adverse poverty effects (Winters and Martuscelli, 2014). For instance, using a model on heterogeneous firms, Helpman et al. (2010) show that trade liberalisation increases wage inequality while Taplov (2007) using firm level data on districts, found no significant relationship between trade liberalization and poverty or income inequality for the average district in either rural or urban India. Kis-Katos and Sparrow (2015) on the other hand differentiate between input and output tariff liberalisation to show that the former reduces poverty while the latter increases poverty for Indonesia. With regards to export taxes, studies such as Anderson and Strutt (2015), Bussiere et al. (2010), Piermartini (2004), Soelleder (2013), and Waschick and Fraser (2007) examined aggregate national welfare effects and the general conclusion was that, any welfare gains (if at all) were small and temporary.

3. Poverty, income inequality, and the resurgence of trade protectionism in Indonesia

Indonesia is a low middle income economy with an average GDP growth of about 6% since 2010 (computed from *Statistics Indonesia*). Although the economy suffered a major financial crisis in 1997/98, overall, there has been high economic growth in the past three decades. In addition, Indonesia has been successful in reducing its poverty incidence from 40.1% in 1976 to 10.96% in September 2014, and regional success was also seen in the decrease in rural (urban) poverty from 40.4% (38.8%) to 13.76% (8.16%).[1] But national income inequality given by the Gini index which fluctuated around 0.30 from 1987 to 2002, has risen since then to 0.43 in 2013, while urban (rural) inequality rose to 0.34 (0.422) since 2011.[2] The rural/urban divide is essential to consider as regional impacts can be very different and thus the use of an aggregated economy-wide analysis is misleading as this will mask such underlying differences. For instance, poverty incidence in Indonesia is higher in the rural than in the urban areas but income inequality is higher in the urban than the rural areas.

On the economic front, however, in the last few years, declines in the demand for commodities and the softening of commodities prices, as well as a sharp rise in oil imports, made Indonesia a net importer of oil and oil products in 2012 (Pangestu et al., 2015). This pushed the trade balance into deficit for the first time. The global economic uncertainty and tumbling world oil prices have only served to exacerbate the situation with the threat of a slowdown. This in part has led to the following protectionist measures since then.[3]

First, there were new regulations in 2012 on horticultural imports where horticulture was allowed to enter only at selected ports (excluding the busiest port of Tanjung Priok in Jakarta) and only registered importers could deal with horticulture imports. The latter required a bureaucratic process of getting a recommendation from the designated directorate general at the Ministry of Agriculture. Following on, the import of salt was prohibited on a seasonal basis; there was a ban on the export of raw and semi-processed rattan and the export tax on crude palm oil had risen to 15%. In May 2012, a new regulation that importers could only import goods that fall under one heading (thereby limiting the number and types of imports), and these had to be finished goods for market testing and as complementary goods. The government has ironically suggested that the new import restrictions will accelerate Indonesia's transformation from an exporter of low-value-added goods to an exporter of high-value-added goods although the process by which that is to happen, is unclear (Damuri and Day, 2015). In late 2012, a new food law to boost food self-sufficiency through quotas and bans on imports; restrictions on exports of unprocessed farm products, as well as greater state involvement in food and feed procurement, distribution and processing, came into place.

The next new policy was the export regulation of 65 mining commodities including nickel, tin, gold, copper, silver, lead, zinc, chromium, platinum, bauxite, iron ore and manganese in 2012. These commodities were subject to a 20% export tax, and to legally be eligible to export, miners had to be first registered by applying to the Ministry of Trade, only after they have first secured an approval from the Ministry of Energy and Natural Resources. Lastly, all exportation has to be verified by surveyors. While export restrictions on timber products followed in 2013, in January 2014, an announcement to escalate the raw mineral export tax gradually until 2016 was made. Indonesia is the world's largest exporter of refined tin and nickel ore and a significant exporter of iron ore and bauxite (Tijaja and Faisal, 2014). Mineral ores have long been a key contributor to Indonesia's exports and it has been argued that with the development of competitive downstream industries, an increase in processed mineral exports would more than offset any initial loss from exports and GDP (ibid).

In October 2014, the Indonesian Trade Minister indicated that one way for Indonesia to improve its competitiveness would be to safeguard its domestic markets. This led the Indonesian administration in December 2014 to enforce existing import regulations when more than 2100 registered importers had their licences suspended for not providing written quarterly reports on their import activities (Damuri and Day, 2015). In January 2015, export restrictions on industrial forestry products were imposed and in July 2015, import taxes for more than 1,000 items covering many consumer goods such as clothes, cars and food were raised to protect the local industry that is competing with imported products. The last time Indonesia actively used such protectionist measures in the form of import substitution was in the late 1970s and early 1980s. As these policies failed to foster economic growth, Indonesia undertook major economic reforms from 1985, including trade policy reforms. But these lessons appear to have been forgotten as the current wave of protectionism does not seem to see signs of abating.

On the international front, under its WTO obligations, Indonesia has bound 96.3% of its tariff lines, with 94.6% of its tariffs at a rate of 40.0% (Tijaja and Faisal, 2014). Although its simple average bound tariff is 37.1%, Indonesia's simple average Most Favoured Nation (MFN) applied tariff of 6.9% is relatively lower than most of the ASEAN economies as seen in Fig. 1. In fact, its simple average applied

[1] See http://bps.go.id, *Statistics Indonesia*.

[2] Accessed from http://iresearch.worldbank.org/PovcalNet/.

[3] For details, see Basri and Patunru (2012), Patnuru and Rahardja (2015) and http://www.eastasiaforum.org/2012/06/18/indonesia-s-new-protectionist-trade-policies-a-blast-from-the-past/.

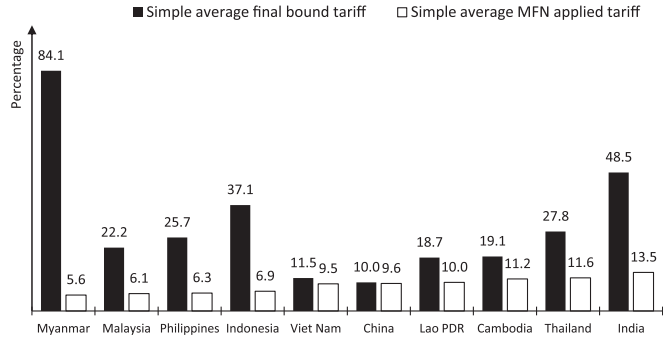

Fig. 1. Average final bound and applied MFN tariffs (%). Source: Data for 2014 from WTO Statistics Database www.stat.wto.org

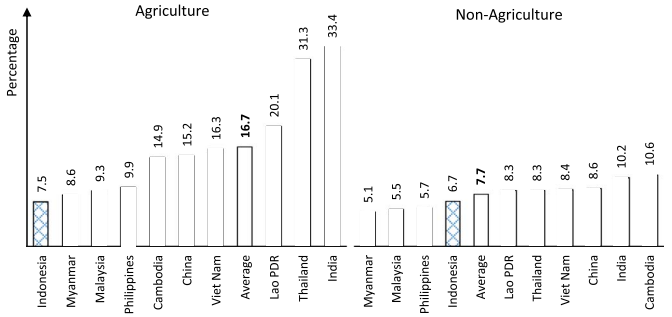

Fig. 2. Average applied MFN tariff rates for agriculture and non-agricultural products. Source: Data for 2014 from WTO Statistics Database www.stat.wto.org

tariff for agricultural (non-agricultural) products is only 7.5% (6.7%) as seen in Fig. 2. These are below the average agricultural and non-agricultural tariffs of 16.7% and 7.7% respectively for the set of countries in Fig. 2. Thus there is considerable tariff policy space for further increases and this has been recently discussed at the ministerial levels (see Ministry of Finance (2016)). As tariffs have minimal contribution to total tax revenue, about 2.7% in 2013 (Ministry of Finance, 2015), Tijaja and Faisal (2014) argue that this provides greater scope to make tariffs a main trade policy instrument.

3.1. Simulation scenarios

In light of the above discussions, the time period up to 2022 was considered for analysis which is 10 years after the implementation of the export mineral tax in 2012. The base year in the model is 2008 and for the period 2009–2012, model growth rates are based on data obtained from published sources on historical data. These are incorporated into the model, making 2012 the base year before simulations and this is the same for all the simulations. The closures used in the model are the same apart from an additional closure for SIM2A (which is explained later) for all the simulations and are as follows: i) for the most part of the model, we follow the standard ORANI-G closures (Horridge, 2003). For instance, technical change and household preferences are set as exogenous. The world price of the commodities is also fixed as Indonesia is a small open economy. ii) For the government sector, government's saving is fixed to accommodate the balanced government budget condition.

3.2. Scenario 1

Increase in the 2016 import tariff of 135 commodities (at the 4-digit industry classification and aggregated to 95 sectors) identified in the model as specified in the Regulation of Ministry of Finance No. 132/2015. Table 1 provides an indication of the extent of increase in some commodities. Thus the starting year of increase is 2016 and the impacts for this one-off increase is considered from 2016 to 2022.

Table 1
Indonesian import tariffs on selected industries (%).
Source: Original tariffs are compiled from the Harmonized Commodity Description and Coding System of the Regulation of Ministry of Finance No. 133/PMK.011/2013 and 97/PMK.010/2015. The new tariffs in SIM1 are compiled from the Regulation of Ministry of Finance No. 132/PMK.010/2015.

Industries	Original Tariffs	New Tariffs	
		SIM1	SIM1A
Basic Machineries	3.84	4.06	4.42
Candy Choco	9.17	16.11	10.53
Clothes	14.50	23.47	16.66
Coffee Products	5.00	20.00	5.75
Dairy Food	5.33	5.54	6.12
Electrical Machineries	8.06	8.28	9.26
Electronics	5.18	5.57	5.96
Foot Wear	15.00	17.74	17.24
Glass	5.81	6.29	6.68
Home Appliances	8.49	8.97	9.76
Leather	7.50	9.97	8.62
Metal Products	8.56	8.64	9.84
Motor Vehicle	16.49	19.00	18.95
Motorcycle	13.83	16.48	15.89
Music Instruments	8.25	10.00	9.48
Non-Alcohol Drink	5.00	9.55	5.75
Non-Food Crop	4.47	5.82	9.98
Other Chemicals	5.03	5.03	5.78
Other Cosmetics	6.86	9.83	7.89
Other Food	11.30	14.21	12.98
Other Machineries	5.06	5.19	5.81
Other Manufactures	4.95	5.03	5.69
Other Rubber Products	8.56	9.08	9.84
Other Transport Equipment	4.86	5.69	5.59
Paint Products	5.21	5.34	5.98
Plastic Products	9.67	10.41	11.11
Processed Fish	5.41	8.85	6.22
Processed Meat	4.26	13.28	4.90
Processed Vegetable & Fruit	5.83	6.01	6.70
Soap	4.81	5.93	5.53
Textile	9.73	10.90	11.18
Textile Products	11.29	14.71	12.98
Wood Furniture	4.90	11.22	5.63
Wood Products	1.67	1.80	1.92
Yarn	7.15	7.21	8.22

3.3. Scenario 1A

Increase in the import tariff of all agricultural products from 7.5% to 16.7% and non-agricultural products from 6.7% to 7.7%. This considers the current thinking (see Ministry of Finance (2016)) to potentially raise the current low tariff rates further in line with the existing average applied MFN tariff rates. Thus the starting year of increase is 2016 and the impacts for this one-off increase is considered from 2016 to 2022.

3.4. Scenario 2

Implementation of a raw mineral export tax in 2012–2014 of 20% (see Regulation of Ministry of Finance No. 75/PMK.011/2012) and a subsequent increase in the mineral export of 40% and 60% to be implemented in 2015 and 2016 respectively (see Regulation of Ministry of Finance No. 6/PMK.011/2014). The latter was to allow for the development of smelters to be completed to process minerals. Thus the starting year of increase is 2012 and the increases are undertaken from 2012 to 2016 as detailed in Table 2.

3.5. Scenario 2A

This scenario considers scenario 2 in addition to the development of smelters in 2015 and 2016 as the mineral export ban stipulated in the Regulation of Ministry of Finance No. 6/PMK.011/2014 will come to

Table 2
Indonesian mineral export taxes (%).
Source: Regulation of Ministry of Finance No. 75/PMK.011/2012 and No. 6/PMK.011/2014

Commodities	2011	2012	2013	2014	2015	2016
Bauxite ore	0	20	20	20	40	60
Copper ore	0	20	20	20	40	60
Gold ore	0	20	20	20	40	60
Iron ore	0	20	20	20	40	60
Nickel ore	0	20	20	20	40	60
Non-metal minerals	0	20	20	20	40	60
Other metal ore	0	20	20	20	40	60
Silver ore	0	20	20	20	40	60
Tin ore	0	20	20	20	40	60

an end in 2017. After 2017, the production capacity of the basic non-ferrous industry (which is the main user of bauxite, copper and tin ore as intermediate inputs) is increased to absorb the banned mineral exports locally. The starting year of the mineral export tax increase is 2012 and this goes on until 2016 as stated above since it includes the second scenario. Investment in the basic non-ferrous industry is however endogenous until 2014, and from 2015–2017, it becomes exogenous to allow for the investment in smelters. Thus during 2015–2017, the capital stock of the basic non-ferrous industry is held fixed until the smelter development project is completed. After 2017, when the smelter development project is completed, the capital stock and technical change parameter of the basic non-ferrous industry is increased so that its production capacity rises by 40% to absorb the increase in the domestic supply of mineral ores that are banned for export. Similar to scenario 2, the impacts are considered from 2012 to 2022 with the additional simulations in 2015–2017.

4. Framework of the computable general equilibrium model

The approach adopted in this study is to use a national CGE model to capture the above trade protectionist measures in line with the objective of examining the impacts on the domestic economy in a detailed manner. The CGE model used for the policy simulations is modified from the static ORANI-G type model (see Horridge (2003)) of INDOFISCAL (Amir et al., 2013), by incorporating dynamic features as explained later. The INDOFISCAL model uses the standard Indonesian IO Table which has 175 industries and 175 commodities. The IO tables focus on output production and price composition and is the main source of database. But these tables have limited information on the flow of financial transactions particularly related with the government institution (taxes, transfer, subsidy, and other government transactions). This limited information is however available in the SAM. Hence the Indonesian 2008 SAM (see Badan Pusat Statistik (2011) for details) which has 24 industries and 24 commodities is incorporated into the modified database following the approach of PHILGEM (see Corong and Horridge (2012) for technical details on how this is done). Fig. 3 shows the set up and stages of developing the model for use.

The production structure of ORANI-G is given by each industry having a single output, using the inputs from domestic and imported good as intermediate inputs, primary factors and other costs. The primary factors of production include land, capital, and labour and intermediate inputs are sourced domestically or imported with an imperfect substitution between these sources given by the Armington assumption (Armington, 1969). The structure of the final demand for investment by industries is very similar to those in the structure of production except there is no requirement for primary factors and other costs and capital is assumed to be produced with inputs from domestic and imported commodities.

As the trade policy simulations involve shocking the tariffs, it was important to align the model's database to the Harmonized System Code of tariff classification. This system is a multipurpose international product nomenclature developed by the World Customs Organization which provides information on customs tariffs for many products. According to this system, based on 10-digit codes, there are 9,652 commodities imported by Indonesia of which 1,151 commodities are affected by the increase in import tariff analysed in the paper. For practical reasons and ease of analysis to focus on key commodities, we aggregate the final classification to 95 commodities.

Next, to consider the impact of the tariffs on poverty and income inequality, the household categories were disaggregated into urban and rural percentiles of income. This was based on the information on 200 representative households from the National Socio-Economic Survey (SUSENAS) which were incorporated into the model using the integrated multi-household method following Balasko and Tourinho (2014). Drawing from Warr and Yusuf (2014) on their study on Indonesia, households are first categorized into 100 subcategories of rural and 100 subcategories of urban households arranged by expenditure per capita (that is, from the lowest/poorest percentile to the richest percentile). Following Warr and Yusuf (2014), poverty incidence measured by the headcount ratio is computed for each subcategory using the following formula:

$$P\left(\{y_c\}, y_p\right) = \max\left\{c | y_c < y_p\right\} + \frac{y_p - \max\left\{y_c | y_c < y_p\right\}}{\min\left\{y_c | y_c > y_p\right\} - \max\left\{c | y_c < y_p\right\}} \quad (1)$$

where y_p=poverty line;

y_c=expenditure per capita of a household of the c-th centile
c=1, 2, ..., 100.

Hence, y_1 is the poorest centile group while y_{100} is the richest centile group, and by construction, $y_{i+1} \geq y_i$. The above equation describes the poverty level as the highest percentile for which the expenditure per capita is less than the poverty line, plus a linear approximation to where the poverty incidence lies between this centile and the next centile. Poverty line data for rural and urban regions are obtained from Badan Pusat Statistik (2015) and are updated every year using the consumer price index. Appendix A summarises the method from Warr and Yusuf (2014) that is used to compute the impacts of the simulation on poverty. The same method is used to compute income inequality using the Gini coefficient, $G(y_c)$ defined in Yusuf (2013) as:

$$G(y_c) = \frac{1}{n}\left(n + 1 - 2\frac{\sum_{c=1}^{n}(n + 1 - c)y_c}{\sum_{c=1}^{n} y_c}\right) \quad (2)$$

The poverty head count given by Eq. (1) and the Gini given by (2) are calculated with 200 representative households as studies such as Amir et al. (2013), Yusuf (2007), and Warr and Yusuf (2014) on CGE models on Indonesia tested and found that a representative sample of 200 households from the SUSENAS data set was sufficient for the incorporation of the information based on 200 households to be integrated into the CGE model.

Lastly, the model adopts the recursive dynamic mechanism of the ORANIGRD model of Horridge (2002). The model is recursive dynamic in the sense that each period is solved as a static equilibrium problem given the stock of capital and investment and the results for a particular period are used to update the database to form the basis for the next simulation and so on. The dynamic features work through three mechanisms: (i) capital accumulation (ii) investment and (iii) employment/real wage adjustment. In the capital accumulation mechanism, the growth rate of capital stock is linked to investment at the beginning of the period, less depreciation. Investment itself is determined by the rates of return for each industry. The last mechanism works via the adjustment of real wages to employment levels. That is, real wage rises if end-of-period employment exceed some trend.

To assess the impacts of the trade scenarios set out earlier, the

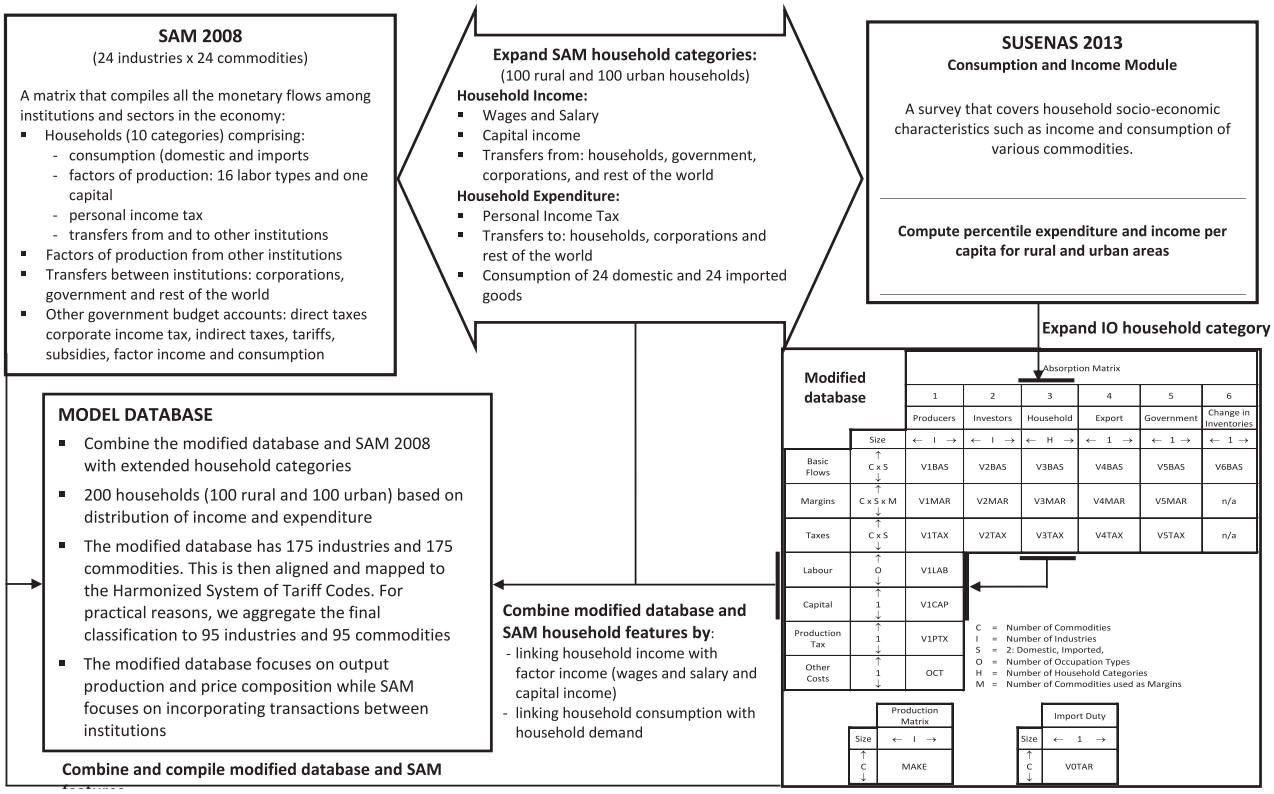

Fig. 3. Construction of the model's database.

model was first used to produce a base case projection, which is defined as the growth path the economy would take without the policy, that is, under business as usual conditions. Following that, we undertake a second (deviation) projection with the policy change in place. The impacts of the policy changes are then measured by the differences between the deviation and the business as usual projections. The model's base year is 2008 and for the period 2009–2012, model growth rates are based on data obtained from published sources on historical data. The variables that are forecast in the base case projections are set exogenous and shocked according to their projected values. In the deviation simulation, these variables revert to being endogenous. Additional shocks are then added in the deviation simulation to consider the impact of the four policy scenarios.

5. Empirical results and analysis

The macroeconomic effects are presented in Table 3 while the sectoral effects for the import tariffs and mineral export taxes are set out in Tables 4 and 5 and Fig. 4. We first discuss the impacts of the import tariffs. The imposition of an import tariff is said to bring about two price effects (Metzler, 1949). One is the primary price change where the domestic price of imports over and above world price constitutes an immediate benefit to the industries competing with the imports. But on the other hand, the tariff also causes a series of events which tend to reduce the domestic price of the country's imports relative to the prices of its exports, and this improves the terms of trade.

It can be seen that for Indonesia, there is a slight improvement in the terms of trade and this is more favourable with higher import tariffs as seen in scenario 1A compared to scenario 1 in Table 3. On a sectoral basis however, the net effect of these price changes is mixed. If the net effect is that the tariff reduces the domestic prices of imports relative to prices of exports, then, resources will shift from industries competing with imports to the export industries, thereby leading to a fall in the output of the protected industries (Metzler, 1949). This means that protectionism has failed to deliver the goal of stimulating these very industries it hoped to help, because the terms of trade effect outweighed the size of the tariff (ibid).

Table 4 shows that only half of the protected industries under scenario 1 registered an increase in output while the higher import tariffs under scenario 1A show that 26 of the 35 industries' showed a

Table 3
Macroeconomic effects (cumulative percentage change from 2012 to 2022).
Source: Compiled from simulation results.

	SIM1[a]	SIM1A[a]	SIM2	SIM2A
Real GDP	-0.024	-0.175	-0.449	-0.057
Consumer Price Index	0.053	0.130	-0.293	0.349
Real Household Consumption	-0.044	-0.286	-0.387	0.127
Government Consumption Expenditure	0.164	0.831	1.860	2.235
Aggregate Employment	-0.005	-0.049	-0.038	0.026
Aggregate Import (in nominal value)	-0.179	-0.742	-0.420	0.122
Aggregate Import (in volume)	-0.179	-0.742	-0.420	0.122
World Import Price	0.000	0.000	0.000	0.000
Domestic Import Price	0.126	0.612	0.000	0.000
Aggregate Export (in nominal value)	-0.122	-0.344	0.101	-0.038
Aggregate Export (in volume)	-0.149	-0.405	-1.086	-1.729
Terms of Trade	0.027	0.061	1.187	1.691
Normalized Trade Balance (net exports/ total trade)	0.0003	0.0021	0.0025	-0.0020
Real devaluation	-0.056	-0.151	-0.015	-0.770
Import Tariff Revenue (in million US$)	4.588	21.806	-0.326	0.190
Export Tax Revenue (in million US$)	-0.065	-0.153	76.118	72.385
Average Payments to Capital (in real terms)	0.030	0.058	-0.367	0.366
Average Payments to Labour (in real terms)	0.013	-0.166	-0.499	0.629
Average Rural Wage (in real terms)	0.011	-0.162	-0.500	0.625
Average Urban Wage (in real terms)	0.015	-0.169	-0.497	0.633

Notes: As Indonesia is a small economy in the global market, it has no impact on world import prices. Hence the nominal value and volume change in aggregate imports are the same.

[a] The percentage change for these simulations are from 2016 to 2022.

Table 4
Effect of import tariffs on selected industries (cumulative percentage change from 2016 to 2022).
Source: Compiled from simulation results.

Industries	GDP/Output		Value of Imports		Domestic Price	
	SIM1	SIM1A	SIM1	SIM1A	SIM1	SIM1A
Basic Machineries	-0.074	-0.697	-0.076	-0.637	0.025	0.242
Candy Choco	1.970	0.246	-12.781	-3.436	-0.167	0.067
Clothes	0.361	-0.217	-31.641	-7.053	0.024	0.058
Coffee Products	0.869	-0.080	-38.078	-6.197	-0.002	-0.026
Dairy Food	0.047	1.210	-0.115	-3.391	0.024	-0.110
Electrical Machineries	-0.080	-0.388	-0.093	-0.910	0.023	0.035
Electronics	-0.140	-0.614	-0.315	-1.146	0.076	0.255
Foot Wear	0.027	0.117	-3.942	-7.920	0.031	0.027
Glass	-0.027	-0.309	-0.525	-2.343	0.018	0.101
Home Appliances	0.605	1.072	-1.355	-3.104	-0.011	0.035
Leather	0.157	-0.081	0.023	-0.277	0.018	-0.011
Metal Products	-0.080	-0.600	-0.057	-0.766	0.027	0.165
Motor Vehicle	0.021	-0.012	-0.281	-1.103	0.061	0.165
Motorcycle	-0.281	-0.706	-0.447	-1.161	0.310	0.711
Music Instruments	-0.125	-0.146	-0.280	-1.345	0.024	0.038
Non-Alcoholic Drinks	0.065	-0.237	-15.387	-2.052	0.024	0.110
Non-Food Crop	0.011	0.255	-0.033	-0.707	0.016	-0.050
Other Chemicals	0.023	0.155	0.065	-0.478	0.009	0.046
Other Cosmetics	0.638	0.208	-4.186	-3.441	-0.015	0.135
Other Food	-0.062	-0.107	-0.390	-1.730	0.054	0.171
Other Machineries	0.234	0.183	-1.475	-2.440	0.016	0.030
Other Manufactures	-0.065	-0.760	-0.065	-0.700	0.015	0.421
Other Rubber Products	-0.081	-0.222	-0.062	-0.964	0.030	0.152
Other Transport Equipment	-0.036	-0.232	-0.197	-1.671	0.025	0.147
Paint Products	-0.064	-0.356	-0.079	-1.387	0.017	0.116
Plastic Products	0.394	-0.058	-5.089	-5.036	0.009	0.239
Processed Fish	-0.015	-0.172	-1.490	-0.586	0.030	0.020
Processed Meat	6.349	1.115	-12.522	-2.787	-1.399	-0.272
Processed Vegetable & Fruit	-0.028	0.557	-0.064	-4.351	0.025	-0.081
Soap	0.010	-0.196	-0.781	-3.005	0.017	0.160
Textile	0.036	-0.391	0.036	-0.721	0.033	0.175
Textile Products	0.023	-0.194	-0.831	-4.075	0.028	0.118
Wood Furniture	-0.044	-0.066	-1.404	-1.276	0.022	-0.019
Wood Products	-0.098	-0.289	-0.089	-0.375	0.020	-0.039
Yarn	-0.091	-0.932	0.012	-1.043	0.026	0.285

decline in output. These include basic machineries, electronics, wood products, yarn, electrical machineries, metal products, wood furniture, glass amongst others. The fall in output cautions against higher import tariffs (such as that of scenario 1A) in particular, as the goal of protecting industries does not appear to be attained. The expansion in the protected industries was not substantial either as there was not a lot of contraction in the other domestic industries resulting from the limited movement in the factors of production out of these industries to the expanding protected industries.

Hence there was a decrease in aggregate GDP and employment and this was more pronounced with a larger increase in import tariffs under scenario 1A. However, the import tariffs did discourage imports as intended (see Table 4) and thus trade balance improves (see Table 3). But the import tariffs lead to an increase in the domestic price of the commodities (see Table 4) and hence the CPI (see Table 3) due to an increase in the demand for the local import-competing goods while the local currency given by the rupiah loses value due to a fall in the demand for foreign currency to buy the more expensive imports.

International trade taxes comprising import and export duties have not exceeded 5% (1%) of total tax revenue (GDP) in the Indonesian economy since 2005. While trade tax revenue is not a major revenue source for Indonesia, it nevertheless is not insignificant as it amounted to about US$5.55 billion in 2013 (Ministry of Finance, 2015). The tariff revenue from imports is seen to increase government consumption

Table 5
Effect of mineral export taxes on selected industries (cumulative percentage change from 2012 to 2022).
Source: Compiled from simulation results.

Industries	GDP/Output		Value of Exports		Value of Imports	
	SIM2	SIM2A	SIM2	SIM2A	SIM2	SIM2A
Food Crop	-0.228	0.146	3.077	-2.664	-1.125	0.820
Non Food Crop	0.360	-0.423	0.867	-1.009	0.141	0.208
Fruit Vegetable	-0.039	0.098	0.969	-1.231	-1.318	1.482
Livestock & Fishery	-0.120	-0.040	0.899	-1.093	-1.046	1.050
Forestry	-0.176	-0.242	1.251	-1.411	-0.088	0.377
Coal	0.651	-0.573	1.086	-0.934	0.159	0.212
Tin Ore	0.814	-0.420	-1.353	-1.069	1.400	0.567
Nickel Ore	-36.609	-8.733	-3.573	-3.859	-13.490	-20.800
Bauxite Ore	-50.963	-14.236	-1.355	-1.061	-17.401	-17.878
Copper Ore	-42.752	-8.162	-3.874	-6.288	-13.539	-21.147
Gold Ore	5.194	3.175	-0.736	6.881	5.523	9.324
Silver Ore	-0.101	-0.529	-1.109	-0.043	0.042	0.783
Iron Ore	-6.718	-7.485	-1.166	-0.823	-0.669	-1.054
Other Mining	-0.691	0.178	0.336	-1.274	-0.845	0.393
Meat	-0.139	0.017	2.161	-2.400	-1.203	1.086
Processed Meat	0.176	-0.367	2.480	-3.559	-0.985	1.060
Dairy Food	0.097	-0.484	2.237	-2.965	-1.135	1.166
Rice	-0.256	0.162	7.881	-7.413	-1.422	1.054
Sugar	0.072	-0.360	1.346	-1.693	-0.935	0.866
Coffee Products	-0.293	0.069	0.916	-0.998	-1.403	1.278
Tea Products	0.229	-0.506	1.035	-1.249	-1.447	1.478
Non-Alcoholic Drinks	-0.312	0.067	0.420	-0.480	-1.405	1.318
Cigarette	-0.310	0.091	0.347	-0.362	-0.605	0.399
Textile Products	0.395	-0.367	2.063	-2.087	-0.969	1.059
Clothes	0.919	-0.781	1.967	-1.558	-1.327	0.906
Foot Wear	1.335	-1.342	2.530	-2.368	-1.227	0.982
Paper Manufacturing	0.807	-0.589	1.925	-1.718	-0.179	0.079
Paint Products	-0.094	-0.317	1.544	-2.491	-0.700	0.363
Soap	0.012	-0.228	1.567	-1.738	-1.182	1.158
Plastic Products	0.094	-0.303	1.431	-1.601	-0.792	0.647
Glass	-0.215	-0.303	1.388	-2.410	-0.608	0.711
Ceramic Products	0.321	-1.049	1.742	-2.546	-0.891	0.465
Cement	-0.700	0.181	0.918	-1.453	-0.884	0.468
Non Metal Products	-0.485	-0.140	1.351	-2.677	-0.813	0.629
Basic Metal Non Ferrous	5.194	76.746	4.855	74.289	0.421	2.504
Metal Products	-0.643	0.064	1.677	-2.783	-0.964	0.290
Electronics	0.393	-0.667	1.889	-2.138	-0.044	0.082
Home Appliances	0.440	-0.432	2.185	-2.327	-0.899	0.691
Motor Vehicles	0.403	-0.259	1.829	-1.938	0.003	0.366

expenditure (see Table 3) but this was not enough to outweigh the negative GDP growth.

With the mineral export tax in scenario 2, the export price of minerals increase, leading to a fall in the demand for exports and hence the fall in the output of the various minerals is substantial as seen in Fig. 4. It also appears that the local demand for these minerals does not rise enough, thereby leading to falls in GDP and aggregate employment (see Table 3). This leads to a fall in the returns to capital and labour, hence adversely affecting rural and urban wages. These declines in income lead to a fall in consumption and hence a fall in inflation given by the consumer price index (CPI). However, if the smelter development comes through as simulated in scenario 2A, these adverse effects will be mitigated with an expansion in the use of capital and labour, thereby increasing employment, and raising rural and urban wages. This stimulates increases in real household consumption (and raises CPI) and hence the output of the expansion in smelter development enables the initial decline in GDP brought upon by the mineral export tax to be lowered (see Table 3). There is also substantial mineral export tax revenue at the government's disposal valued at US$76 million

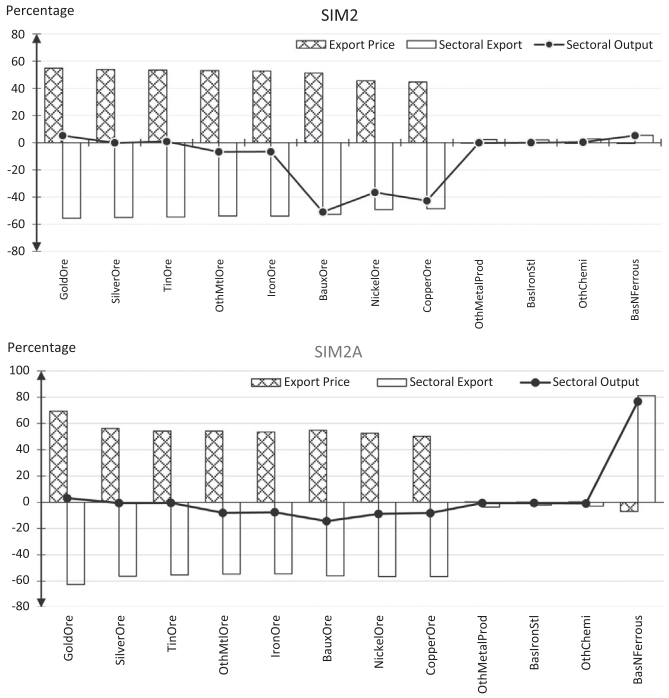

Fig. 4. Sectoral impacts on minerals from mineral export taxes (cumulative percentage change from 2012 to 2022). Source: Compiled from simulation results.

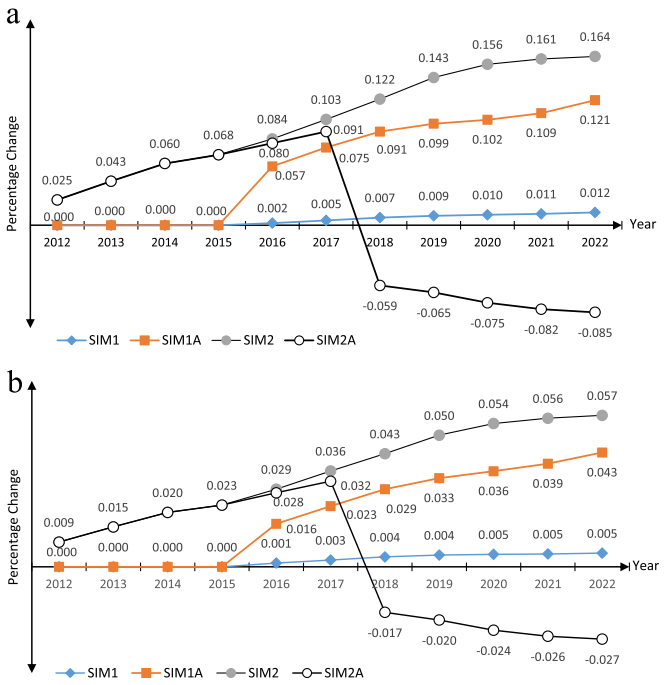

Fig. 5. a. Impact on rural poverty (percentage change). b. Impact on urban poverty (percentage change). Source: Compiled from simulation results.

which may have partially enabled government consumption expenditure to increase but this was not enough to lead to an increase in GDP growth.

One positive impact of the mineral export tax is that there is an improvement in the terms of trade. This is brought upon by the increase in the price of the taxed commodity and this will increase the relative price of exports compared to imports (Piermartini, 2004). Thus for each unit of the exported commodity, Indonesia will be able to import more. However, the rise in mineral export price leads to a fall in the demand for mineral exports as expected but exports from other industries increase (see Table 5). This is due to the availability of inputs to other sectors from the contraction of the mineral sector, which lead to lowering of wages, thereby making other export-oriented sectors more competitive. The boost to exports of these other sectors is also provided by the rupiah devaluing due to the fall in the demand for mineral exports because of the mineral taxes. At the same time, due to lowering of wages, the decline in real household consumption leads to a fall in the demand for domestic goods (decline in the output of several domestic-oriented industries such as food crops, fruit and vegetables, rice, metal products etc.), and for imports based on the marginal propensity to import (see Table 5). Overall, as seen in Table 3, SIM2 leads to a very small positive change in the trade balance of 0.0025% as the value of exports from other non-mineral industries managed to counter the decline in import value.

With the development of the smelters in SIM2A, the reverse happens. The rise in wages due to the demand for labour in the expansion in smelter development leads to an increase in imports as a result of the marginal propensity to import from the increase in income. At the same time, unlike SIM2, there is also a fall in the exports of other industries (see Table 5) due to declines in the output of some of these industries resulting from the loss in the inputs employed due the movement of inputs into the expanding smelter development. Some of the fall in the exports of these industries could also be due to the increase in the local demand for these goods due to an increase in real household consumption. Overall, there was a negative trade balance but once again, this was small at 0.002% (see Table 3).

The frequently regarded truism that a tariff injures export industries and benefits industries competing with imports, is not self-evident in the Indonesian case study. What is even less obvious in partial equilibrium analysis is, how these forces interplay to affect the welfare of the people in terms of increases in the incomes of the lower deciles of the population and income inequality in the country. For instance, when protected industries expand output, there will be a need to increase the inputs required for production. According to the Stolper-Samuelson theorem, this will raise the rates of return to the scarce factor of production due to the increased demand for it, altering the real and relative rates of return of these scarce factors in the national income. How much and how quickly these rates will rise depends on how substitutable these scarce inputs are by other inputs and how elastic the supply of these inputs are (Taplov, 2007). The general equilibrium analysis here allows for these adjustments and alterations to take place to provide the results on the changes in poverty incidence arising from the protectionist measures in Fig. 5 while Appendix B provides the poverty rates in 2022 for all the scenarios.

It can be seen from Fig. 5 that the higher the import tariffs (SIM1A as opposed to SIM1), the higher the poverty incidence in both urban and rural areas. This is due to larger falls in employment and declines in wages under scenario SIM1A (see Table 3). In terms of percentage point increases, the rural region is worse off than the urban region in SIM1A. The mineral export tax also has a greater adverse effect on the poverty levels for urban and rural regions than the import tariffs brought upon by larger falls in real wages (see Table 3). But the development of the smelters creates employment and increases real wages and this addresses the poverty increase to show declines in both rural and urban poverty levels. Accordingly, real household consumption decreases with the import tariffs (SIM1) and mineral export taxes (SIM2) but improves with the development of smelters (SIM2A) as seen in Table 3.

In terms of the Gini ratio however, there was no change after the simulations of import tariffs (SIM1) and mineral export taxes (SIM2) for the national, rural and urban ratio. For example, for these scenarios, the national Gini ratio was 0.4314 in 2022 compared to 0.4315 in the base year and it remained the same at 0.366 for the rural and 0.44 for the urban similar to the base year values. This is because the lower income groups also experience declines in their income and the decline in the higher income groups go some way to reduce the Gini

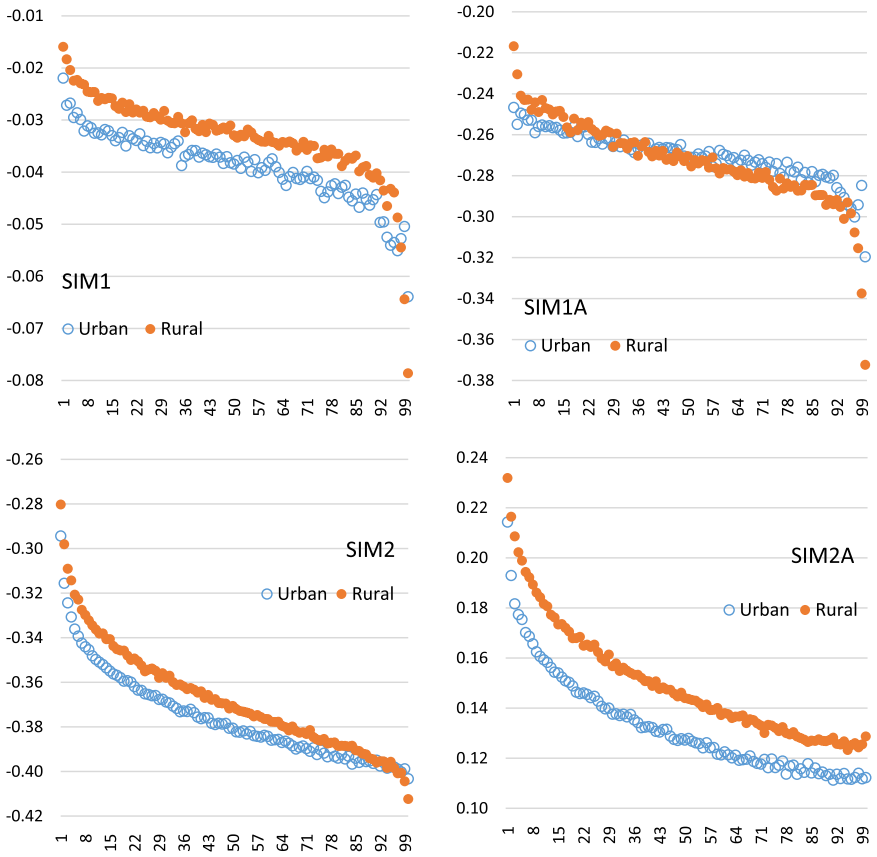

Fig. 6. Impact on household income by income percentile (cumulative percentage change). Notes: The vertical axis indicates percentage change in income and the horizontal axis denotes the income percentile of the population. Also, for SIM1 and SIM1A, the changes are from 2016 to 2022 and for SIM2 and SIM2A, they are from 2012 to 2022. Source: Compiled from simulation results.

but do not sufficiently counter the decline in the lower income groups. But Harrison et al. (2003) explains that a concern for the poor is not the same thing as a concern for equity in general. They further explain that using the simple Gini ratio can be misleading because even if the Gini ratio falls due to trade reform, this could be due to the richest households losing income, thereby offsetting the losses of the poorest households. Hence we examine the percentile incomes of the population to provide a better picture of the impacts on the poor and rich households in Fig. 6.

With the import tariffs (SIM1), the higher decreases in income is experienced by the high income groups but with the higher import tariffs (Sim1A), the declines in rural population income are more than their urban counterparts. With the mineral export taxes (SIM2), the decline in the income of the urban population is slightly more than the rural population. The smelter development (SIM2A) however raises the income of the lower end income group more than the higher end income group, and it is seen to benefit the rural population more than the urbanites.

Lastly, some sensitivity analyses were undertaken by varying the Armington elasticities and the export demand elasticities inherent in the CGE model. Table 6 shows that the results on GDP growth, poverty, and income inequality remain robust regardless of whether these elasticities are lower or higher than the ones used in the model.

Table 6
Sensitivity analysis of the impact in 2022.
Source: Compiled from simulation results.

Armington elasticities (varying elasticities for SIM 1)						
	0.5	1	2	**4**	6	8
GDP growth	-0.030	-0.029	-0.027	**-0.024**	-0.022	-0.021
Poverty Incidence						
Aggregate	6.916	6.916	6.915	**6.914**	6.913	6.911
Urban	5.163	5.162	5.162	**5.160**	5.159	5.158
Rural	9.789	9.788	9.786	**9.782**	9.779	9.776
Gini Ratio						
Aggregate	0.431	0.431	0.431	**0.431**	0.431	0.431
Urban	0.440	0.440	0.440	**0.440**	0.440	0.440
Rural	0.366	0.366	0.366	**0.366**	0.366	0.366
Export demand elasticities for minerals (varying elasticities for SIM 2)						
	0.45	0.9	**1.8**	3.5	5	
GDP growth	-0.169	-0.324	**-0.449**	-0.462	-0.448	
Poverty Incidence						
Aggregate	6.871	6.914	**6.976**	7.015	7.025	
Urban	5.134	5.167	**5.212**	5.241	5.248	
Rural	9.706	9.800	**9.934**	10.019	10.041	
Gini Ratio						
Aggregate	0.431	0.431	**0.431**	0.431	0.431	
Urban	0.440	0.440	**0.440**	0.440	0.440	
Rural	0.366	0.366	**0.366**	0.366	0.366	

Note: The values in bold in the column are based on the assumptions in the CGE model used.

6. Conclusions

This paper is a first in many respects. Contrary to common analyses on trade liberalisation, here we examine the impact of trade protectionism and do so using a dynamic CGE model for the first time. Second, a detailed regional analysis of trade protectionism on both rural and urban poverty and income inequality is presented for the first time. Third, both import tariffs and mineral export taxes are analysed in a comparative framework for the first time. The contributions of these analyses are important as the pressure to undertake protectionism measures by countries is not likely to go away due to the vulnerable

macroeconomic context, unemployment risk and widening external trade imbalances that countries encounter.

This paper is thus a timely reminder that import tariffs and mineral export taxes are distortionary and although there is some improvement in terms of trade and the trade balance, these are outweighed by the decline in household expenditure and hence a lowering of GDP growth. The mineral export taxes lead to an increase in poverty incidence in both urban and rural areas, more so in the rural than in the urban areas but with the smelter development, there is a decline in poverty. Income inequality with the mineral export taxes is not affected as changes in the incomes of the poor are not significantly different from that of the rich. However, with smelter development, there is some decline in income equality. With the import tariffs, neither poverty nor income inequality are affected but if this is raised from the current average MFN applied rates, then poverty and income inequality could worsen.

Patnuru and Rahardja (2015) have described Indonesia's trade protectionism as 'bad times and bad policy' but this trend enjoys broad political support in Jakarta and that is a cause for concern. While protectionism is far from being even a second best trade policy, if it is deemed necessary for a country to take on such a policy, then the results from this paper suggest that ways in which the tax (if this is the chosen tool) revenue earned is spent could be considered in countering negative impacts to go beyond the short or medium term over which the protectionist measures are in place. The ways in which the tax revenue is used and its impacts on poverty and income redistribution effects is an interesting avenue for future research. For instance, reforms in the financial sector as shown by Agnello et al. (2012) can reduce income inequality.

Lastly, some limitations of the analyses presented here need to be noted. First, it was not possible to consider the 'beggar-thy-neighbour' policy whereby other countries retaliate to the import tariffs and mineral export taxes imposed by Indonesia. These countries could impose high barriers and such actions would have repercussions on Indonesia that are not captured in this study. This would require a multi-country regional model for analysis but that would come at a cost of aggregation and less comprehensive effects and economic structure specific to Indonesia. Second, the restrictive assumptions such as the utility-maximising and profit-maximising behaviour of consumers and producers, perfect competition in factor and commodity markets and perfect capital and risk markets, are constraints in the model that need to be acknowledged.

Third, this study did not take into consideration inter-state disparity in economic growth, poverty and income inequality within Indonesia (see Ministry for Economic Affairs (2011), Miranti (2011)). For instance, the island of Java, particularly, Jakarta, has been the epicenter of growth while provinces such as Papua, Aceh, and Nusa Tenggara have high levels of poverty (Miranti, 2011). Such geographical differences can be expected to have differential impacts on their poverty and income inequality and thereby require different mitigation strategies. Thus state-specific regional CGE models can shed an important light on the role of regional differences.

Appendix A. Computing poverty before and after the simulations

The Foster–Greer–Thorbecke (FGT) class of the headcount poverty measure (which is a secondary derivation of the original FGT measure), P_α, is given by:

$$P\left(\{y_c\}, y_p\right) = \max\left\{c | y_c < y_p\right\} + \frac{y_p - \max\left\{y_c | y_c < y_p\right\}}{\min\left\{y_c | y_c > y_p\right\} - \max\left\{c | y_c < y_p\right\}} \tag{A1}$$

The general equilibrium simulation of the impact of a particular shock generates estimated percentage changes in the distribution of real per capita expenditures. The meaning of 'real' is that the deflators used to obtain the distribution of real expenditures from the distribution of nominal expenditures are indices of consumer prices specific to the household centile categories concerned. They are calculated using the budget shares corresponding to each individual centile group. Let $\hat{y}_c$ denote the estimated percentage change in the real expenditure per capita of centile group c. The estimated *ex post* (after the shock) level of real expenditure per capita, as estimated by the general equilibrium model, is given by y^*_c, where

$$y^*_c = \left(1 + \frac{\hat{y}_c}{100}\right) \cdot y_c \tag{A2}$$

Different centile categories may be affected quite differently by the shock, as captured by the simulation results, and the ordering of centile groups according to their *ex post* real expenditures per capita may thereby have changed from their *ex ante* ordering. The distribution y^*_c is therefore not necessarily smooth; it may not be the case that $y^*_{i+1} \geq y^*_i$. If so, the method of the headcount measure given by Eq. (A1) could not be applied directly to the distribution y^*_c. The 100 household categories in the ex post distribution y^*_c are now re-sorted according to real expenditures per capita in the same way as described above, to obtain a new distribution y^{**}_c such that $y^{**}_{i+1} \geq y^{**}_i$. The distribution y^{**}_c differs from the distribution y^*_c only by this re-sorting. Because of the re-sorting, the particular households belonging to the i-th centile subcategory of the re-sorted *ex post* distribution y^{**}_c do not necessarily correspond to those contained in the i-th centile subcategory of the *ex ante* distribution y_c.

The re-sorted *ex post* distribution y^{**}_c is now used as the basis for recalculating poverty incidence in the same manner in Eq. (A1) and substituting y^{**}_c for y^*_c to obtain $P_\alpha(y^{**}_c, y_P)$. That is, the same method is used to calculate the level of the poverty measure in the sorted *ex ante* and the re-sorted *ex post* distributions. The estimated change in the poverty measure after a policy shock is now

$$\Delta P_\alpha = P_\alpha(y^{**}_c, yp) - P_\alpha(y_c, yp) \tag{A3}$$

Source: Warr and Yusuf (2014).

Appendix B

See Table B1.

Table B1
Poverty rates.
Source: Compiled from simulation results.

	Rural Households	Urban Households	National Level
Before simulation in 2012	14.700	8.600	11.66
Baseline in 2022	9.770	5.155	6.909
After SIM1 in 2022	9.782	5.160	6.914
After SIM1A in 2022	9.891	5.198	6.957
After SIM2 in 2022	9.934	5.212	6.976
After SIM2A in 2022	9.685	5.128	6.878

Note: Baseline 2022 refers to poverty rates in the business as usual scenario when there are no mineral export taxes or import tariffs.

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