COMPARING TRADE BALANCE CLOSURES IN THE GTAP-RECURSIVE DYNAMIC (GTAP-RD) MODEL FRAMEWORK

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ABSTRACT

This paper explores the importance of macro closure rules governing the balance of trade and foreign savings in the results of model simulations using a recursive dynamic, multi-country CGE model. It first presents a stylized shock in which a single country—Vietnam—experiences a total output productivity shock, and compares results when global capital is assumed to move across regions until expected rates of return are equalized, versus a closure that fixes the region's real trade balance. Results between the two closures differ in magnitudes and in many cases differ in sign as both macro and micro adjustments occur to accommodate the alternative closure rules. After illustrating these mechanisms, the paper provides a simulation of a tariff reduction under the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), comparing selected results under two closure rules. The main findings of the paper is that a closure that allows capital inflows to equalize expected rates of return allows a capital-deepening over time that leads to stronger economic growth, increased imports but lower exports, both terms of trade and welfare gains, and a change in sectoral structure that favors capital-intensive and income-sensitive industries. A closure that imposes a fixed trade balance has negligible capital-deepening and so the same shock has weaker growth and income effects, increases in both imports and exports, a terms of trade loss that reduces welfare gains, and a change in sectoral structure that favors exportable industries.

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Introduction

This paper provides a comparison of two alternative approaches to modeling trade balances (macroeconomic closure) in the GTAP-Recursive Dynamic (GTAP-RD) model framework (Aguiar, Corong, and Mensbrugghe, 2019). The default closure in the GTAP-RD model features savings as a Cobb-Douglas share of income, and investment is allocated across regions such that percentage changes in regional expected rates of return are equalized. Therefore, when simulating a scenario using the expected rate of return closure (RORE) in the GTAP-RD model, capital moves across regions and regions' trade balances change accordingly. We contrast the RORE closure with an alternative closure that assumes a fixed trade balance, which limits international capital flows. We compare the driving mechanisms in the two closures and draw conclusions on the choice of trade balance closure in a recursive dynamic model.

The RORE closure assumes that capital flows into regions with above average rates of return and that regions can experience a continuous capital inflow over time. However, some empirical literature has found evidence that the opposite occurs, and that capital moves from emerging market economies to developed countries such as the United States. This means that capital moves from high-growth regions, that are relatively capital-scarce, to low-growth regions that are relatively capital-rich. Other empirical literature finds that running a continuous and growing current account deficit might not be sustainable. For instance, Edwards (2005, 2006) finds that a major current account reversal is positively affected by larger current account deficits, and that current account reversals are likely to result in a significant reduction in economic growth. Finally, some countries, from time to time, adopt different measures to restrict capital flows. For instance, China has been adopting measures to restrict capital outflows for years. After the 1997 Asian financial crisis, some Asian countries like Malaysia also took measures to restrict capital flows. The Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER) published by the International Monetary Fund (IMF) summarizes regulatory controls over capital account transactions. Based on the restrictions outlined by AREAER, Chinn and Ito (2002, 2006) developed a measure to quantify the intensity of capital controls by country. More recently, Fernandez et al. (2016) also developed an overall capital control restrictions index which was derived from disaggregated scores for the existence of control measures on both capital inflows and outflows by country. In sum, empirical evidence indicates that the RORE approach to the macroeconomic closure in a CGE model might not be applicable to all countries.

The empirical literature offers some insights on the choice of macro closure in the GTAP-RD model framework. This paper compares the results of two simulations with two different closures for the trade balance. The simulations are: 1) a stylized scenario in which one region's total output productivity increases by 20 percent[1] and 2) a tariff reduction among eleven member countries under the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP). We compare simulation results under the following closures: 1) the expected rate of return (RORE) approach and 2) a fixed trade balance, in which the nominal trade balance of a region as a share of world income is fixed.[2] We focus on analyzing simulation results for one country—Vietnam. Under the RORE closure, capital can flow freely across regions, and investment in each region is allocated such that percentage changes in regional expected rates of return to investment are equalized. Under the fixed trade balance closure, investment spending in Vietnam is allowed to adjust in order to maintain a fixed ratio of the trade balance to global income. The latter approach is more reflective of monetary policy interventions by the Vietnamese government.[3] Bekkers et al. (2020) explore the two trade balance closures in more detail, in a study of alternative trade balance closures in dynamic baselines. For each simulation, we examine how results for Vietnam's trade balance, capital stock, imports, exports, terms of trade, welfare, factor prices and economic structure differ under the two different trade balance closures.

The paper is organized as follows: Section 2 provides a brief introduction to the structure of the GTAP-RD model, and describes the baseline projection. The section also introduces a stylized simulation of increased total output productivity in Vietnam under the two closures, and analyzes results of the simulation under the RORE closure with the baseline projection, as well as the results of the simulation under the fixed trade balance closure compared to the same baseline projection. Section 3 details the policy simulations under the CPTPP trade liberalization scenario and discusses and compares results under the two trade balance closures. Section 4 concludes the paper.

[1] In the GTAP-RD framework, we shock aoreg("VNM") = 20;

[2] We fix the nominal trade balance as a share of world income, rather than fixing it as a share of regional income. This practice is generally applied when all model regions have a fixed trade balance because then it does not matter which country is treated as the omitted, residual region.

[3] In the GTAP-RD framework, we swap cgdslack = del_tbalry for Vietnam. This means that investment spending in Vietnam adjusts to maintain the fixed trade balance ratio; it is more reflective of monetary policy interventions. The alternative, not explored in this paper, is to swap the trade balance ratio with the dpsave variable, and let the domestic savings rate adjust to clear the trade balance; it is more reflective of fiscal policy interventions.

Baseline Projections and Stylized Simulation of an Increase in Total Output Productivity

The paper uses the GTAP-RD model, with a base year of 2011. The model has 23 regions, 5 production activities and 18 commodities.[4]

Baseline Projections

The baseline projection is run from 2011 to 2021 and includes projections for growth in real GDP per capita, population, and the skilled and unskilled labor supply for all regions. The baseline projection information comes from the Shared Social-Economic Pathways (SSP) database, and this paper uses the SSP2 projections. The baseline projection is run under the RORE closure for all regions.

As shown in Table 1, as real GDP per capita in Vietnam grows over time, the country runs a growing trade deficit with the rest of the world under the RORE closure, with a continued inflow of capital.

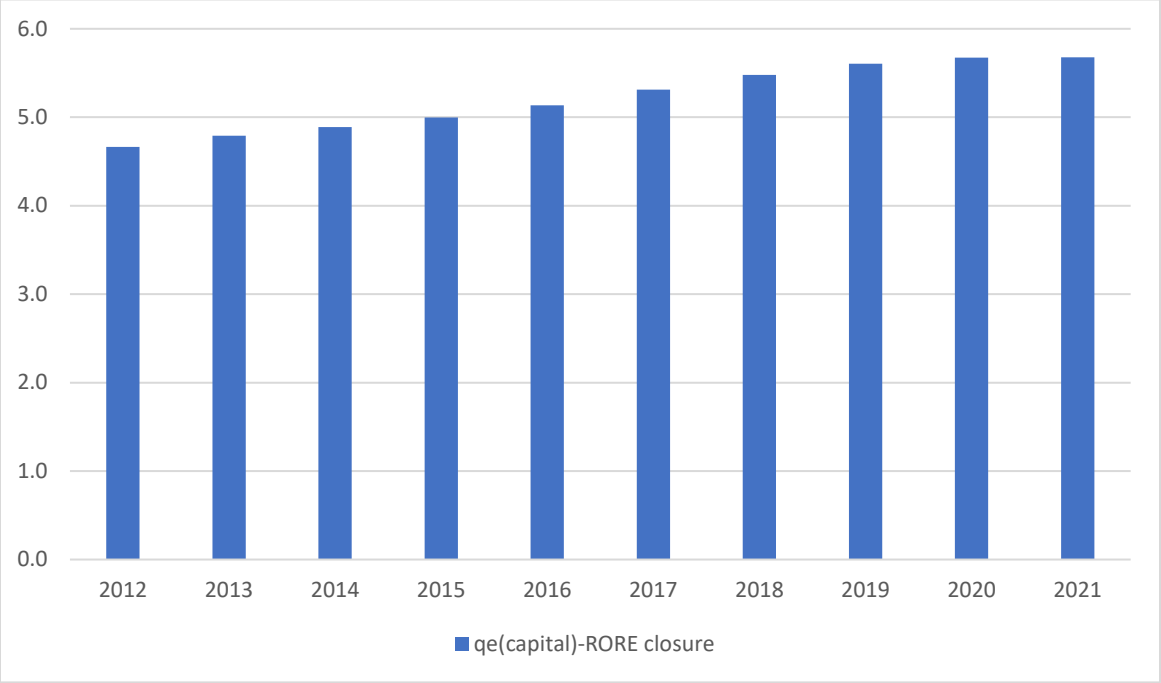
Table 1: Change in Trade Balance in Vietnam, Year by Year, in the Baseline, in $US millions

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
RORE closure	-1,334	-1,200	-1,286	-1,487	-1,746	-1,769	-1,617	-1,368	-1,070	-768

Correspondingly, Figure 1 shows the annual percentage change in the quantity of capital stock (*qe*) in the Vietnamese economy under the RORE closure. There is a continued growth in its capital stock in the baseline projection because, under the RORE closure, Vietnam does not place any restrictions on capital inflows.

[4] The 23 regions include 11 CPTPP member countries (Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, Peru, New Zealand, Singapore and Vietnam) as well as China, Korea, India, the United States, Argentina, Brazil, EU27, Britain, Turkey, Russia, Rest of Asia and the rest of the world.

Figure 1: Changes in Capital Stock, Year by Year, in the Baseline, in Percent



Results of the Simulations Under Two Different Closures Relative to the Baseline Projection

We carry out a stylized simulation in which total output productivity in Vietnam increases by 20 percent in 2012. We apply the policy shock under the two different trade balance closures. Because this productivity shock applies to all sectors in Vietnam, the shock does not introduce any sectoral distortions, thereby keeping the analysis tractable and allowing a more transparent interpretation and comparison of the macroeconomic mechanisms at work.

We frame the simulation in the following order:

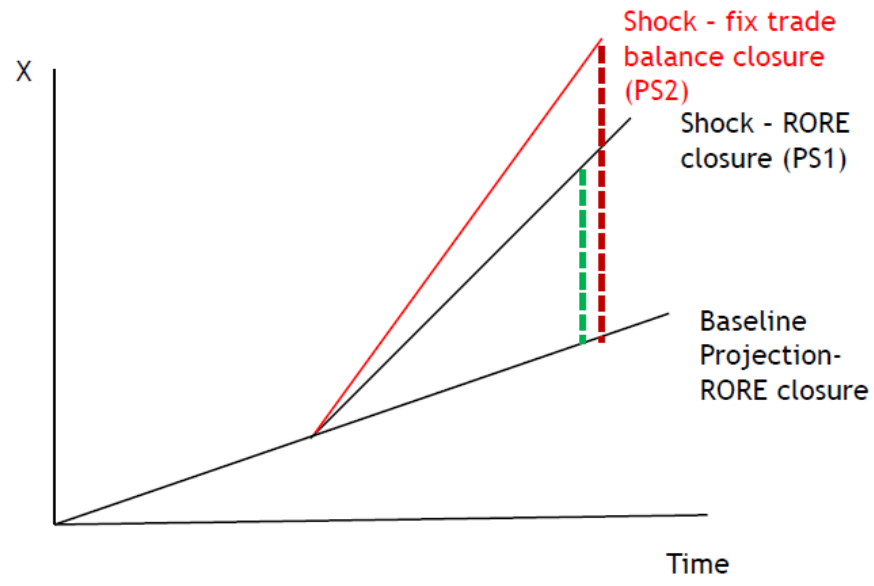
Baseline Projection: includes SSP projections as illustrated above, with the RORE closure for every region (results illustrated in the previous section)

Policy Simulation 1 (PS1): Baseline projection + policy shock in which total output productivity in Vietnam increases by 20 percent, under the RORE closure for every region

Policy Simulation 2 (PS2): Baseline projection + policy shock in which total output productivity in Vietnam increases by 20 percent, with a fixed trade balance ratio for Vietnam and RORE closure for all other regions[5]

We present the following results: 1) the differences between simulation results of PS1 and the baseline projection, as demonstrated by the green line in Figure 2; and 2) the differences between simulation results of PS2 and the baseline projection, as demonstrated by the dark red line in Figure 2. That is, for each year in the adjustment path, we compare the percentage difference between the level of a variable in the simulation relative to its level in the baseline. The comparison of results 1) and 2) illustrates the difference in results when applying different macroeconomic closures. In general, it is desirable to assume the same closures in both the baseline and a simulation. We set up the simulations in this order because our paper reports results of simulations in percent changes from baseline values, so it is convenient and transparent to compare simulation results with two different closures as percent changes from the same baseline values generated by the same baseline projection.[6]

Figure 2: Illustrative Demonstration of Simulation Results



[5] This simulation is completely stylized. However, if we put PS2 in a policy context, it says that the rapid productivity increase makes the Vietnamese government concerned about possible burgeoning trade deficit and volatility in capital flows. Therefore, the Vietnamese government adopts monetary policy to fix trade balance in real terms.

[6] We explored assuming the same RORE and fixed trade balance assumptions in both the baselines and simulations, finding small differences in the baselines, so that a departure from that practice has minimal impact on our analysis and conclusions.

Results in 2012: Changes in Trade Balance, Capital Stock, Imports, Exports, Terms of Trade, Welfare and Factor Prices

In this section we compare the simulation results under the two different macroeconomic closures compared to the same baseline projection. We examine how the two different approaches affect the changes in the trade balance, capital stock, imports, exports, terms of trade, welfare and factor prices. We also give insights as to how the sectoral results differ under two different closures. Results in 2012 and 2013–2021 are discussed separately, as the former are mainly driven by the productivity effect which only occurs in 2012, while the latter are mainly due to the capital deepening effects which occur in the RORE case but not in the fixed trade balance closure.

In 2012, with the **RORE closure**, as the Vietnamese economy becomes more productive, higher income leads to greater absorption (domestic consumption of imports, as well as domestically-produced and exportable goods and services). This causes quantities of imports to increase, and export supply to decline — with an increased trade balance deficit relative to the baseline (see Figures 3a and 4). As shown in Figure 3a, Vietnamese overall imports increase by 29.4 percent in 2012 compared to the baseline, while Vietnamese overall exports to the rest of the world decline by 41.4 percent in 2012 compared to the baseline. The lower export supply boosts export prices, providing a terms of trade (ToT) gain, which contributes to the welfare gain —Figure 3a shows that average export prices in Vietnam increase by 9.2 percent, with a gain of 9.4 percent in terms of trade. The ToT gain contributes to the increase in welfare (measured by equivalent variation) of $94.2 billion in 2012 compared to the baseline. Higher domestic demand also boosts factor prices (see Figure 3b) — this is a real exchange rate appreciation that also contributes to declining exports and growth in the trade deficit (Figure 3 and Figure 4).[7]

In the RORE closure, the capital stock and capital-labor ratio in 2012 are unchanged relative to the baseline. This is because, in the dynamic framework, the investment inflow occurs in 2012, the year of the shock, and is spent in that year on capital goods. The capital goods are not installed as new capital stock until the following year, 2013.

[7] The real exchange rate appreciation is measured by variable *pfactor* in the GTAP-RD model, which is the percent change in a region's index of factor prices. An increase in a region's *pfactor* relative to other regions acts in a similar manner as a real appreciation.

Figure 3: Changes in Quantities of Exports and Imports, ToT, Factor Prices and Factor Price Index in Vietnam in 2012 under the Productivity Shock, Compared to the Baseline, in Percent

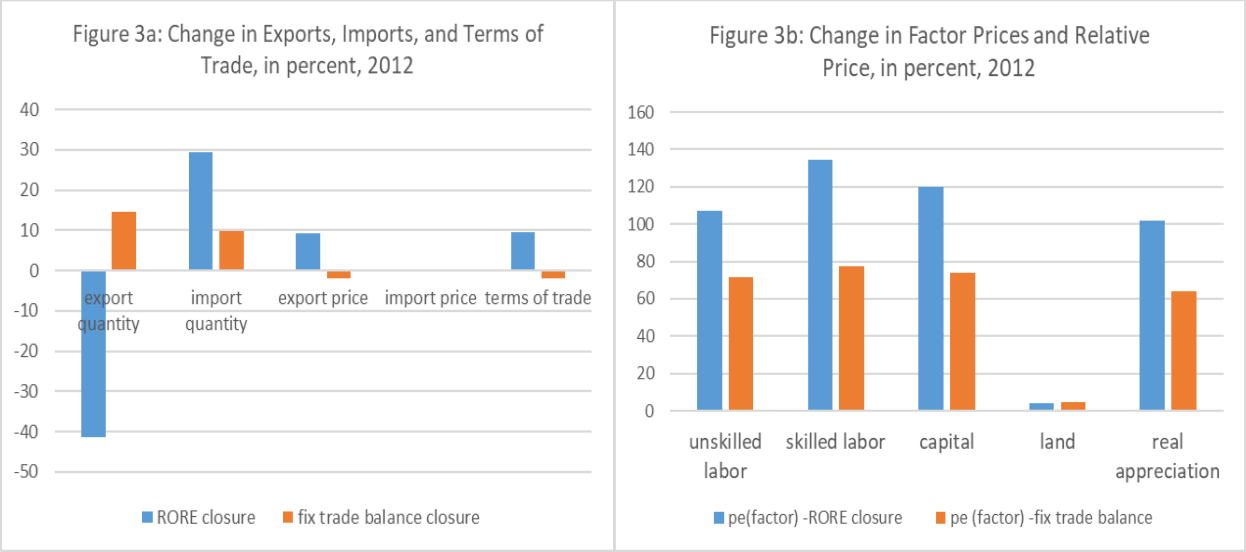
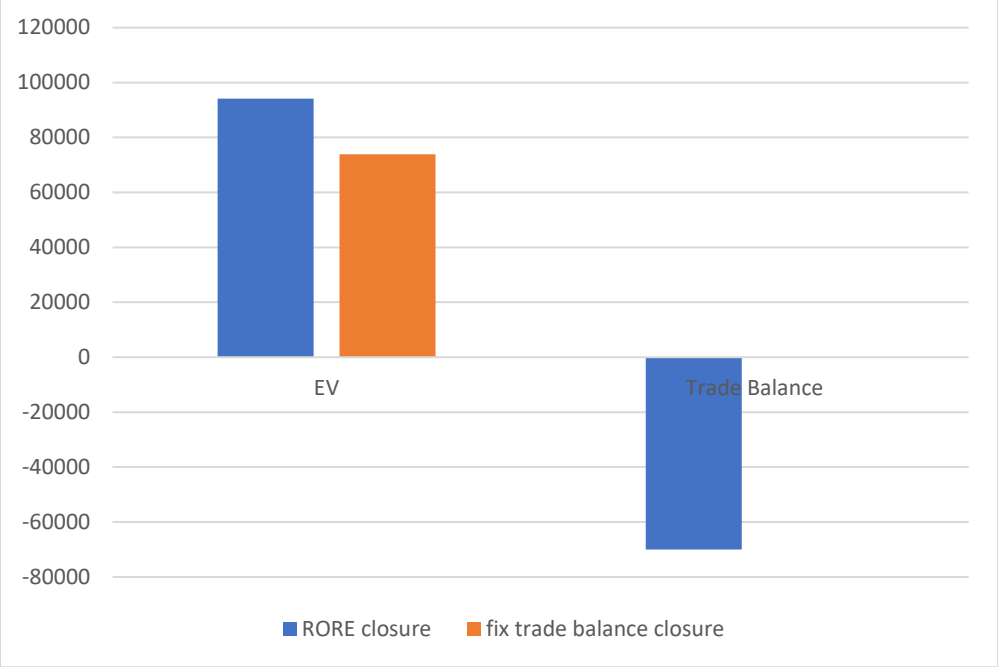


Figure 4: Changes in Equivalent Variation (EV) Welfare and Trade Balance in Vietnam in 2012, due to Productivity Shock, Compared to the Baseline, in $US millions

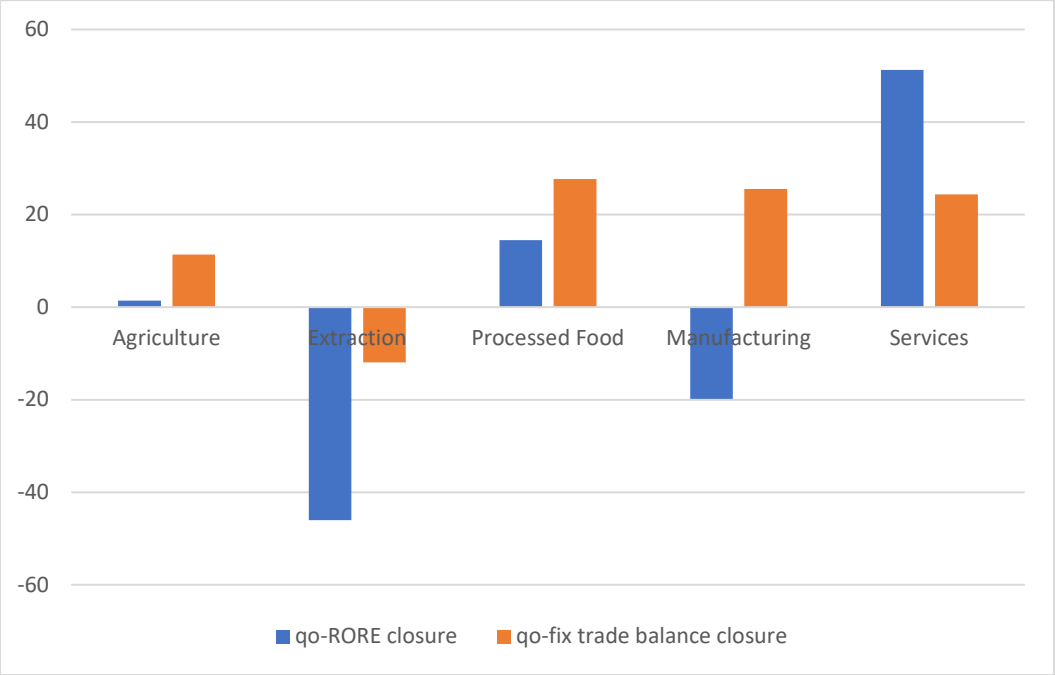


Under the **RORE closure**, in 2012, sectoral effects are similar to those of Dutch disease.[8] The relatively high income elasticity of demand for services boosts demand for services compared to non-

[8] Dutch disease refers to the structural changes associated with a price boom in an export sector, such as natural resources, and a large inflow of capital. The income or "spending" effect occurs, and resources move towards

services. Because services are mostly a non-traded good, increased demand is met by increased domestic production of services, which draws in resources from other sectors — especially manufacturing goods, which are a traded commodity. As higher imports of manufacturing goods substitute for domestic production of manufacturing goods, the output of Vietnam's large manufacturing industry declines relative to the baseline (Figure 5).

Figure 5: Changes in Sectoral Output (qo) in Vietnam in 2012, due to Productivity Shock, Compared to the Baseline, in Percent



In 2012, with a **fixed trade balance closure**, the increase in productivity and income cause import demand to rise, similar to the RORE case, but exports must increase as well to maintain the fixed trade balance. Therefore, Vietnamese exports rise, instead of falling, as in the RORE closure (Figure 3). As shown in Figure 3a, Vietnamese overall exports increase 14.5 percent in 2012 compared to the baseline. To achieve growth in exports, export supply needs to expand, causing export prices to fall, leading to a decline in ToT (unlike the rise in ToT in the RORE case), and contributing to a smaller welfare gain (Figures 3a and 4). Average export prices decline by 2.0 percent and the ToT decreases by 1.9 percent in 2012 relative to the baseline. Meanwhile, factor prices do not rise as much compared to the RORE closure, muting the exchange rate appreciation, which helps to maintain the fixed trade balance (Figure

production of the non-tradable and income-sensitive services sector at the expense of tradable sectors like manufacturing.

3b). With the trade balance fixed in real terms, there is no increase in capital inflows in 2012, setting the stage for slower capital stock growth in the future periods compared to the RORE closure.

Sectoral effects under the fixed trade balance closure also differ significantly from the RORE case. The need for export expansion causes exportable sectors to expand even as demand for non-traded services rises due to the shock's income effect. Due to resource competition between services and exportable sectors, services output increases by less than under the RORE case. In particular, as a major tradable sector, output in the manufacturing sector rises instead of falls (see Figure 5).

Results in 2013–2021: Effects of Capital-deepening with RORE Closure Compared to the Fixed Trade balance Closure

The adjustment path over 2013 to 2021 relative to the baseline under the two different closures is mostly a story of capital-deepening in Vietnam in the RORE closure compared to the fixed trade balance closure, in which the capital stock falls slightly relative to baseline (Figure 6). In the **RORE closure** case, the large trade deficit that occurs in 2012, the year of the productivity shock, provides a large capital inflow from the "global bank", followed by smaller and diminishing increases in capital inflows that continue over the 2013–2021 adjustment period (Table 2). This capital-deepening is an increase in productive resources that supports higher real GDP growth and larger welfare gains relative to the baseline (Tables 3 and 4). The economy also becomes more capital intensive, as shown in Table 5, with a capital to labor ratio for the Vietnamese economy in 2021 that is substantially higher (1.02) under the policy shock compared to the baseline projection (0.90). In the **fixed trade balance closure**, the capital stock declines slightly over the adjustment period and the economy becomes slightly less capital-intensive over time relative to the baseline (Figure 6 and Table 5).

The capital-deepening during 2013–2021 under the RORE closure leads to a growth in output in all sectors in Vietnam compared to the baseline (Table 6). In contrast, the fixed trade balance closure results in smaller growth in sectoral outputs, and even some declines, relative to the baseline. The difference in capital stock growth and therefore in the capital-labor ratios between the two closures is a key driver of the differences in these sectoral results. In the RORE closure case, capital-deepening favors larger expansions in output of Vietnam's most capital-intensive sectors – extraction, services and manufacturing. In the fixed trade balance closure, as the capital stock declines slightly relative to the baseline, outputs of the capital-intensive services and manufacturing industries instead decline and the two sectors become less capital-intensive.

Figure 6: Changes in Capital Stock in Vietnam in 2013–21, due to Productivity Shock, Compared to the Baseline, in Percent

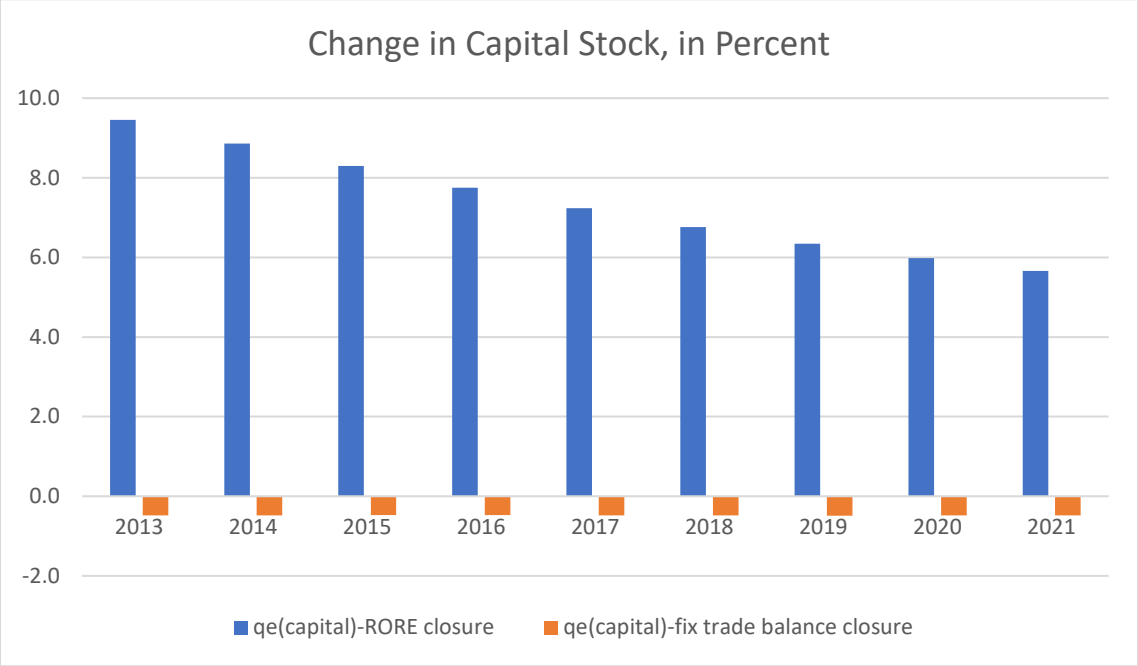


Table 2: Change in Trade Balance in Vietnam in 2013–21, due to Productivity Shock, Compared to the Baseline, in $US millions[9]

	2013	2014	2015	2016	2017	2018	2019	2020	2021
RORE closure	-6,172	-6,045	-5,966	-6,018	-6,252	-6,544	-6,804	-6,973	-7,005
Fixed trade balance closure	0	0	0	0	0	0	0	0	0

Table 3: Growth in real GDP in Vietnam in 2013–21, due to Productivity Shock, Compared to the Baseline, in Percent

	2013	2014	2015	2016	2017	2018	2019	2020	2021
RORE closure	4.4	4.1	3.9	3.7	3.5	3.3	3.1	3	2.8
Fixed trade balance closure	-0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1

Table 4: Welfare Changes in Vietnam (Equivalent Variation) in 2013–21, due to Productivity Shock, Compared to the Baseline, in $US millions

[9] Under the "fix trade balance closure", we fix the Vietnamese nominal trade balance as a share of world income. Therefore, the change in trade balance in Vietnam (in dollar value) from 2013 to 2021 is smaller than -0.5 million each year.

	2013	2014	2015	2016	2017	2018	2019	2020	2021
RORE closure	17,812	18,974	20,457	22,246	23,759	24,847	25,485	25,656	25,440
Fixed trade balance closure	4,867	5,402	6,142	7,042	7,762	8,247	8,508	8,556	8,449

Table 5: Capital/Labor Ratios in 2021 by Production Activity under Different Closures, due to Productivity Shock, Baseline VS. Shock[10]

RORE closure	**Agriculture**	**Extraction**	**Processed Food**	**Manufacturing**	**Services**	**Total**
2021 baseline	0.47	3.33	0.75	0.83	0.95	0.90
2021 productivity shock	0.32	2.20	0.80	0.95	1.15	1.02
Fixed trade balance closure	**Agriculture**	**Extraction**	**Processed Food**	**Manufacturing**	**Services**	**Total**
2021 baseline	0.47	3.33	0.75	0.83	0.95	0.90
2021 productivity shock	0.48	3.41	0.75	0.82	0.94	0.89

Table 6: Changes in Output in Vietnam in 2013–2021 Compared to the Baseline, due to Productivity Shock, in Percent

RORE closure	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Agriculture	1.8	1.8	1.8	1.8	1.7	1.6	1.5	1.4	1.3
Extraction	9.7	9.1	8.4	7.7	6.9	6	5.2	4.5	3.9
Processed Food	2	2	1.9	1.9	1.8	1.7	1.6	1.5	1.4
Manufacture	4.7	4.8	4.8	4.7	4.5	4.2	4	3.8	3.7
Services	4.7	4.3	3.9	3.5	3.2	3	2.9	2.8	2.7
Fixed trade balance closure	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Agriculture	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Extraction	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Processed Food	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Manufacture	-0.6	-0.6	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
Services	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1

[10] The capital to labor ratio is calculated by taking the value of EVFB (expenditure on endowment e used by different activities in Vietnam) for capital and labor, and divide between the two.

Tariff Liberalization under the CPTPP

In this section we compare the same scenario of tariff liberalization under the CPTPP under the RORE and fixed trade balance closure assumptions. The simulations run from 2011 to 2036. We assembled information about tariffs as specified in the CPTPP text. The CPTPP, also known as TPP11, is a trade agreement between Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam. According to the tariff schedule from the CPTTPP, the tariff reduction starts in 2019. Phase-in periods for tariff elimination differ by country and by commodity. Most of the trade liberalization is front-loaded in the early years of the implementation period. By 2036, most of the tariffs among CPTPP countries will be eliminated.

In contrast to our stylized simulation of a single country's productivity shock, there is substantial noise around our analysis of the two closure assumptions in the CPTPP scenario because the levels of tariff distortions and reforms vary by country and commodity; all member countries are implementing trade reforms at the same time; and the tariff policy shocks continue over the whole 2019–2036 time period. Nevertheless, the same key mechanisms identified in our stylized simulation can be recognized in the results of the CPTPP shocks. We separately discuss results for 2019, before capital inflows are installed as working capital stock, and 2020–2036 when capital deepening may occur.

Results in 2019: Effects under the CPTPP Trade Liberalization Scenario

With the **RORE closure**, the reduction of tariffs among Vietnam and the other 10 CPTPP member countries leads to an increase in import demand by Vietnam as well as an increase in demand for Vietnamese exports, mainly from the other 10 CPTPP countries. The increased demand for Vietnamese exports drives up export prices in Vietnam relative to its import prices. Meanwhile, a small real appreciation in Vietnam, reflected by an increase in its factor price index of 0.64 percent (Figure 7), also makes Vietnamese exports more expensive relative to its imports. Therefore, Vietnamese overall real exports to the world decline by 0.1 percent while its overall imports from the world increase by 0.5 percent in 2019 relative to the baseline. The increase in its imports coupled with a decline in exports corresponds with an inflow of capital into Vietnam and an increase in its trade deficit compared to the baseline (Figure 8). The increase in its export prices relative to import prices leads to a gain in terms of trade (ToT). The ToT gain, plus the allocative efficiency gains from tariff reforms, account for the majority of the increase in Vietnam's welfare in 2019 compared to the baseline (Figure 8).

Figure 7: Changes in Exports, Imports, ToT and Relative Factor Prices in Vietnam in 2019 due to CPTPP Compared to the Baseline, in Percent

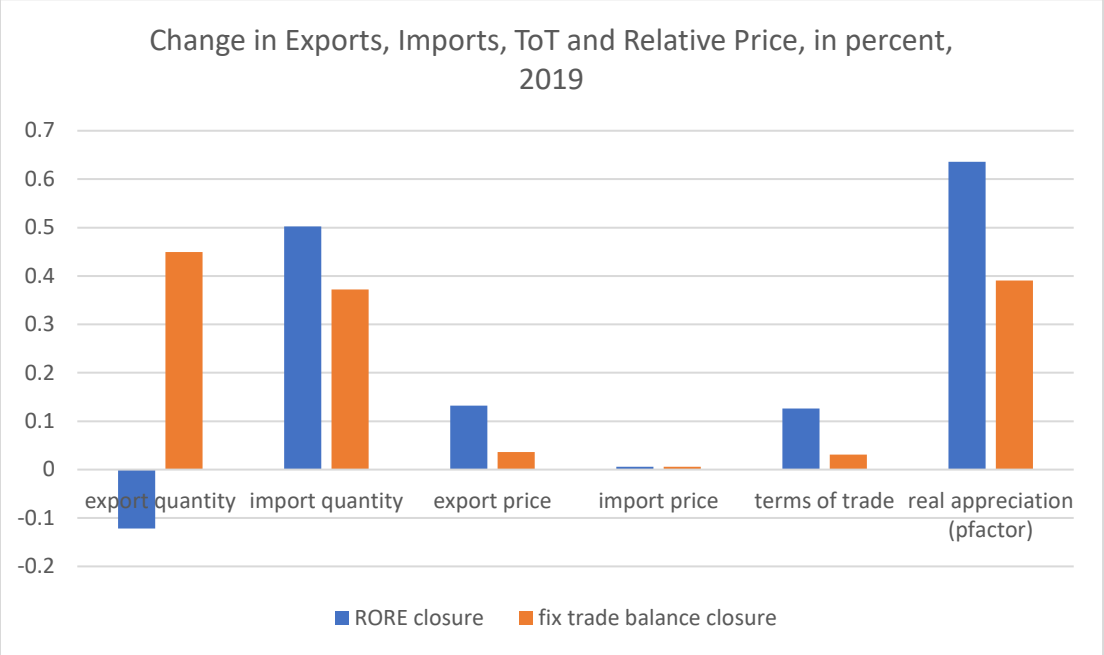
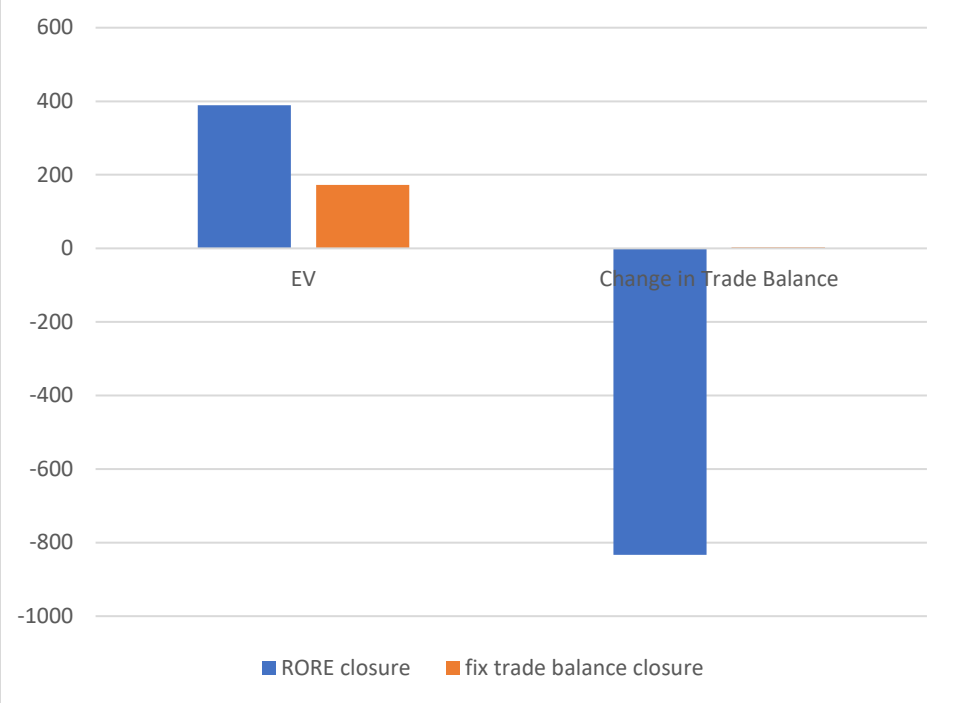


Figure 8: Changes in Equivalent Variation (EV) Welfare and Trade Balance in Vietnam in 2019 due to CPTPP Compared to the Baseline, in $US millions



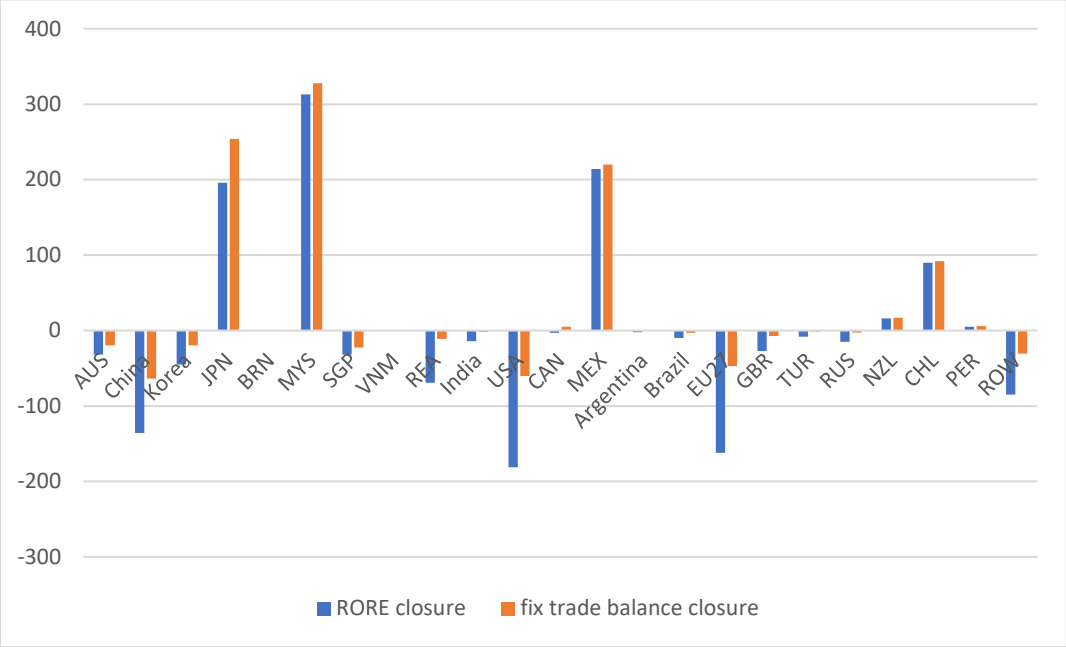
Under **the fixed trade balance closure**, the reduction of tariff barriers among CPTPP member countries also causes an increase in import demand in Vietnam in 2019. However, in order to maintain the fixed trade balance ratio, Vietnamese export supply also needs to increase. Therefore, Vietnamese exports to the world rise by 0.45 percent rather than falling as in the RORE closure (Figure 7). The increase in Vietnamese export supply has a depressing price effect that offsets some of the increase in export price due to higher CPTPP demand (Figure 7). The smaller export price increase, compared to the RORE case, leads to a smaller gain in ToT and in turn a smaller gain in welfare — welfare increases by $173 million under the fixed trade balance closure relative to the baseline (Figure 8).

Trade Diversion Effects under Two Different Closures

The trade balance closure assumptions matter to both the size and the positive/negative direction of change in Vietnam's aggregate trade flows due to the CPTPP, but there are relatively small differences between the closures in their effects on bilateral market shares in Vietnam's world trade. Trade diversion occurs in both cases: Under the tariff liberalization scenario in CPTPP, Vietnam exports more in total to CPTPP member countries, and less to non-members. As shown in Figure 9, under the **RORE closure**, the value of Vietnamese exports to some CPTPP member countries increases in 2019 — its exports to Japan increase by $196 million, Malaysia by $313 million, Mexico by $214 million and Chile by $90 million, compared to the baseline.[11] The value of Vietnamese exports to non-CPTPP member countries declines by $754 million in 2019 under the RORE closure compared to the baseline.

[11] Change in value of exports is measured by the change in the FOB value (VFOB) of exports from source to destination country.

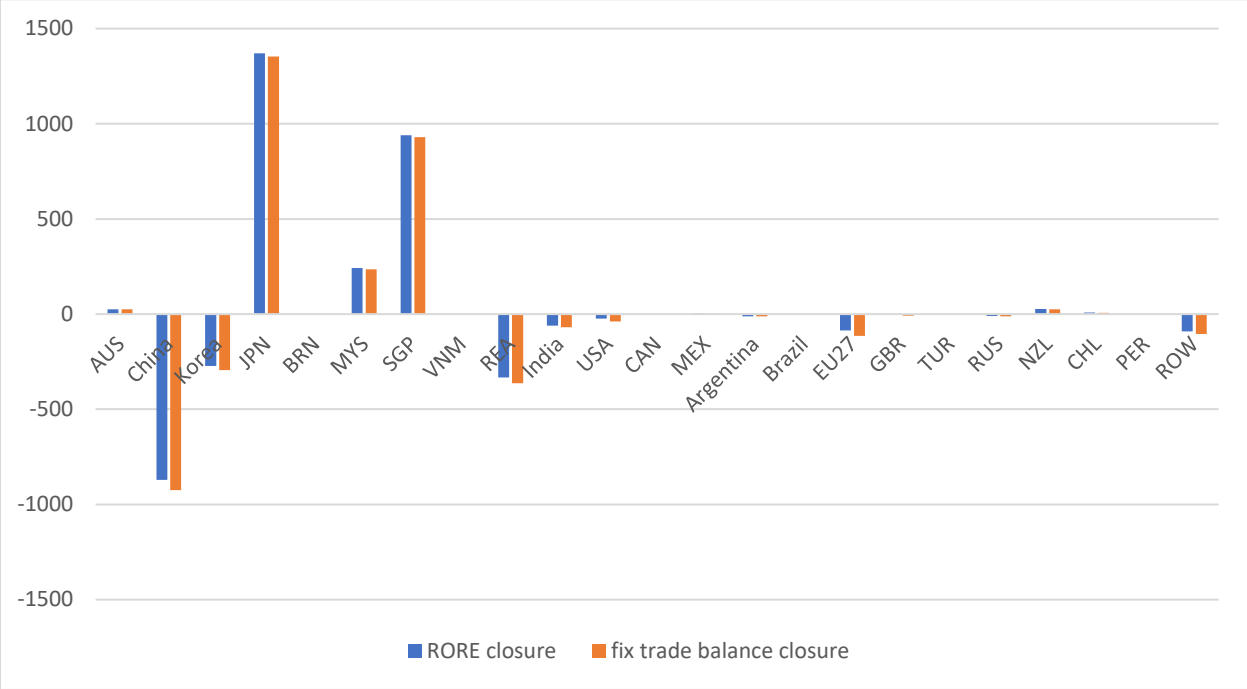
Figure 9: Changes in Value of Exports in 2019 due to CPTPP Compared to the Baseline, in $US millions



Under the **fixed trade balance closure**, Vietnamese exports to non-CPTPP member countries also decline, by $249 million, a smaller scale than under the RORE closure. The increase from baseline in Vietnamese exports to key CPTPP member countries is larger under the fixed trade balance closure compared to the RORE closure— Vietnamese exports to Japan increase by $254 million, Malaysia by $328 million, Mexico by $220 million, and Chile by $92 million. The reason for the differences in scale of the bilateral trade flows between the two closures is because, under the fixed trade balance closure, when Vietnamese imports increase, the country's overall exports also need to increase to maintain the fixed trade balance in real terms. This constraint pushes up the increase in Vietnamese exports to the CPTPP member countries compared to the RORE closure.

Trade diversion also happens on the import side: Vietnamese imports from CPTPP member countries increase significantly in 2019 under the tariff liberalization—under the RORE closure, the country's imports from Japan increase by $1,370 million, Malaysia by $242 million, and Singapore by $940 million (Figure 10). Imports are mainly diverted away from non-member Asian countries—Vietnamese imports from China decline by $871 million, Korea by $273 million and rest of Asia by $333 million in 2019.

Figure 10: Changes in Value of Bilateral Imports in Vietnam in 2019 due to CPTPP Compared to the Baseline, in $US millions



Under the **fixed trade balance closure**, the increase from baseline in Vietnamese imports from CPTPP member countries is slightly lower in value compared to the RORE closure — Vietnamese imports from Japan increases by $1,353 million, Malaysia by $235 million and Singapore by $929 million in 2019 (Figure 10).

Vietnam-Japan Trade in the CPTPP

The CPTPP member countries with which Vietnamese trade increases the most due to the CPTPP are Japan and Malaysia. Taking Japan as an example, shown in Figure 11, the value of Vietnamese exports to Japan increases the most for light manufactured commodities, followed by processed food and heavy manufactures in 2019 compared to the baseline, under both closures. Because the fixed trade balance closure requires an increase in Vietnam's exports, the increase in its exports to Japan is higher under the fixed trade balance closure compared to the RORE closure, in which Vietnam's aggregate exports decline. Differences in relative tariffs and initial trade values also have a role. Japan has a higher level of tariff reduction on Vietnamese exports of light manufacturing goods than most other CPTPP member countries, and Vietnamese exports of light manufacturing goods compose a large value share of total

Vietnamese exports to Japan. These factors help to explain why the value of Vietnamese exports to Japan increases the most in the light manufacturing sector.

Figure 11: Changes in Vietnamese Exports to Japan in 2019 due to CPTPP Compared to the Baseline, by Commodity, in $US millions

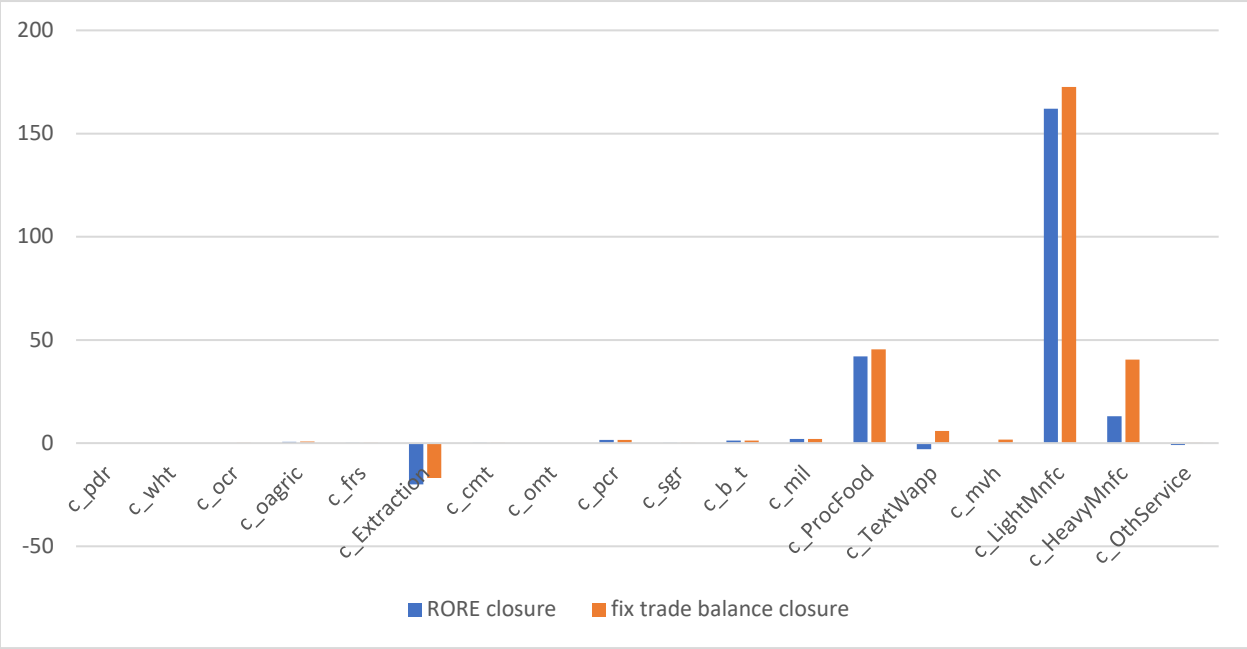
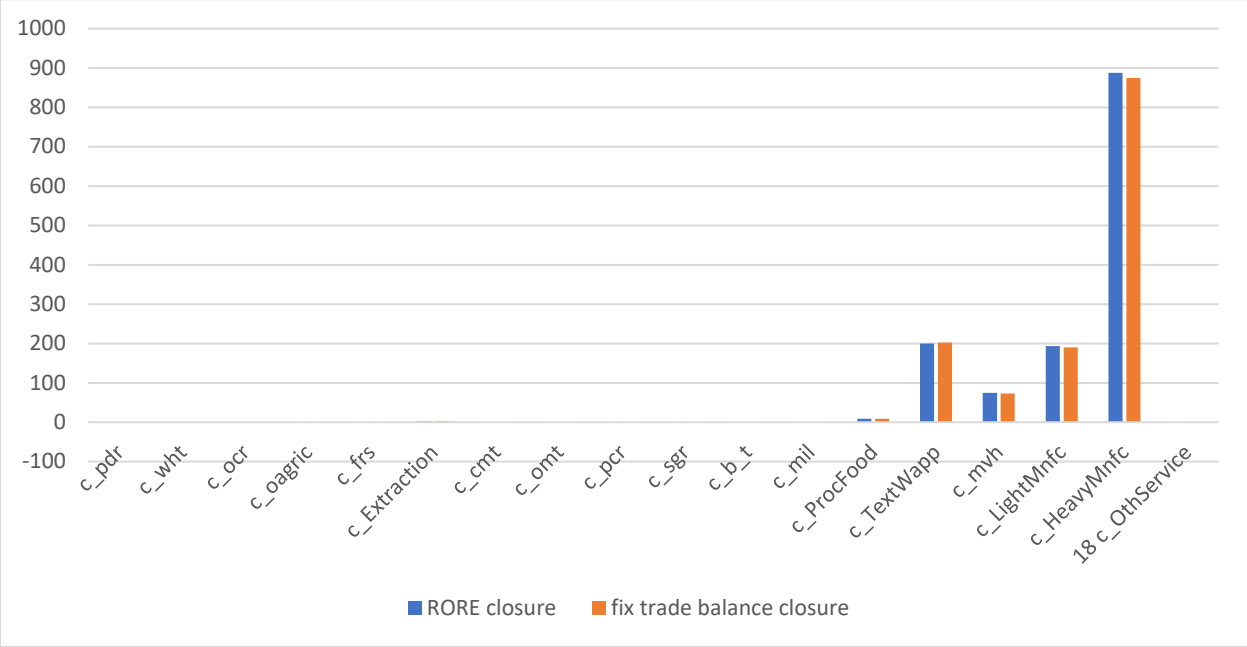


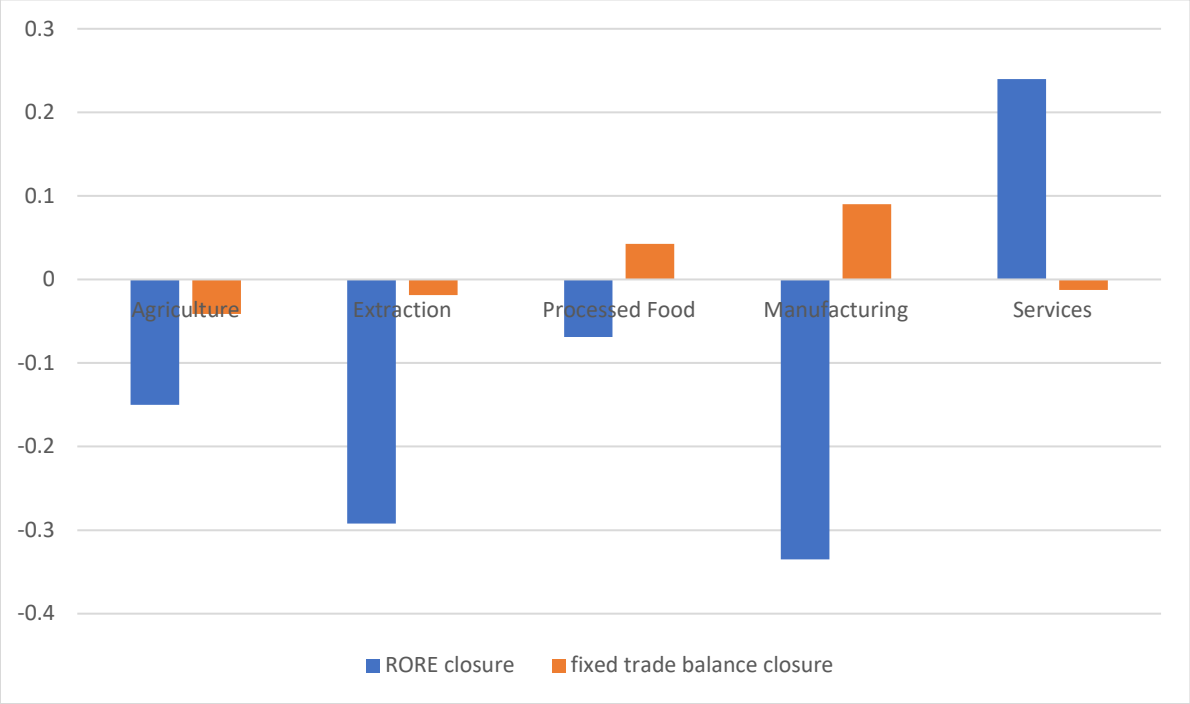
Figure 12 shows changes in Vietnamese imports from Japan in 2019 compared to the baseline. Vietnamese imports from Japan increase the most in the heavy manufacturing sector, followed by textile and apparel, light manufacturing and motor vehicles and parts. Vietnam has a higher level of tariff reduction against Japanese heavy manufacturing products compared to its imports of such products from most other CPTPP member countries. Meanwhile, heavy manufacturing products compose the largest share of total Vietnamese imports from Japan in 2011 (the base year of the model). These two factors contribute to the large increase in value of Vietnamese imports from Japan of heavy manufacturing products.

Figure 12: Change in Vietnamese Imports from Japan in 2019 due to CPTPP Compared to the Baseline, in $US millions



The causes of the CPTPP's effects on output in Vietnam in 2019 under the **RORE closure** include elements identified in the stylized productivity growth simulation. Due to Vietnam's relatively high income elasticity of demand for services, its income growth due to capital inflows and the efficiency gains from tariff reform drive up its demand for services relative to non-services sectors. Since services is mainly a non-traded good, the increased demand for services leads to their increased domestic production, which results in declining output in the non-services sectors that compete with services for productive resources (Figure 13). The manufacturing sector has the largest decrease in output. Manufacturing goods are traded and therefore increased manufacturing imports can substitute for declining domestic production of manufacturing goods, which is not the case for services. The removal of Vietnam's relatively high tariffs on manufacturing also contributes to the decline in output of the manufacturing sector.

Figure 13: Changes in Output in Vietnam in 2019 due to the CPTPP Compared to the Baseline, in Percent



Under the **fixed trade balance closure**, sectoral effects in 2019 differ significantly from the RORE closure case. The need to increase exports due to the fixed trade balance constraint requires that exportable sectors expand, particularly the processed food and manufacturing sectors. And, income growth is smaller under this closure so growth in the demand for services is dampened. Both factors contribute to an increase in the outputs of the processed food and manufacturing sectors relative to the baseline, rather than the decline as in the RORE closure, and to a decline in production of services relative to the baseline, rather than an increase as in the RORE case.

Results in 2020 to 2036: Also a Story of Capital-deepening in Vietnam with RORE Closure Compared to the Fixed Trade balance Closure

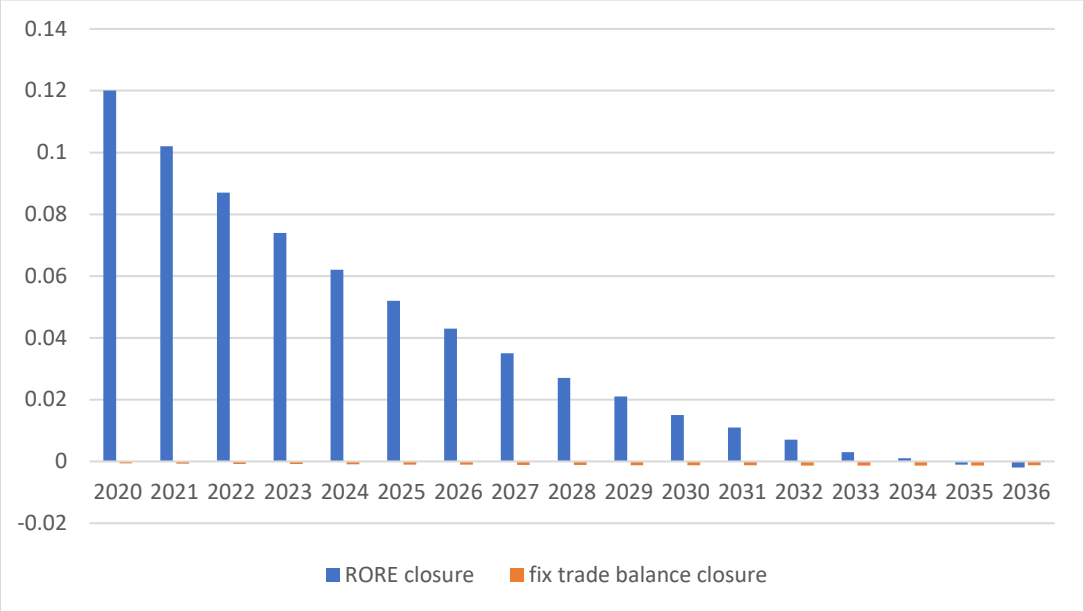
Similar to the story of a total output productivity shock, the results from 2020 to 2036 under the CPTPP tariff liberalization scenario with the **RORE closure** reflect a capital-deepening in Vietnam (Table 7). Under the RORE closure, its large trade deficit in 2019 gradually narrows over 2020-36 as tariff reductions become smaller over time and its expected rate of return diminishes. Capital inflows from Vietnam's trade deficit are invested in capital equipment that adds to the capital stock in the following

year, also at a declining rate over the adjustment period (Figure 14).[12] The trade balance is almost unchanged under Vietnam's **fixed trade balance closure** and its capital stock declines slightly relative to the baseline over the adjustment period. The capital-deepening in the RORE case provides an increase in productive resources that leads to larger welfare gains and higher GDP growth over most of the adjustment period compared to the fixed trade balance closure, though the scale of the effects nearly converges overtime under the two closures (Figures 15 and 16).

Table 7: Changes in Trade Balance in Vietnam in 2020-36 due to the CPTPP Compared to the Baseline, in $US millions

	2020	**2022**	**2024**	**2026**	**2028**	**2030**	**2032**	**2034**	**2036**
RORE closure	60.7	49.1	46.4	44.9	42.7	40.0	36.3	31.2	26.1
Fix trade balance closure	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1

Figure 14: Changes in Capital Stock in Vietnam in 2020–36 due to the CPTPP Compared to the Baseline, in Percent



[12] As can be seen from Figure 14 below, the change in capital stock under the RORE closure occurs at a declining speed and converges over time with the change in capital stock under the fixed trade balance closure. With the total output productivity shock discussed in the previous section (see figure 6), the same convergence of capital stock would occur if we extend the simulation period to beyond 2040.

Figure 15: Changes in Welfare (Measured by EV) in Vietnam in 2020-2036 due to the CPTPP Compared to the Baseline, in $US millions

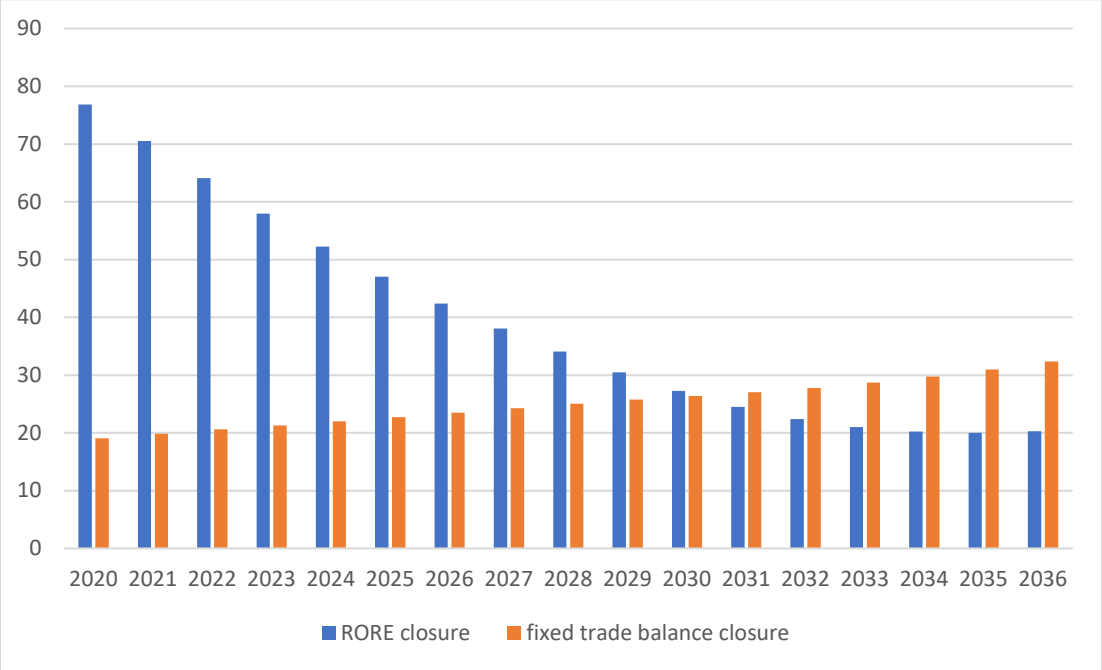
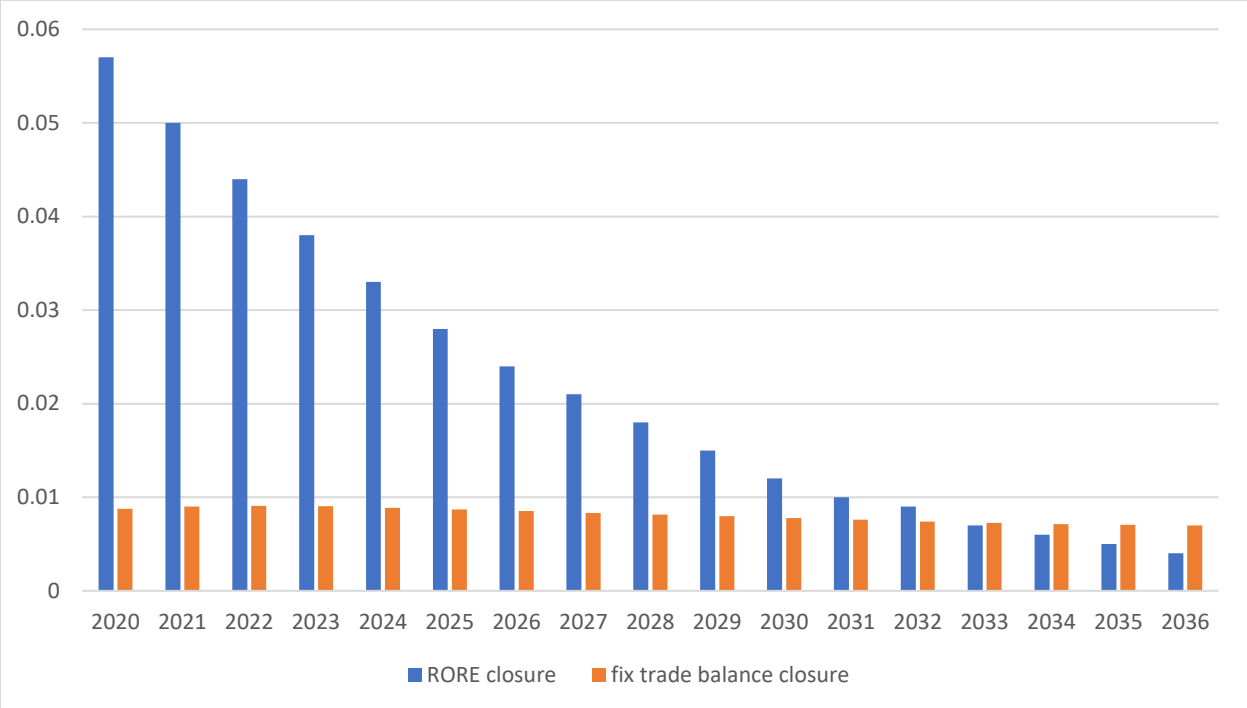


Figure 16: Real GDP Growth in 2020–36 due to the CPTPP Compared to the Baseline, in Percent



From a sectoral perspective, the choice of closure contributes to differences over time in the effects of the CPTPP on the structural composition of output (Table 8). During the 2020–2036 adjustment period,

the role of capital inflows becomes a key driver of sectoral change under the **RORE closure,** rather than CPTPP tariff reductions because these are mostly implemented in 2019. Capital inflows cause the Vietnamese economy to become slightly more capital intensive relative to the baseline by 2036 (Table 9). The large capital inflow into Vietnam early in the adjustment period leads to higher growth in output in all sectors relative to the baseline**,** particularly its capital-intensive manufacturing and extraction sectors and its income-sensitive services sector. By the end of the adjustment period, as the capital inflows into Vietnam diminish and their effects on income growth likewise decline, output of Vietnam's services sector falls relative to the baseline. Under the **fixed trade balance closure**, output changes relative to the baseline are much smaller compared to the RORE closure because they are determined largely by the sectoral effects of remaining CPTPP trade reforms over the adjustment period.

Table 8: Changes in Sectoral Output in Vietnam in 2020–36 due to the CPTPP Compared to the Baseline, in Percent

RORE closure	**2020**	**2022**	**2024**	**2026**	**2028**	**2030**	**2032**	**2034**	**2036**
Agriculture	0.039	0.029	0.021	0.016	0.011	0.008	0.005	0.003	0.002
Extraction	0.096	0.062	0.04	0.026	0.016	0.01	0.005	0.002	0.000
Processed Food	0.037	0.026	0.019	0.013	0.009	0.005	0.002	0.001	-0.001
Manufacturing	0.126	0.091	0.069	0.051	0.037	0.025	0.016	0.008	0.004
Services	0.025	0.018	0.011	0.004	0.000	-0.004	-0.006	-0.007	-0.007
Fixed trade balance closure	**2020**	**2022**	**2024**	**2026**	**2028**	**2030**	**2032**	**2034**	**2036**
Agriculture	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Extraction	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000
Processed Food	-0.003	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Manufacturing	-0.003	-0.003	-0.003	-0.002	-0.002	-0.001	0.000	0.001	0.002
Services	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001	-0.001	-0.001

Table 9: Capital-Labor Ratios by Sector in 2036 due to the CPTPP under Different Closures

RORE closure	**Agriculture**	**Extraction**	**Processed Food**	**Manufacturing**	**Services**	**Total**
2036 baseline	0.575	4.127	0.726	0.773	0.859	0.876
2036 CPTPP policy shock	0.572	4.108	0.727	0.774	0.861	0.877
Fixed trade balance closure	**Agriculture**	**Extraction**	**Processed Food**	**Manufacturing**	**Services**	**Total**
2036 baseline	0.575	4.127	0.726	0.773	0.859	0.876
2036 CPTPP policy shock	0.575	4.127	0.726	0.773	0.859	0.876

Concluding Remarks

The main objective of the paper is to illustrate and explain, theoretically, how simulation results differ under different macroeconomic assumptions about capital markets and the trade balance closure, using the GTAP-RD framework. The motivation for this exploration is that the empirical literature has found that the intensities of capital control measures adopted by countries all over the world are different.

Our paper examines two commonly used, alternative macroeconomic closures to describe the trade balance in the recursive dynamic GTAP-RD model — the expected rate of return equalization (RORE) approach and a fixed trade balance closure. We compare model results under the two different closures from two simulation scenarios. One is a stylized scenario of a 20-percent total output productivity gain in a single country and the other is a tariff liberalization scenario under the CPTPP. The stylized scenario provides a transparency that allows us to identify and understand the mechanisms that lead to macroeconomic and sectoral results that differ between the two closures in both size and positive/negative sign. The stylized exercise helps us to then recognize and understand the role of these mechanisms in driving the results of a more complicated (yet still hypothetical) trade policy scenario under the alternative closures.

In our stylized productivity simulation, we find that the key drivers of the differences in outcomes stem primarily from the capital-deepening and related income effects that occur with the rate-of-return closure but are absent when assuming a fixed trade balance closure. A closure that allows capital inflows to equalize expected rates of return allows a capital-deepening over time that leads to stronger economic growth, increased imports but lower exports, both terms of trade and welfare gains, and a change in sectoral structure that favors capital-intensive and income-sensitive industries. A closure that imposes a fixed trade balance has negligible capital-deepening and so the same shock has weaker growth and income effects, increases in both imports and exports, a terms of trade loss that reduces welfare gains, and a change in sectoral structure that favors exportable industries.

Our approach in this paper is to first assume an identical, expected rate of return closure for all model regions and then compare those results with the case of a fixed trade balance assumed in only one country - Vietnam. This spare approach simplifies and clarifies our exposition of the effects of alternative closure assumptions. In applied work, when analyzing a real-world policy scenario, there are more dimensions of this macro closure assumption to be considered. The main message from our exercise is

to demonstrate the importance for model results in evaluating countries' policy measures on capital controls and appropriately modeling each country's macroeconomic closure.

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