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Integrated Policy Strategies and Regional Policy Coordination for Resilient, Green and Transformative Development: Supporting Selected Asian BRI Partner Countries to Achieve 2030 Sustainable Development Agenda

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Climate Scenarios for Macroeconomic Policy in Malaysia

Abstract

We explore options to fund climate change mitigation and adaptation with debt, international aid and taxation. We identify the macroeconomic impacts focusing on inequality and external accounts.

Policies and climate trends are examined with a macroeconomic model to trace the interaction of economic activity and emissions: economic activity generates emissions causing global warming and hampering economic activity. The parameters identifying the production-emission relationship vary based on the type of capital accumulation (brown or green investment) and, in so doing, highlight paths to overheating and to climate stabilization. But walking a sustainable path requires adopting green technologies at an appropriate scale and a congenial macroeconomic environment.

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Introduction

As is the case for most countries, Malaysia's greenhouse gas emissions are only a small fraction of the world's total (an estimated 0.69 percent according to UNFCC, 2023) but they have been rising rapidly in the last 20 years making decarbonization an important item on the development agenda.

Progress toward a more sustainable use of energy has been made, with the emission intensity of economic activity decreasing as much as 36 percent since 2005 (Ministry of Environment and Water, 2022), but fast economic growth has meant that total emissions have increased. Furthermore, since 2009, the impacts of climate change have been more severe, including extreme weather events, flooding (causing estimated loss of RM 7.9 billion in 2021), droughts, a rising sea level, and higher temperatures. All this points to the need for Malaysia to take its process of green transformation further.

According to the National Climate Change Plan (NRES, 2024), Malaysia must spend RM 400 billion over the next 50 years to fully adapt to climate change, which adds to the investment necessary to achieve net-zero greenhouse gas emissions by 2050. The Plan highlights as operational priorities the development of cleaner energy and the gradual abandonment of coal and gas in favor of green technologies, as part of a transition that will require an estimated RM 1.2-1.3 trillion in investment by 2050.

Financing such large-scale investment is a major challenge. External funding has provided RM 364.8 million, a small fraction of the required resources (New Straits Times, 2023), highlighting the lack of climate change dedicated funds, faced with a high cost of renewables and green technologies. In addition, green investment is still perceived as risky among financial institutions (NCCP), leaving the government as the main source of funding, with an allocation of approximately 1 percent of GDP, well below what is needed for a full transformation.

As other oil producing and exporting countries, Malaysia also features an energy sector that is deeply intertwined with the rest of the economy and imposes careful planning in order to limit the short-term impact of decarbonization on other sectors' revenue. According to NRES (2024), approximately 30 percent of sectors will likely suffer from "transition risk". As Figure 1 shows, the share of carbon-intensive sectors (utilities, mining, manufacturing and transportation) in value added has been declining since 2007, although it still totaled just under 40 percent[1], while the economy is moving towards more service-oriented sectors. More importantly, the carbon-intensive sectors have been the main contributors to overall productivity in the economy, especially manufacturing. In addition, their (total) share of employment was 23.3 % in 2018. The share of employment in mining and transportation has increased, while manufacturing lost a large share of employment due to productivity growth outstripping demand growth. This makes these carbon-intensive sectors the most vulnerable during the green transition, with an estimated loss of $65.3 billion worth of export revenues during the green transition (Bernama, 2021).

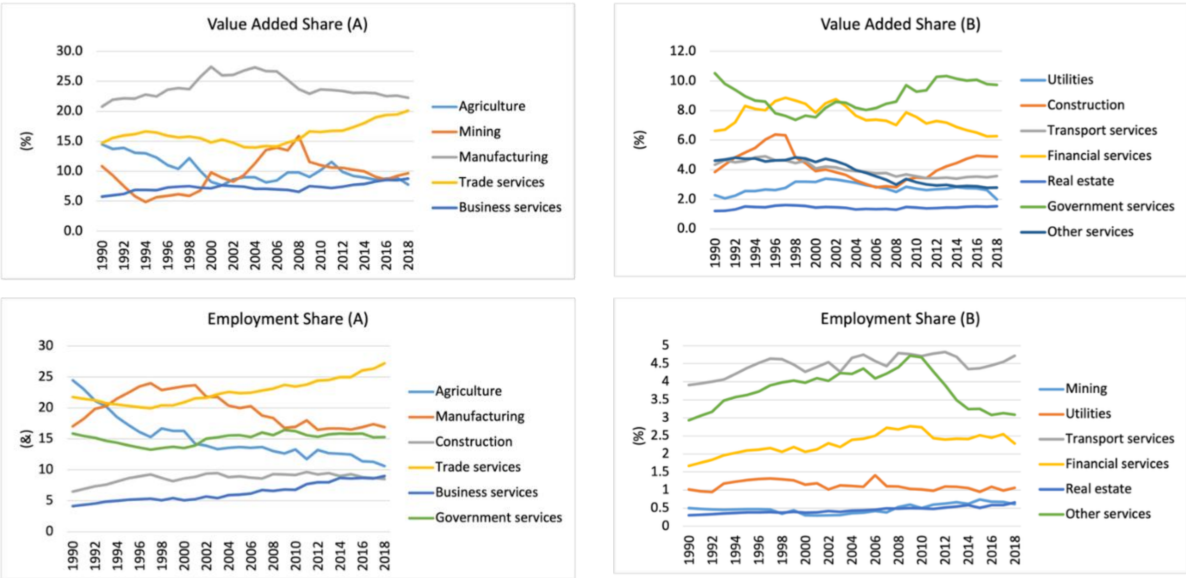
Moreover, there will be additional risks related to the change in the sector composition of the economy. Initially, the labor market will be affected negatively as the new, "greener" structure will require new skills needed for the productive transformation. Indeed, the green transition may cause the displacement of the majority of jobs in current carbon-intensive sectors, mainly in utilities, mining, and manufacturing.

The greatest structural challenge posed by the green transition is perhaps the need to obtain increasing returns to scale with energy savings and green technological change supported by increasing labor productivity. Empirical evidence from other countries indicates that labor productivity growth is highly correlated with energy consumption (Semieniuk, 2016; Semieniuk et al., 2021; Jiang and Kahn, 2017; von Arnim and Rada, 2011). If Malaysia cannot maintain high growth of the output-energy ratios (energy productivity growth) and transition to renewable energy, increased carbon energy consumption – the cheapest option to fuel industrialization –

[1] Mining (10%), Manufacturing (22.3%), utilities (2.7 %), Transportation (3.5%).

will be inevitable. When reserves of gas and oil are depleted, Malaysia may end up importing the necessary energy from the rest of the world to keep up with its current growth path. In the absence of energy saving (and green) technology that gives access to a greener path, countries can be forced to reduce capital accumulation and growth (Marquetti et al., 2019) or continue to generate more and more emissions.

Figure 1: Value added and employment, economic sectors



Source: UNU-WIDER, Economic transformation database

Most developing countries cannot adapt and mitigate as quickly as needed because they lack the necessary technology, hard currency, and policy independence. Fortunately, these challenges faced by most developing countries – lack of the necessary technology, hard currency, and policy independence, which prevent them from adapting and mitigating as quickly as needed – are less drastic in Malaysia, an upper middle-income country that has exhibited sustained growth of incomes and domestic demand, and deep trade integration in its region and beyond. But the increased physical impacts of climate change and transition from fossil fuels and gas can push adaptation and mitigation goals out of reach, especially if financing options are not readily available.

The following sections focus on the implications of these constraints for macroeconomic policies, exploring the impacts of different combinations of fiscal and monetary policies, as well as different options – including taxation, debt financing, and international grants – to finance mitigation and adaptation under alternative baselines of climate change.

2. Simulation scenarios

By the end of 2023, CO2 levels reached around 422 parts per million globally and average temperatures were 1.1-1.2 degrees higher than pre-industrial levels (IPCC, 2023). With this pace of climate change, securing adequate financial resources to transition to low-carbon development and tackle adverse climate impacts is a very demanding task for developing countries. Indeed, an unstable climate adds to the challenges faced by all economies (in the most general terms of generating sufficient growth, distributing its fruits equally and making sure life on the planet can continue indeterminately), but most developing countries also have to deal with trading and financial systems that operate in developed country currencies as well as limited access to critical technology. Overcoming these challenges in order to rebalance the functioning of the global economy requires a policy and investment effort that is certainly large (although not unprecedented) but also needs to be appropriately coordinated, particularly within regions and between developed and developing countries (UNCTAD, 2023). Projections indicate that, from a macroeconomic perspective, such rebalancing will require ensuring that aggregate demand is sustained at an appropriate level in developing countries while developed countries provide sufficient market access.

For Malaysia the necessary resources are estimated to surpass RM 1 trillion, or USD 256 billion at current exchange rates, a very large sum for any country to borrow.

Our simulations focus on alternative “global” baseline scenarios (IPCC Technical Report, 2001; IPCC Technical Paper III, 1997; IPCC- AR5, 2014) as our objective is to capture the impacts of different scenarios of climate change on the Malaysian economy. The first global baseline represents the case of "global business as usual", in which there is no or not enough mitigation effort at the global level. Therefore, atmospheric CO2 concentration reaches a level at which the atmospheric temperature level increases by 3°C, while in the second global baseline, this level stabilizes around +2°C.

3. Alternative Scenarios

This section compares the economic impact of climate change for the business-as-usual case (not enough mitigation) with two different mitigation policy scenarios and a scenario in which Malaysia free rides on mitigation spending (i.e. enjoys the in-excludible benefits of mitigation without paying its share). In the business-as-usual case (BAU, red line), it is assumed that atmospheric temperature levels will reach 3°C above pre-industrial temperatures. In the first mitigation scenario (successful global mitigation scenario), the atmospheric temperature reaches a 2°C threshold in the long run. In the second mitigation scenario, Malaysia mitigates, but the world does not mitigate enough to prevent climate change; therefore, atmospheric temperature levels reach 3°C, meaning that the economy will be affected both by the impacts of climate change and the economic policies that are in effect.

In what follows, in the “stricter policies” scenario (grey lines) mitigation is accompanied by a contractionary macroeconomic package which includes “regressive” taxation (both workers and capitalists are taxed) and monetary tightening. In the “free-riding” scenario (green line), only the rest of the world mitigates while Malaysia free-rides and adopts no policy change. In the “expansionary” scenario (dashed blue line) mitigation spending is financed by a progressive tax increase (levied only on profits, which accrue to the richest 10 percent of households). Each temperature scenario is simulated in two different cases: two fiscal and monetary policy packages to support mitigation and adaptation. In each case, investment levels are dictated by the need to adapt the economy to low emission targets, based on existing evidence.

3.1 Expansionary Policy Scenario (Dashed Blue line)

Expansionary policies have been shown to be effective in preventing stagnation in developed and developing countries, reducing the inflationary side effects of expansionary policies if they crowd-in productive investment and are supported by progressive taxation and/or government transfer policies (Taylor et al., 2015; Omer and Capaldo, 2023). That is because productive investment increases the productive capacity of the economy, reducing inflationary pressures, and creates extra income while progressive taxation and transfer policies redistribute it to lower income classes, limiting increases in profits (or capitalist income). Therefore, in the expansionary policy scenarios:

i. The government spends 2.5% of GDP per year on mitigation and adaptation[2]. For this case under the 3°C pathway, mitigation spending adds up to 10.9 trillion RM (approx. $2.5 trillion, based on 1$ = 4.25 RM as of June 21, 2025) by 2100. Mitigation (and adaptation) spending by the government is assumed to be used only for activities related to the green transition, such as investing in green and renewable energy technologies, subsidizing green manufacturing technologies, reducing motor vehicle use, increasing energy efficiency of buildings, and ending deforestation. As a result, government mitigation spending aims to increase the productive capacity of the economy by attracting and facilitating green private investments.

ii. As government mitigation spending can stimulate private investment, relatively lower and stable interest rates can help the process. Following Omer and Capaldo (2023), we therefore let the real interest rate decline by 1.5 percentage points from its initial level. Under such circumstances, the real exchange rate would be expected to depreciate as a result of lower real interest rates. Therefore, the real exchange rate will depreciate by 6% by 2100. This would positively affect net exports as Malaysian goods and services become less expensive for the rest of the world, depending on the role of imports in Malaysian production. In our simulation scenarios, we assume that the real exchange rate depreciation increases exports and reduces imports. However, net exports (trade balance) will also be affected by the growth of Malaysian economy and the build-up of capital stock, as GDP growth will increase Malaysian imports while a higher capital stock build-up will positively affect exports through the productivity channel.

iii. In addition to the exchange rate and growth effects on net export, we introduce an additional 15% shock (reduction) on exports as the world moves away from Malaysia's (brown) goods and services.

iv. Finally, public spending on mitigation will crowd-in private investment, but financing remains a major concern for all developing economies. Since progressive taxation can help mobilize private savings held by the wealthy and reduces budget concerns for households with a higher propensity to spend, taxes on the capitalist class (the richest 10 percent of households) are increased by 20% while taxes on workers remain the same. Different financing options, such as debt financing and use of grants, are taken up later.

3.2 The "Stricter" Policy Scenario (Gray Line)

In this scenario the government is assumed to spend 1.5% of GDP per year on mitigation efforts (as opposed to 2.5% in the expansionary policy scenario), summing to approximately 4.4 trillion RM ($1.03 trillion, based on 1$ = 4.25 RM as of June 21, 2025) by 2100 under the 3°C pathway.

i. In contrast to the expansionary policy case, the real interest rate is assumed to increase by 1.5 percentage points due to fears of inflation. As a result, it is assumed that the real exchange rate will appreciate around 6% by 2100. This potentially would reduce net exports as Malaysian goods and services become more expensive for the rest of the world, but the final net exports will also be affected by the growth and capacity building dynamics, as discussed earlier.

ii. As in the previous scenario, we introduce an additional 15% shock (reduction) on exports as the world moves away from Malaysia's (brown) goods and services.

iii. In order to analyze different tax policies, the taxes on both capitalists and workers are raised by 20% as opposed to the expansionary policy scenario. The idea is to eliminate potential problems related to fiscal space and long-term debt burden.

[2] Mitigation and adaptation spending can be used to invest green and renewable energy technologies, subsidize green manufacturing technologies, reduce motor vehicle use, increase energy efficiency of buildings, end deforestation, etc. As explained in the model section, mitigation expenditure (m) is proportional to GDP mX_t, so annual mitigation spending will vary with economic activity.

3.3 Free-Riding by Malaysia (Green Line):

In this scenario, Malaysia chooses inaction, meaning that mitigation measures to keep the atmospheric temperature around 2°C vs. 3°C, are taken only by the rest of the world, while Malaysia continues to pollute. Therefore:

i. The real interest rate, the real exchange rate, and the tax rates are assumed to remain unchanged.[3]
ii. Unlike previous cases, exports are assumed to fall 25 percent, as the rest of the world would take more severe action against Malaysia's products and services.

4. Simulation results

4.1 Economic Activity

In the simulations, the 3°C-BAU scenario (red line) demonstrates the severity of global warming and its implications for the future of the Malaysian economy in the absence of effective global mitigation (Figure 2). If the world fails to mitigate Malaysia's total damage from climate change may reach 70% of its total capital stock in the long run. In fact, in this case, Malaysia may prefer to adapt rather than mitigate.

The macroeconomic outcomes of Malaysia in the BAU scenario are shown in Figure 2a in detail. In 2023, real GDP per capita is around 3% per year and continues to grow at a slower rate until the early 2070s, when output peaks and environmental breakdown occur.[4] Although climate damage negatively affects the profits, since the labor market is affected negatively, the profit share increases from 52% to 56% as the labor market becomes less tight. However, in the 2°C scenario, the profit share decreases and stabilizes around 40% in the long run as a result of higher economic activity: Higher economic activity cuts into profits due to tighter labor market dynamics. As a result, even though the climate damage effect is less severe than in the 3°C scenario, it cannot prevent profit shares from declining.

In the 3°C case, the employment-to-population rate declines from 46% initially to 43% in 2072 and 41% in 2100. However, in the 2°C case, expansionary policies seem to help create more jobs than in any other policy scenario (employment increases to 53% in 2072 and 56% in 2100). Productivity follows a similar pattern in regard to capital stock and economic activity. Under the 3°C-BAU, it increases initially, but after a few decades, it stabilizes as climate damage cuts into profitability and capital stock. Real output peaks around 2070 then stabilizes, leading to a sharp decline in capital utilization. The stricter policy scenario under the 3°C pathway generates the worst outcome for every variable, followed by the free-rider scenario. For the free-rider scenario, the shock in net exports is the main driver of the economic failure, while in the stricter policy case, higher interest rate policies and real exchange rate appreciation with a regressive taxation policy play a major role: both consumption and investments suffer.

Figure 2b compares different policy scenarios in the 2°C pathway with the 3°C pathway. As the figure shows, climate damage is mostly eliminated (the damage-to-capital-stock ratio reaches 20% by 2100) thanks to global mitigation efforts. In the expansionary policy (blue-dashed) scenario under the 2°C pathway, economic activity increases more than in other scenarios. The effect of climate damage on profits is mostly offset by global mitigation efforts. Therefore, any decline in the profit share is caused primarily by increased economic activity as employment and real wages reach higher levels. As the profit share stabilizes at a lower rate (approximately 30%) in the long run due to strong labor market dynamics and progressive taxation, profits are squeezed. Real wages follow the same path as labor productivity, which means that increasing labor productivity is mostly

[3] This is likely not feasible, but the goal here is to focus on the best conceivable "free riding" scenario as a thought experiment.
[4] The real GDP per capita growth rate is 3% in 2023, 1.15% in 2072 and 0.3% in 2100 (Appendix A).

translated into increasing real wages[5]. Combined with increasing employment, this results in a higher wage share and hence a reduction in income inequality.

4.2 External Account

As Figure 3a shows, in the case of 3°C-BAU, the trade balance deteriorates over time as the initial increase in economic activity increases the demand for imports, and the rest of the world (ROW) moves away from Malaysian goods and services. The fiscal balance deteriorates because tax revenues cannot keep up with government spending. Declining economic activity reduces tax revenues, while increased fiscal deficits pushes the government to borrow more, adding to national debt. However, as private investment declines faster than private savings, the private sector protects its position as a net lender, helping an initial decline in the debt-to-GDP ratio until 2050. However, this does not change the final outcome of debt-to-GDP increases after the 2050s in each policy case, mostly because of the increased debt services. Thus, the negative effects of climate change prove to be unsustainable in the long term. As a free rider, the government becomes a larger net borrower earlier than in the BAU scenario, hence inaction leads to a higher debt-to-GDP ratio, of over 280% in 2100. In the expansionary policy case, slow economic growth due to the climate effect and higher mitigation spending with a lack of necessary tax revenues would appear to increase the debt stock to 350% of GDP.

In the stricter policy case scenario under the 3°C pathway, the debt-to-GDP ratio follows a pattern similar to that in the previous cases but remains at a lower level. The private sector becomes a larger net lender as their investment slows down more than their savings due to contractionary monetary policies cutting into investments and reducing total net borrowing. The government becomes the major borrower despite the regressive taxation policy, because the economic slowdown hampers the income generation channel via taxation through automatic stabilizers.

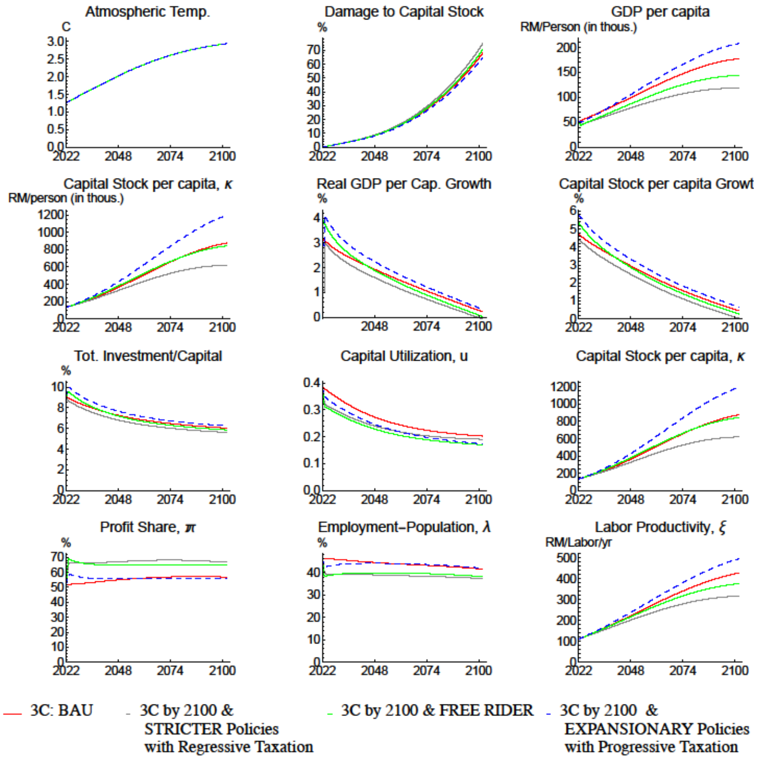
The same policy scenarios under the 2°C pathway generates better results than in all scenarios for the 3°C pathway (Figure 3b). Stricter fiscal and monetary policies (Figure 3b) generate the best external account; a trade surplus remains and the country becomes a net lender, leading to a negative debt-to-GDP ratio, as slower GDP growth reduces the positive effects of real exchange rate appreciations on imports and limits the demand for imported goods and services. In the very short term, aggressive tax increases for both capitalists and workers improve fiscal balance, reducing the need for borrowing by the government. However, in the long term, the fiscal deficit deteriorates as weak economic growth, caused by stricter policies, fails to generate enough tax revenues. As in the BAU scenario, private investment decreases much more than private savings. However, this time the reason is not climate change, but interest rate hikes that discourage investment and the regressive tax policies that encourage savings over consumption. This situation improves the net position of the private sector and is the main driver of the negative debt- to-GDP ratio. In general, Malaysia becomes a net lender, lowering the debt-to-GDP ratio in the long term, but the trade-off is costly: an economic structure with low productivity, low growth, low potential output and higher inequality.

In the free riding case, the trade deficit worsens sharply as a result of an initial negative shock to exports, then remains stable in proportion to GDP (approx. -5% of GDP). Slow economic activity mostly caused by lack of investment and low taxes compared to other cases results in higher fiscal deficits and total net borrowing larger than in the stricter policy scenario. In this case, the debt-to-GDP ratio climbs to 100% of GDP by 2100 which is below those for the BAU and expansionary scenarios. However, given the nature of the free-riding case, in which long-term economic activity is anchored to remain low due to lack of productive investment, long-term debt is not sustainable.

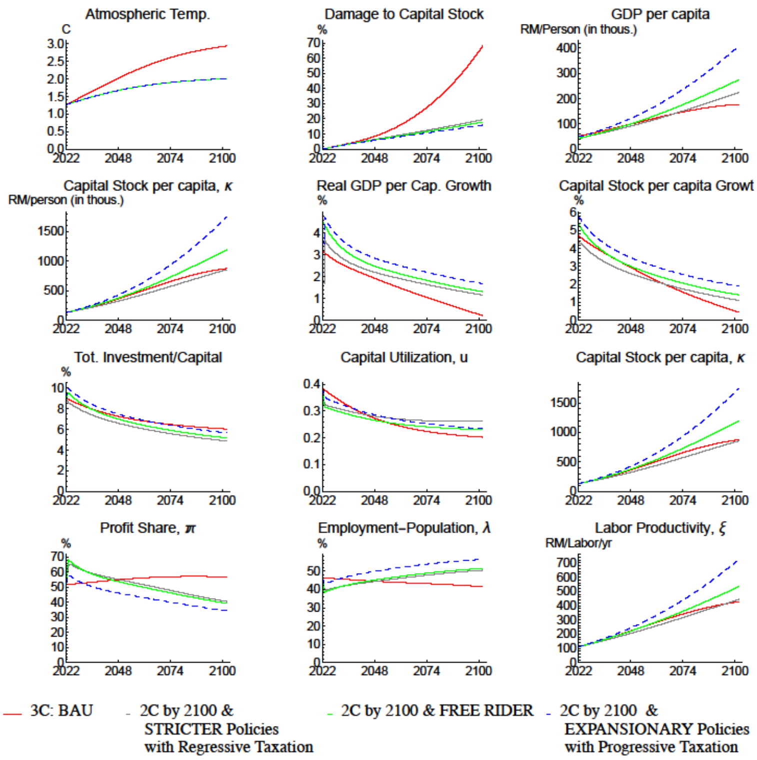
[5] Under the 2°C pathway with mitigation and expansionary policies, by 2072, real wage growth slightly surpasses productivity growth (2.4% and 2%, respectively), reducing income inequality.

Figure 2: Economic Activity under 2°C vs. 3°C

A. BAU (3 C) with different policy scenarios



B. BAU (3 C) vs. BAU (2 C) with different policy scenarios



The impact of expansionary policies on fiscal balance, net borrowing, and on debt sustainability are a major concern for developing countries (and for their lenders). However, if these policies generate higher economic activity—via investment, productivity, real growth, and employment channels – they can lead to sustainable and equitable growth while supporting long-term debt sustainability. In the expansionary policy case (blue line), the trade surplus decreases and becomes a deficit due to increased imports but can be stabilized later at around 8% of GDP. Government net borrowing reaches a better rate than in the BAU scenario, supported by higher economic activity and progressive taxation. Higher economic activity drives up tax revenues mainly from the capitalist class (top 10% of households), while relatively lower tax rates on workers (bottom 90% of households) with higher economic activity increase workers' consumption more than capitalist consumption because workers have lower saving rates. When we look at the borrowing behavior of the sectors, lower interest rates and the crowding-in effect of government spending are projected to stimulate private investment. As a result, net savings of the private sector remain positive, but lower than in the previous cases. Therefore, the debt-to-GDP ratio reaches 150% of GDP by 2100. But this increase in the debt-to- GDP ratio remains lower relative to other 3°C cases because high economic activity supported by government spending creates the necessary dynamics to improve the current productive structure and equitable growth simultaneously and eliminates the risk of unsustainable debt problems in the long term.

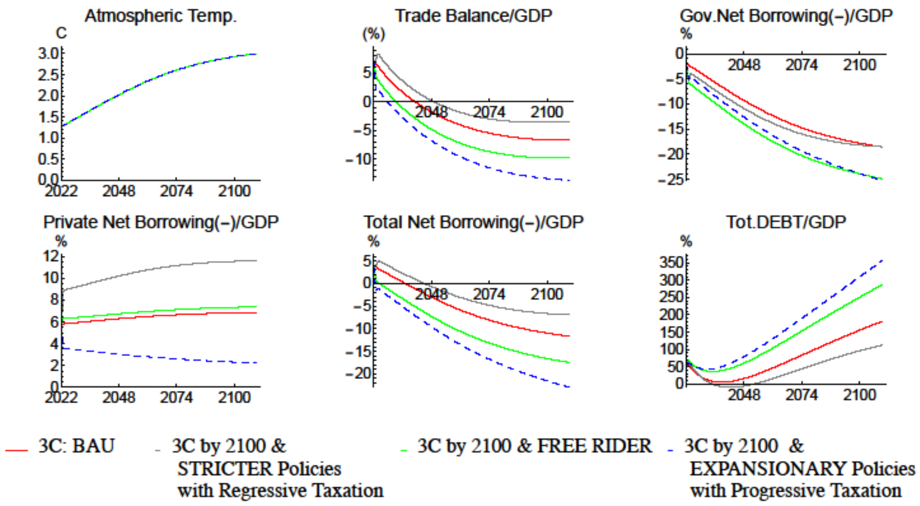
4.3 Income inequality

The impact of progressive taxation policies is more obvious when we look at the distributional dynamics between capitalists (top 10% of households) and workers (bottom 90% of households) in more detail. Figure 4 shows the Palma ratio of disposable income calculated as the ratio between the average disposable incomes of capitalists and workers. In 2022, the average annual disposable income of the top 10% of households was ten times higher than for the bottom 90%. Under BAU (3 C) (red line), in the first few decades with the existing tax policies, disposable income grows faster for capitalists than for workers compared to other scenarios, increasing inequality: Average capitalist income becomes 13.75 times more than the average worker income by 2100 due to a slightly increased profit share. In this case, even though the profits are cut through the climate change effect, the impact of low and declining output on total wages (due to falling employment and declining real wages) is more severe, worsening distributive dynamics, hence causing higher inequality. Therefore, inequality is worse under 3°C scenarios compared to each policy scenario under 2°C.

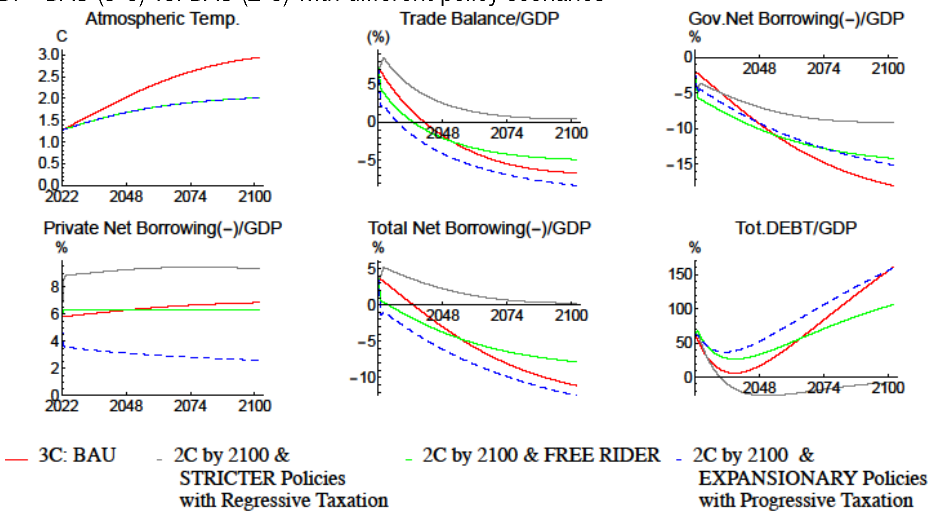
In the 2°C-free-riding case, a larger export shock (25% initially), first pushes down capacity utilization and increases unemployment, driving up the profit share. In addition, increased mitigation by the rest of the world reduces the impacts of climate change, also contributing to profit growth. The Palma ratio initially increases until employment begins to rise, squeezing profits. Wages and workers' consumption increase while capitalist income, consumption, and savings decline. As a result, the Palma ratio still declines to 7 which is below its initial level in 2022.

Figure 3: External Account

A. BAU (3 C) with different policy scenarios



B. BAU (3 C) vs. BAU (2 C) with different policy scenarios

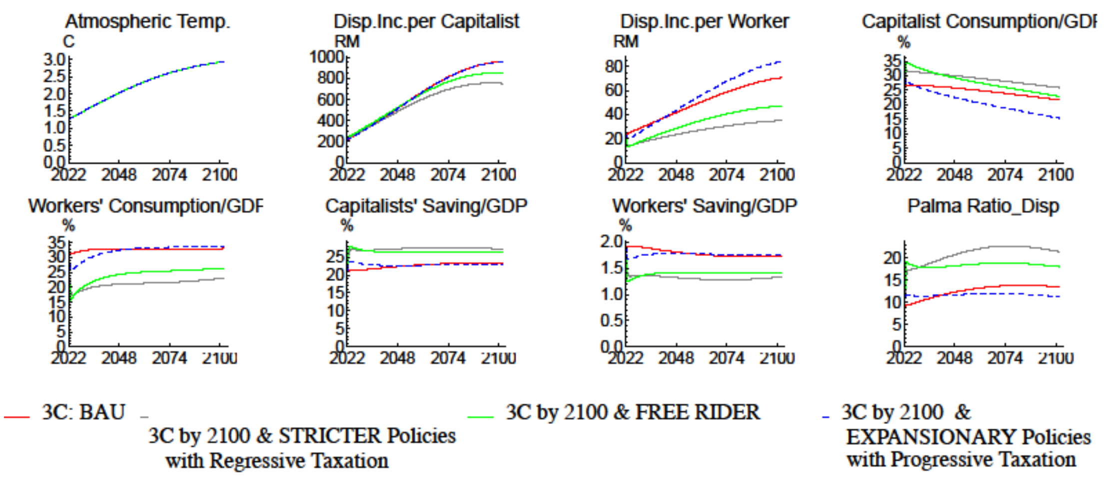


In the 2°C with stricter policy scenario (gray line), economic activity increases at a much slower rate than in the free riding case due to higher interest rates, appreciated exchange rates, and high taxes on both capitalists and workers. In addition, the average disposable income of capitalists rises more than the disposable income per worker. Therefore, overall distributive dynamics give rise to the worst inequality outcome, both due to higher a profit share and regressive taxation.

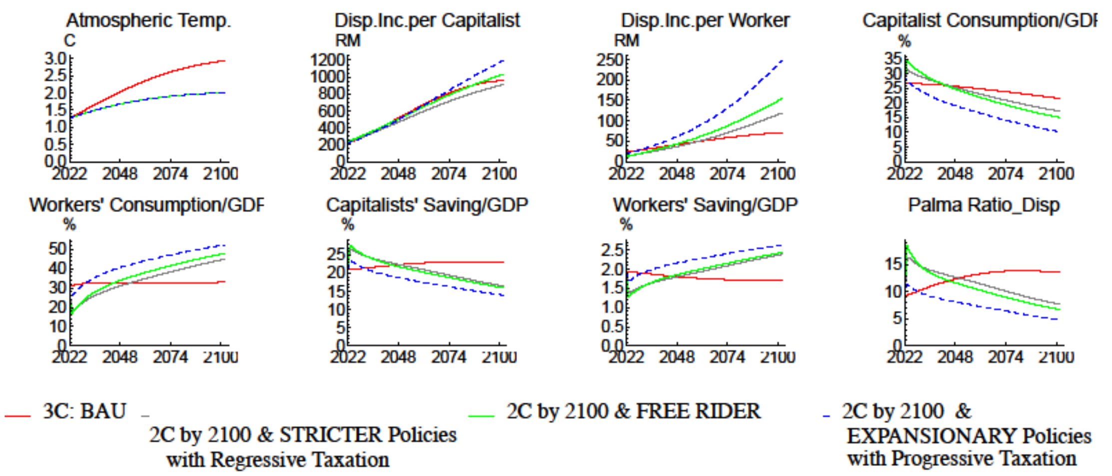
Finally, in case of expansionary policies under 2°C (blue line), with the help of progressive taxation and high economic activity driven profit squeeze, disposable income per worker grows faster than disposable income per capitalist. Higher taxes (20% increase) on capitalist income cut into their income and spending. Their savings are also negatively affected. Meanwhile, higher economic activity helps redistributing generated income towards workers, increasing their income and consumption and pushing up their savings. As a result, the Palma ratio stabilizes at a lower level compared to 2022, indicating a sharp decline in income inequality.

Figure 4: Income Inequality

A. BAU (3 C) with different policy scenarios



B. BAU (3 C) vs. BAU (2 C) with different policy scenarios



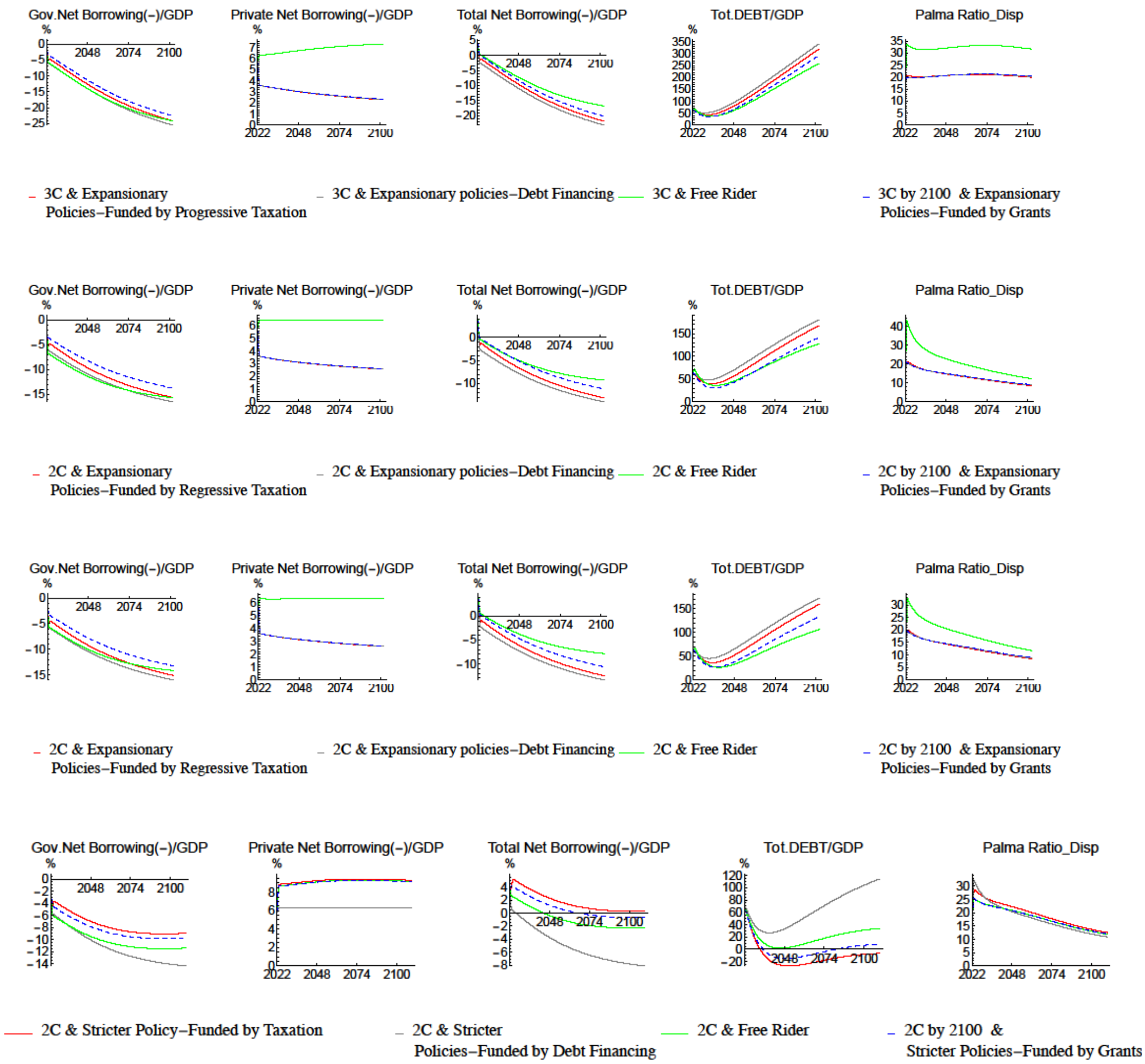
5. Alternative financing options for mitigation

Mitigation and adaptation efforts are costly. Based on our scenarios, mitigation and adaptation expenditures can add up to $1.02 to $2.5 trillion under the 3°C pathways, depending on the rate of mitigation spending and economic activity. As our simulations demonstrate, regressive taxation may generate enough tax income to cover the mitigation and adaptation expenses preventing external imbalances from getting out of hand. However, the trade-off is the risk of long-term stagnation with low or no economic growth, high unemployment and rising income inequality. Progressive taxation can generate some income to partially cover the cost without cutting into economic activity or deteriorating inequality. However, progressive taxation might meet with political concerns and barriers. In addition, many developing countries do not have a reliable tax base to generate income systematically through taxation. In those cases, alternative financing options such as debt financing and non-conditional grants from the rest of the world, similar to the UN's Loss & Damage Framework, can be used if available to the country. Figure 5 compares the financing options that Malaysia may have under the

2°C vs. 3°C pathways.

The impacts of climate change and the financing of climate mitigation and adaptation have different socioeconomic implications that create trade-offs for economic growth, distribution, external balances, and debt sustainability.

Figure 5: Financing Mitigation and Adaptation Under 2°C vs 3°C



Financing through grants generates the lowest debt-to-GDP ratio under each pathway, as expected. Under the 3°C pathway with expansionary policies, progressive taxation, and debt financing lead to similarly negative outcomes: The debt-to-GDP ratio hovers around 350%, while stricter policies lead to relatively lower debt ratios, especially for financing through grants and regressive taxation. At the same time, financing through regressive taxation generates lower economic growth and employment.

Under the 2°C pathway with expansionary policies, debt becomes more sustainable compared to the 3 C pathway, and debt financing generates the worst outcome of all considered financing options, followed by regressive taxation and free riding. Under the 2°C path with stricter fiscal policies, financing through regressive taxation results in the lowest debt-to-GDP ratio as the economy stagnates and Malaysia remain a net lender. A negative debt-to-GDP ratio combines with the cost of stagnating economic activity.

In terms of income inequality, expansionary policies under both the 2°C and 3°C pathways lead to better outcomes than their counterparts under the stricter policy case, since both, higher economic activity and progressive taxation employed under expansionary policy scenarios, cut into profits and thus capitalist disposable income, reducing income inequality.

6. Conclusions

As a fast-growing upper middle-income country with growing concerns about climate change and rising inequality, Malaysia faces the difficult challenge to decarbonize its economy without losing its development momentum and while improving social outcomes.

We compared alternative projections for the Malaysian economy, based on the global baseline scenarios discussed in recent IPCC reports (IPCC Technical Report, 2001; IPCC Technical Paper III, 1997; IPCC- AR5, 2014), to capture the impacts of these scenarios on Malaysia by combining fiscal and monetary policy responses supported by different financing options for adaptation and mitigation. The first global baseline represents “global business as usual” and features no mitigation effort at the global level. Therefore, average atmospheric temperature levels increase by 3 degrees, while in the second global baseline, this increases by 2 degrees. Unsurprisingly, the latter scenario is the successful case in which global cooperation manages to stabilize the climate.

Alternative spending packages, combining fiscal and monetary policies, were introduced and compared with the two baseline scenarios. Alternative financing options were also considered to support Malaysia's adaptation and mitigation spending: regressive taxation, progressive taxation, debt financing, and international grant options. The general assessment of the model simulations for Malaysia is as follows:

i. In the business-as-usual scenario (3°C-BAU), inaction proves catastrophic, pushing Malaysia’s economic output down. Free-riding and stricter fiscal and monetary policies will place the economy onto a slow growth path even under the best-case climate change scenario (2°C pathway), although free riding creates better outcomes than the stricter policy case. Expansionary policies, together with progressive taxation, can support green structural change with sustainable and equitable growth.

ii. The impact of expansionary policies on fiscal balance, net borrowing, and debt sustainability is a major concern for developing countries (and their lenders). However, if these policies generate higher economic activity – through investment, productivity growth and employment – they can lead to more sustainable and equitable growth while supporting long-term debt sustainability. In the expansionary policy case (blue line), the trade surplus decreases and gives way to deficits due to increased imports but stabilizes around 8 percent of GDP in the medium term. Government net borrowing reaches a better rate than in the BAU scenario, supported by higher economic activity and progressive taxation. Higher economic activity drives up tax revenue mainly from the capitalist class (top 10% of households), while relatively lower tax rates on workers (bottom 90% of households) further strengthen aggregate demand (the increase in workers’ consumption is larger than the decrease in profit-earners’ consumption, due to the latter’s higher saving rate).

iii. Turning to the net borrowing of each sector, lower interest rates and the crowding-in effect of government spending are projected to stimulate private investment. As a result, private net saving remains positive, but lower than in previous cases. The debt-to-GDP ratio reaches 150% of GDP by 2100 but the increase remains lower relative to other 3°C cases because high economic activity supported by government spending creates the necessary dynamics to improve the current productive structure and simultaneously stimulate growth eliminating the risk of unsustainable debt burdens in the long term.

iv. Inequality is worse under the 3°C scenarios compared to each policy scenario in the 2°C baseline. In the 2°C case with stricter policies (gray line), the average disposable income accruing to profit earners increases more than workers' disposable income. Therefore, overall distributive dynamics give rise to the worst inequality outcome, due to a higher profit share and regressive taxation.

v. With expansionary policies under the 2°C pathway (blue line), with the help of progressive taxation and a profit squeeze triggered by higher economic activity, disposable income per worker grows faster than disposable income per capitalist. Higher taxes (20% increase) on capital income cut the income and spending of the wealthy. Their saving is also negatively affected. Meanwhile, higher economic activity helps redistributing income towards the workers, increasing their income and consumption. As a result, the Palma ratio stabilizes at a lower level, indicating a decline in income inequality.

vi. Financing through international grants generates the lowest debt-to-GDP ratio in each pathway.

vii. Under the 3°C pathway with expansionary policies, progressive taxation, and debt financing lead to a debt-to-GDP ratio hovering around 350%. Stricter policies lead to relatively smaller debt ratios, especially for financing through grants and regressive taxation. However, financing through regressive taxation generates lower economic growth and employment.

viii. Under the 2°C pathway with expansionary policies, debt becomes more sustainable compared to the policies under the 3°C pathway, and debt financing generates the worst outcome among all financing options, followed by regressive taxation and free riding. Under the 2°C pathway with stricter policies, financing through regressive taxation results in the lowest debt-to-GDP ratio as the economy stagnates and Malaysia remains a net lender.

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Appendix A: model description

Macro Balance and Short Run Economic Activity & Distribution

In the model, everything is in real terms, and short to medium term economic activity and distribution are represented by capacity utilization, $\boldsymbol{u[t]} = \frac{Output}{Total\ capital\ Stock} = \frac{X[t]}{K[t]}$ and profit share, $\boldsymbol{\pi[t]} = \frac{Profits}{Output} = \frac{P[t]}{X[t]}$, respectively while long run trajectories are shaped by the dynamics of endogenous capital stock per capita $\boldsymbol{\kappa[t]} = \frac{K[t]}{Population}$, labor productivity $\boldsymbol{\xi[t]} = \frac{Output}{Labor} = \frac{X[t]}{L[t]}$ and exogenously determined GHG accumulation.

Let X be real GDP (output), $\boldsymbol{C}$ total consumption, $\boldsymbol{I_g}$ and $\boldsymbol{I_P}$ the investments of the government and private sector, and $\boldsymbol{G_g}$ and M non-mitigation and mitigation expenditures on GHG mitigation efforts, respectively[6]. T represents taxes. EX and IM are exports and imports. The model introduces different classes with different saving rates—s_c, the saving rate of capitalists out of capitalist household income, consisting entirely of profits, and s_w, the saving rate of workers out of worker household income, consisting entirely of wages. The total saving rate is $\frac{S[t]}{X[t]} = s[t] = s_c\,\pi[t] + (1 - \pi[t])\, s_w$, where $s_c > s_w$.

As a result, the macro balance can be represented as:

$$X[t] = C[t] + I_P[t] + I_g[t] + M[t] + G_g[t] + (EX[t] - IM[t])$$

The consumption function is $C = (1 - s[t] - \tau)X[t]$, where the saving ratio $s[t]$ is an increasing function of the profit share $(\pi[t])$. $M[t]$ and $G_g[t]$ represent mitigation and non-mitigation expenditures of the government, respectively.
Following Kalecki (1971) and the structuralist Keynesian tradition (Taylor et.al, 2015; 2018, 2020), we assume that gross fixed capital formation (private investment), $I_P[t]$is driven by profit rate $p_r[t] = \pi[t] * u$[t], animal spirits $(g_o - g_i r)$ and economic activity $u[t]$ so that

$$I_P[t] = ((g_o - g_i r) + \alpha\pi[t]u[t] + g_u u[t])K[t]$$

where $(\boldsymbol{g_o} - \boldsymbol{g_i r})$ represents animal spirit and takes the changes in the (level) of real interest rate $\boldsymbol{r}$ into account[7]. As a result, the private investment-capital stock ratio is $\frac{I_P[t]}{K[t]} = \boldsymbol{g[t]} = (g_o - g_i r) + \alpha\pi[t]u[t] + g_u u[t]$.

Government investment is proportional to capital stock accumulation, $K[t] = \kappa[t]Pop[t]$;

$$I_g[t] = \iota_g K[t]$$

[6] All the variables are treated as "flows" per unit of time.
[7] For the purpose of assessing the monetary policies in our simulations, real interest rate r, is introduced as an exogenous parameter, where $\frac{\partial I}{\partial r} < 0$.

Exports are assumed to be driven by an exogenous real exchange rate, z, and capital stock-GHG concentration ratio (K[t]/G[t]).[8]

$EX[t] = \epsilon\left(\frac{K[t]}{G[t]}\right)^{f} z[t]^{\gamma}$ where $\{f, \gamma\} > 0.$

Exports are assumed to be proportional to GHG accumulation because the impacts of climate change and /or transition to a net zero carbon economy by the rest of the world will reduce the demand for Malaysian export commodities; first, via declining income of the rest of the world, and second through declining incentives for fossil-fuel based commodities.

Similarly, imports are determined by domestic income and the changes in real exchange rate. Any increase in domestic income pushes up demand for imports while the depreciation of the real exchange rate pushes it down.

$IM[t] = a\frac{X[t]}{z[t]^{c}}$ where a is the import ratio, and $c > 0$.

Mitigation expenditures ($\boldsymbol{M[t] = m\,X[t]}$) and the leakages (taxes, savings and imports) are set proportional to output while the injections (exports, investment, and non-mitigation government spending) are proportional to capital stock (K[t]). Therefore, macro balance becomes:

$$X[t] = (1 - s[t] - \tau)X[t] + (g_o + \alpha\pi[t]u[t] + g_u u[t])\,K[t] + \iota_g K[t] + (\beta\,K[t] + mX[t]) + \epsilon\left(\frac{K[t]}{G[t]}\right)^{f} z[t]^{\gamma} - a\,z[t]^{-c}\,X[t]$$

As mentioned earlier, the profit share represents short to medium term distributional dynamics. In the model, capitalist savings and investments are positively related to the profit share (profit-led economy). If the increase in investment is strong enough, output, employment and capital stock can go up. GHG accumulation reduces profits and investment demand.[9] If global emissions can be reduced by higher global mitigation efforts, the system may stabilize at a lower GHG concentration—our simulations will be set to produce different paths for different potential GHG concentration scenarios.

In the labor market, when the employment is higher (labor market is tighter) due to increasing economic activity, the profit share will decline such that increased economic activity will be partially offset by profit-squeeze (a` la Marx and Goodwin). In the meantime, labor productivity may rise with a higher level of investment and lower employment[10] while higher GHG concentration can reduce productivity. Through time, capital accumulation will be driven by investments as the size of the economy expands.

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[8] Real exchange rate z[t] is introduced as an exogenous variable where $\frac{z\prime[t]}{z[t]} = \sigma\,(1 - z[t]/2)$. It is assumed to be constant. Some simulations allow it to depreciate or appreciate for policy purposes. An increase in z[t] means depreciation of local currency.

[9] GHG accumulation is exogenous because Malaysia plays a negligible role in affecting the atmospheric GHG concentration. Therefore, GHG accumulation is set as an exogenous variable using an exogenous dynamic equation to represent potential global responses to climate change and their impacts on Malaysian economy. On the contrary, it is an endogenous state variable in the original “global climate” model, where its dynamics are driven by global emissions, natural abatement rate, mitigation rate, energy intensity and energy productivity.

[10] It can also increase as a result of an increase in energy intensity (energy/labor ratio) but they are not included explicitly in this version of the model. See Rezai et al. (2018) for the “global” version of the model.

In the model, any increase in GHG accumulation has an impact on profit share through a damage function, affecting profitability. Overall, profit share is represented as a function of GHG concentration ($G[t]$) via damage function Z[G] and employment-population ratio, $\lambda = \frac{\kappa\, u}{\xi}$, such that

$$\pi_{[t]} = f(G,\lambda) = f\left(Z(G), \frac{\kappa\, u}{\xi}\right) = \frac{(\phi\, Z[t])^{A}}{\lambda[t]^{B}}$$

where κ is capital stock per capita, u is capacity utilization and ξ is labor productivity. We set A, B > 0, $\eta = 0.5$ so the damage function, $Z[t]$ is

$$Z[t] = \left(1 - \left(\frac{G[t] - G_{(Preindustrial)}}{G_{Max} - G_{(Preindustrial)}}\right)^{\frac{1}{\eta}}\right)^{\eta}$$

$G_{(Preindustrial)}$ represents the preindustrial level of atmospheric CO_2 concentration, which is equal to 280 ppmv (parts per million per volume) while G_{Max} is 780 ppmv. GHG accumulation and a tighter labor market cut into profit share so that partial derivatives of G and λ are negative $\left(\frac{\partial f}{\partial\, G}\ and\ \frac{\partial f}{\partial\, \lambda} < 0\right)$.

Long Run Equations:

Our first endogenous, dynamic "state variable" represents the dynamics of the capital stock per capita $\kappa[t]$. The growth rate of capital stock per capita $\hat{\kappa}[t]$ is

$$\frac{\dot{\kappa}[t]}{\kappa[t]} = (g[t] + \iota_g) - \delta_0 - Pop[t] - \delta_1 G[t]$$

where $g[t] = \frac{I[t]}{K[t]} = ((g_o - g_i r) + \alpha\pi[t]u[t] + g_u u[t])$, $\boldsymbol{\delta_0}$ is capital stock depreciation, $\boldsymbol{\delta_1}$ is the depreciation caused by GHG accumulation G[t], Pop[t] is the population growth rate[11], and $\boldsymbol{\iota_g}$ is the government investment-capital stock ratio. GHG accumulation (G[t]) has a direct impact on capital stock through increasing depreciation. As a result, capital stock per capita is determined by capital accumulation, population growth and the depreciation caused by global GHG accumulation.

Our second long run equation is labor productivity growth, represented as "a technical progress function" (Kaldor, 1978). It shows that faster output growth and/or higher investment results in increasing returns to scale with decreasing cost and leads to use of more advanced technologies. Therefore, the growth rate of labor productivity is

$$\hat{\xi}[t] = \frac{\dot{\xi}[t]}{\xi[t]} = \gamma_0 + \gamma_1\hat{\kappa}[t] - \gamma_2(\lambda[t] - \bar{\lambda})$$

where $\gamma_0 > 0$ is the exogenous rate of productivity growth, $\gamma_1 > 0$ represents the capital deepening affect caused by capital accumulation, and γ_2 captures the labor market dynamics—a tighter labor market (lower unemployment) has a negative effect on productivity growth. Increased GHG accumulation could also diminish productivity indirectly via its effect on capital stock accumulation ($\hat{\kappa}[t]$).

An "exogenous" GHG accumulation equation, representing the changes in atmospheric CO_2 concentration is introduced in order to trace potential future climate change dynamics and their impacts on the Malaysian economy. G[t] is exogenously set to generate different global climate scenarios.

$\hat{G}[t] = \frac{\dot{G}[t]}{G[t]} = a\left(1 - \frac{G[t]}{\bar{G}}\right) - \frac{\Omega(1-e^{-\varphi\, t})}{\varphi}$.

[11] An exogenous dynamic equation is introduced to determine the long-term population dynamics.

Additionally, we introduced an accumulation function for debt— $\widehat{D}[t]$, which is determined by the dynamics of lending/borrowing and capital stock, working as a scale of the system. This way, we will be able to analyze the long-term behavior of debt dynamics in the economy based on

$$\widehat{D}[t] = \frac{\dot{D}[t]}{D[t]} = \frac{\left[(I_P[t] - S_c[t] - S_w[t]) + \left(I_g[t] - S_g[t]\right) - S_f[t]\right]}{K[t]}.$$

$(\boldsymbol{I_P[t] - S_c[t] - S_w[t]})$ is private sector's net lending/borrowing; $\left(\boldsymbol{I_g[t] - S_g[t]}\right)$ is government's net lending borrowing; $\boldsymbol{S_f[t] = IM[t] - EX[t] + r_0\, D[t]}$ is the rest of the world's net lending/borrowing (or their savings), and $\boldsymbol{r_0\, D[t]}$ is the net interest payments on debt. As a result, if $\boldsymbol{Total\ Investments} >$ $(\boldsymbol{Total\ Savings + Net\ Debt\ Payments})$ national debt increases.

Finally, assuming that the Malaysian population will reach 44 million and stabilize in the long run, population growth is represented by an exogenous dynamic equation, $\frac{\dot{Pop}[t]}{Pop[t]} = n\left(1 - \frac{Pop[t]}{44}\right)$. We assume that population growth increases the sizes of the bottom 90% of the households, while the sizes of the top 10% of the households stays the same.[12]

Workers vs. Capitalist

Consumption is divided between workers, $\boldsymbol{C_w[t]}$ and capitalists, $\boldsymbol{C_c[t]}$. Total consumption after tax and savings is

$$C[t] = C_w[t] + C_c[t]$$
$$C_w[t] = X[t] * (1 - \pi[t])\,(1 - \tau_w)(1 - s_w) - (\theta_w * r_0\, D[t]) + (r_1 * S_w[t]) + c_w$$

$\boldsymbol{\tau_w}$ is the tax rate of workers and $X[t] * (1 - \pi[t])\,\tau_w$ is their total taxes; $\boldsymbol{s_w}$ is the saving propensity of workers and $\boldsymbol{S_w[t]}$ is the savings of workers—they still save a small but positive amount out of their wages, and $\boldsymbol{r_1}$ is the interest on their savings such that $(r_1 * S_w[t])$ represents the wealth effect on consumption while $(\boldsymbol{\theta_w * r_0 * D[t]})$ represents their share in net interest payments. $\boldsymbol{c_w}$ is the constant coefficient of consumption13. Workers' saving equation, therefore is

$$S_w[t] = s_w\,(1 - \pi[t])\,X[t]$$

Their disposable income is

$$DYH_w = C_w[t] + S_W[t].$$

Capitalist consumption is

$$C_c[t] = X[t]\,\pi[t]\,(1 - \tau_c)\ (1 - s_c) + (r_1 * S_c[t]) - (\theta_c * r_0\, D[t]) + c_c$$

where $\boldsymbol{\tau_c}$ is the tax rate of capitalists and $X[t]\,\pi[t]\,\tau_c$ is their total taxes. $\boldsymbol{s_c}$ is the saving rate of capitalists, $\boldsymbol{S_c[t]}$ is their savings, and $(\boldsymbol{r_1 * S_c[t]})$ represents a positive wealth effect on their consumption while $(\boldsymbol{\theta_c * r_1 * D[t]})$ is their share in net interest payments. $\boldsymbol{c_c}$ is a constant coefficient. Capitalists' saving and their disposable income equations are:

$$S_c[t] = s_c\,\pi[t]\,X[t]$$
$$DYH_c[t] = C_c[t] + S_c[t]$$

Based on this income disaggregation, we can calculate the Palma Ratio as the ratio of average disposable income of workers to average disposable income of capitalists

[12] This assumption allows us to calculate disposable income per-capita of different households so that we can also calculate the Palma ratios of different income classes, which sheds light on the dynamics of income inequality.
[13] Interests on total debt are assumed to be paid only by the government and the capitalist class.

$$Palma_{DYH}[t] = \frac{\left(\frac{DYH_c[t]}{Pop_c[t]}\right)}{\left(\frac{DYH_w[t]}{Pop_w[t]}\right)}.$$

The Government

Government expenditure (mitigation and non-mitigation spending) is

$$M[t] + G_g[t] = m\,X[t] + \beta\,K[t] - ((1 - \theta_c - \theta_w) * int_0 * D[t])$$

where $(1 - \theta_c - \theta_w) * int_0 * Debt[t]$ represents net interest payments on debt.
Government Investment (spending) is

$$I_g[t] = \iota_g\,K[t].$$

Its income (total taxes on workers and capitalists) is

$$T[t] = (\pi[t] * X[t] * \tau_c) + (1 - \pi[t]) * X[t] * \tau_w.$$

As a result, government saving (Fiscal Balance) becomes

$$S_g[t] = T[t] - \left(M[t] + G_g[t]\right).$$

Closing the model, the rest of the world's (ROW) saving equation is:

$$S_f = IM[t] - EX[t] + r_0\,D[t]$$

Appendix B: Global projections

Projections presented in UNCTAD (2023) illustrate a path for the global economy that allows to sustain economic growth (higher in developing countries, lower in developed ones), high employment (particularly in industrial economies that suffer more from unemployment), rebalance income distribution, and reduce emissions to the point of ensuring climate stability. This outcome requires profound changes in the stance of economic policy both domestically (including more fiscal spending, stronger social protection and tighter control on financial activities) and internationally, in the sense of extensive coordination in trade and finance. Figures B.1-B.4 illustrate the main outcomes of those projections for developed and developing countries, updated to 2030.

Figure B.1: GDP Growth, 2000-2030 (Blue line: baseline; red line: rebalancing scenario)

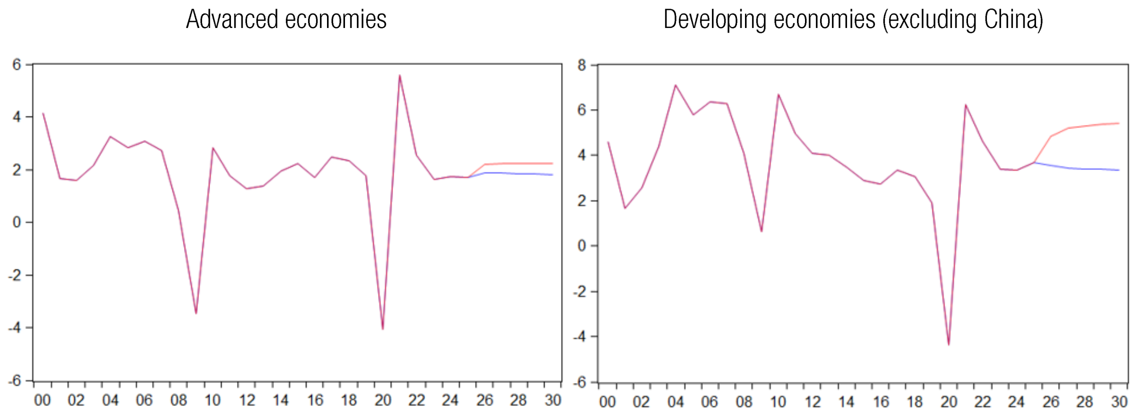

Figure B.2: Labor share of value added, 2000-2030, wages and employers' social security contributions as percentage of GDP (Blue line: baseline; red line: rebalancing scenario)

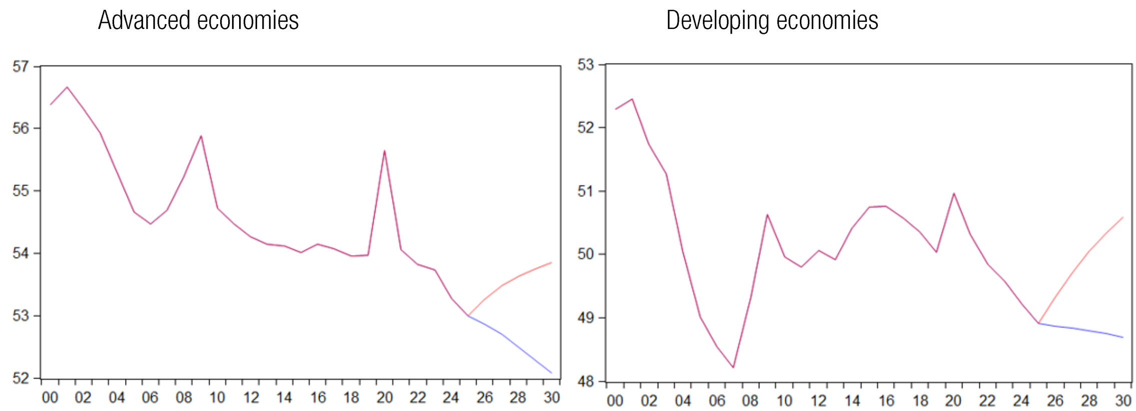

Figure B.3: Current Account, 1980-2030, percentage of GDP (Blue line: baseline; red line: rebalancing scenario)

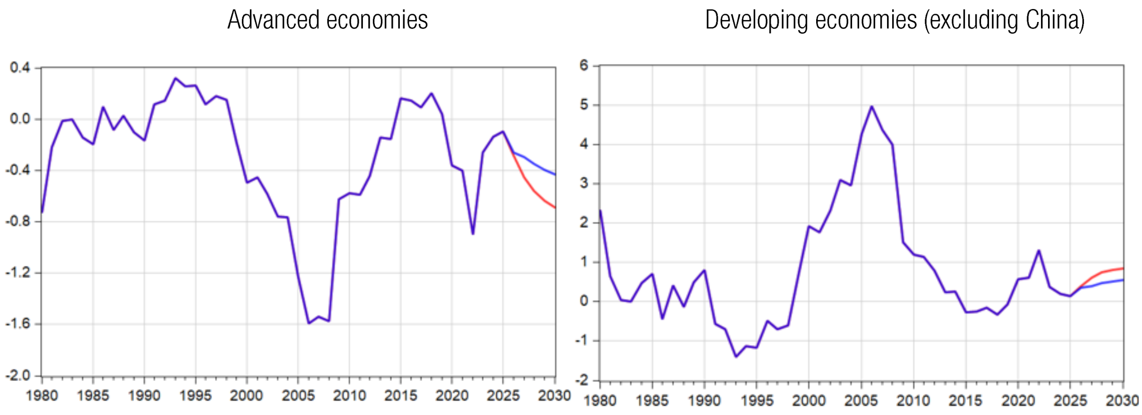

Figure B.4: CO2 intensity of GDP, 2000-2030, percentage change (Blue line: baseline; red line: rebalancing scenario)