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Rising Tides, Sinking Revenues: Vietnam's Fiscal Policy Amidst Climate Change

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Abstract

This case study examines the critical role of fiscal policy in addressing the multifaceted challenges posed by climate change in Vietnam. Given the country's high vulnerability to climate-induced natural disasters and its economic dependence on sectors like agriculture and aquaculture, the study aims to assess the efficacy of fiscal measures in enhancing economic resilience and sustainability. Through a comprehensive discussion of current fiscal policies, this research identifies the direct and indirect impacts of climate change on Vietnam's economy, evaluates the current fiscal policy landscape, and explores the challenges and opportunities in leveraging fiscal policy for climate adaptation and mitigation. The study highlights the urgent need for strategic fiscal interventions to safeguard against climate risks and promote sustainable development. The findings suggest that while Vietnam has made strides in integrating climate considerations into its fiscal policy framework, significant gaps remain, particularly in financing climate adaptation and mitigation efforts, enforcing policy measures, and aligning fiscal strategies with long-term sustainability goals.

Keywords: Climate change adaptation; fiscal policy; Vietnam; economic resilience; sustainable Development

JEL classification: Q54, Q56, H12, H50, O13.

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About the Resilience Adaptation Mainstreaming Program (RAMP) and the RAMP University Network

The Resilience and Adaptation Mainstreaming Program (RAMP) builds capacity in ministries of finance and other relevant public institutions in climate-vulnerable countries to embed climate adaptation into their core fiscal, budgetary and macro-economic functions, enabling governments to manage climate risks, design effective policy responses to build economy-wide resilience, and align adaptation funding with development priorities. RAMP is a strategic partner of the Coalition of Finance Ministers for Climate Action and works in close partnership with international financial institutions, regional development banks, and other stakeholders.

At the heart of RAMP's approach to capacity-building is its University Network for Strengthening Macrofinancial Resilience to Climate and Environmental Change ('the RAMP University Network'). Launched in 2022, the RAMP University Network consists of leading universities in vulnerable countries that seek to develop and deliver high-quality multi-disciplinary teaching and research on adaptation economics and climate risk management, train public officials, and serve as centres of expertise that ministries of finance and other public institutions can rely on. This approach ensures that skills and knowledge are embedded locally, strengthening partner countries' ability to integrate climate risks into economic decision-making.

Co-founded by the Centre for Sustainable Finance (CSF) at SOAS University of London and the World Resources Institute, RAMP is currently managed by the CSF, which also acts as Secretariat for the RAMP University Network. For more information visit: https://www.soas.ac.uk/university-network

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1. Introduction

Climate change represents an unprecedented global challenge, affecting nations worldwide irrespective of geographical boundaries or economic status. Its far-reaching impacts influence various sectors, including agriculture, health, infrastructure, and ecosystems. As the Intergovernmental Panel on Climate Change (IPCC) reports, the increasing frequency and severity of extreme weather events, alongside rising sea levels and temperatures, pose significant risks to food security, water supplies, and human livelihoods (IPCC, 2023). These changes demand urgent and concerted efforts from countries worldwide to adapt to and mitigate the effects of climate change. Within this global context, the specific vulnerabilities and challenges faced by Vietnam become a critical focal point for analysis. The country's geographic positioning exposes it to a high risk of floods, typhoons, and other climatic hazards, making it a critical case study for examining the efficacy of fiscal policies in combatting climate change impacts.

Vietnam's geographical location, alongside its economic dependencies on agriculture and aquaculture, significantly heightens its vulnerability to the adverse effects of climate change. Positioned in Southeast Asia, with an extensive coastline along the South China Sea, Vietnam faces an increased risk of severe weather events, including typhoons, floods, and rising sea levels. These climatic hazards threaten the physical landscape and the livelihoods of millions who depend on agriculture and aquaculture for their subsistence and income. According to the Ministry of Natural Resources and Environment of Vietnam (MONRE), the country experienced one of its most devastating typhoon seasons in recent years, with Typhoon Molave (2020) displacing thousands and causing widespread damage to crops and infrastructure (MONRE, 2021). Furthermore, the agriculture sector, which employs approximately 30% of the national workforce, could lose significantly from temperature increases and altered precipitation patterns, with marginal loss to agricultural productivity up to 2.6% (Nguyen & Scrimgeour, 2022). These challenges underscore the urgent need for Vietnam to devise and implement robust adaptation strategies to mitigate the impacts of climate change on its economy and populace.

The economic ramifications of climate change for Vietnam are profound and multifaceted, necessitating a reevaluation of fiscal policy as a crucial instrument for addressing these challenges. Climate-induced impacts are already disrupting economic activities and undermining growth, with the World Bank reporting a loss of approximately $10 billion in 2020 alone, equating to 3.2% of Vietnam's GDP. This trend is projected to escalate, potentially costing Vietnam about 12% to 14.5% of its GDP annually by 2050, which could thrust up to one million people into extreme poverty by 2030 (World Bank, 2022a). The direct financial losses incurred due to climate-related impacts underscore the tangible and immediate effects on the nation's economy. These losses affect the country’s economic output and have broader implications for fiscal variables, including government revenue and expenditure.

Moreover, research indicates that climate change significantly affects fiscal aggregates, including revenue and expenditures in Vietnam. Economic responses to climate-related shocks and policy interventions designed to mitigate these impacts can lead to fiscal adjustments. For instance, as climate change exacerbates the frequency and severity of extreme weather events, increased government spending on disaster relief, infrastructure repair, and adaptive measures becomes necessary. At the same time, these environmental challenges can disrupt economic activities, potentially reducing government revenue from the affected sectors. Fankhauser and McDermott (2014) highlight that these dynamics often result in a widening budget deficit, as government expenditures rise more steeply than revenues in response to climate-induced economic disruptions. The authors underscore the need for well-structured fiscal policies that can accommodate these shifts, suggesting that without adequate planning and adaptation, the economic burden of climate change could severely impact fiscal stability and economic growth.

Vietnam's public finances face significant risks due to climate change, which can broadly be categorised into increased disaster-related expenditures, reduced revenues from high-risk sectors, and rising costs of sovereign debt. Understanding these risks is essential for developing effective fiscal policies that enhance economic resilience and sustainability.

Climate change-induced extreme weather events necessitate substantial unplanned government expenditures for immediate relief and long-term recovery. In Vietnam, the recurring nature of storms, floods, and droughts demand significant fiscal outlays. Financing these expenditures often requires the government to issue more debt, especially when existing fiscal space is constrained (Fankhauser & McDermott, 2014). This continuous financial strain can undermine fiscal stability and exacerbate sovereign risk (Volz et al., 2020).

The agriculture, tourism, and manufacturing sectors are particularly vulnerable to climate impacts. Disruptions in these sectors due to extreme weather events can lead to substantial declines in productivity and output, resulting in lower tax revenues. For instance, reduced agricultural yields due to changing precipitation patterns and increased temperatures directly affect government revenues derived from the agricultural sector (World Bank, 2022b). Similarly, the tourism sector faces declining revenues as rising sea levels and extreme weather events damage infrastructure and deter tourists (Scott et al., 2008). The manufacturing sector, concentrated in coastal areas, is susceptible to disruption from extreme weather, affecting export revenues and overall economic performance (Adger et al., 2003).

Climate-related financial risks can also affect the cost of sovereign borrowing. Increased disaster-related expenditures and reduced revenues can lead to higher borrowing costs as investors perceive greater risks associated with lending to countries highly exposed to climate impacts. This situation is exacerbated by the need for substantial investments in climate adaptation and mitigation, potentially increasing public debt levels (Beirne et al., 2021).

The aims and objectives of this case study are centered on exploring the critical role of fiscal policy in enhancing Vietnam's resilience to climate change. The case study primarily utilises published analyses to evaluate the effectiveness of fiscal policies in addressing the challenges posed by climate change. This is motivated by the escalating economic and social costs attributed to climate-related impacts within the country.

1. How can fiscal policy effectively mitigate the adverse effects of climate change on Vietnam's economy and society?
2. What are the potential impacts of climate change on Vietnam's fiscal sustainability, including government revenue, expenditure, and public debt levels?
3. Which sectors are most at risk from climate change in Vietnam, and how can fiscal interventions be tailored to support these sectors?
4. How do Vietnam's fiscal policy responses to climate change align with broader sustainable development and environmental protection goals?

The scope of this analysis spans an evaluation of the direct and indirect economic impacts of climate change on Vietnam, with a particular focus on the fiscal implications. This encompasses an assessment of the vulnerability of critical sectors such as agriculture, aquaculture, manufacturing, and tourism, and the subsequent effects on government revenue streams and expenditure patterns. The paper also examines the strategic use of fiscal tools, including taxation, budget allocations, and incentives for green investments, in fostering a resilient and sustainable economic model. Additionally, the study considers the challenges and opportunities in mobilising domestic and international financial resources for climate action.

By addressing these questions, the case study offers a comprehensive exploration of the fiscal policy landscape in Vietnam in the context of climate change. It seeks to contribute valuable insights into formulating and implementing fiscal strategies that mitigate climate-related risks and promote economic stability, environmental sustainability, and social well-being. Through this analysis, the study aims to inform policymakers, stakeholders, and the academic community about effective fiscal responses to climate change, with implications for Vietnam and other similar developing countries facing analogous challenges.

The subsequent sections of this study will further analyse the fiscal impacts and strategic responses necessary to address these challenges. Section 2 will delve into the case context, elaborating on Vietnam's vulnerability to climate change and the associated risks. Section 3 will examine how climate change is expected to impact revenue streams. Section 4 will identify and discuss the high-risk sectors critical to the national economy yet vulnerable to environmental changes. Section 5 will provide an in-depth analysis of sovereign debt, exploring how climate change impacts fiscal sustainability through various channels. Section 6 will propose leveraging fiscal policy to achieve Vietnam's climate goals, including integrating climate considerations into public financial management, diversifying public revenue streams, and disaster risk financing. Finally, the study will conclude in Section 7 with a synthesis of findings and policy recommendations.

2. Case Context: Vietnam, climate change, and climate risk

Vietnam’s unique geographical and socio-economic landscape positions it at the forefront of climate-related challenges, with significant implications for its developmental trajectory and fiscal policies. This section delves into Vietnam’s multifaceted climate risks and outlines the imperative for a strategic response to mitigate them and safeguard its future.

Vietnam faces many climate risks, from rising sea levels threatening coastal and delta regions to increased frequency and intensity of extreme weather events (see IMF (2018)). Flooding, typhoons, and droughts are among the most significant hazards, posing direct threats to life, livelihoods, and infrastructure (IMF, 2018). The 2024 INFORM Risk Index highlights Vietnam’s high exposure to these natural disasters, ranking it 78 out of 191 countries regarding disaster risk levels, particularly vulnerable to flooding and cyclones (European Commission, 2024).

The natural disaster statistics shown in Figure 1 underscore the recurrent and severe impact of hydrometeorological events on populations, particularly in the context of Vietnam’s climate vulnerability. Storm occurrences are consistent with Vietnam’s geographical predisposition to tropical cyclones. The country’s extensive coastline along the South China Sea predisposes it to frequent and intense tropical storms, with profound implications for its predominantly rural and coastal populace (UNDRR, 2019). This pattern underscores the critical need for robust early warning systems and disaster preparedness mechanisms, as emphasised by the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNDRR, 2015).

Floods periodically reach the highest magnitudes, signifying the widespread and recurrent affliction caused by this particular type of natural disaster. In the context of Vietnam, a nation with an extensive river system and a monsoonal climate, flooding is a perennial concern exacerbated by the effects of climate change. The deluges are not merely natural phenomena but are increasingly seen as the consequence of anthropogenic climate alterations, leading to more intense and less predictable monsoon patterns (Hoang et al., 2016). The escalation in flood events, particularly in recent decades, aligns with this narrative, indicating an uptrend that poses significant risks to agricultural sustainability, infrastructure resilience, and human security (Tran & James, 2017).

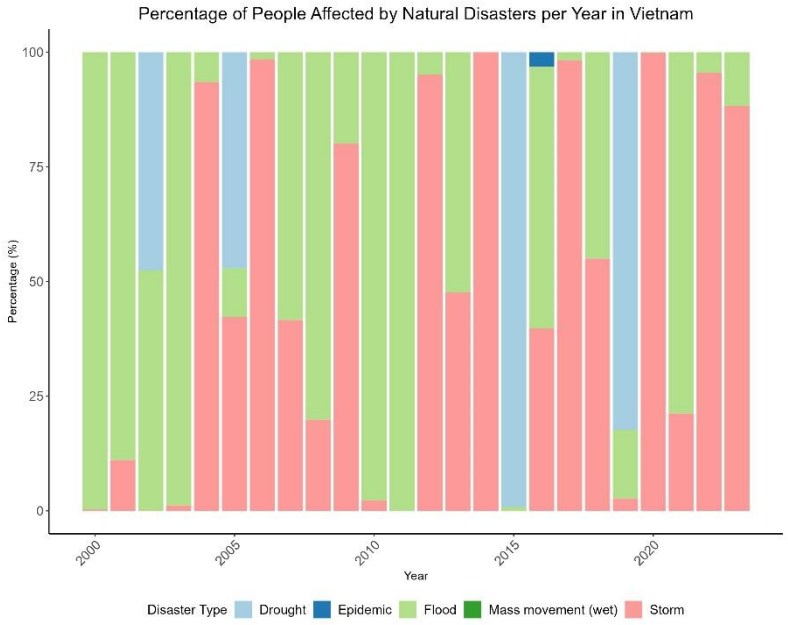
This heightened risk is further augmented by the socio-economic fabric of Vietnam, where a significant proportion of the population and economic activity, including agriculture, is concentrated along the

vulnerable low-lying river deltas. The frequent occurrence of floods translates into substantial socio-economic disruptions, loss of life, and displacement, with the poor and marginalised communities being the most affected (Cumiskey et al., 2019). These recurring flood events necessitate a multifaceted approach to disaster risk management, integrating structural and non-structural measures, community-based adaptation, and sustainable land-use planning (Tran et al., 2008).

The implications of the flood-centric graph are clear—Vietnam's strategies for climate change adaptation and risk mitigation must prioritise flood resilience. This aligns with the nation's action plans under the Paris Agreement and the Sendai Framework for Disaster Risk Reduction, emphasising the need to enhance adaptive capacity, strengthen governance, and mobilise investment in disaster risk reduction (UNFCCC, 2015).

Droughts and epidemics, though less frequent, exhibit significant impacts in certain years, indicating episodic but severe disruptions. These events have been linked to broader climate patterns, such as the El Niño Southern Oscillation, which can induce prolonged dry spells and are anticipated to become more erratic with climate change (McMichael et al., 2006).

Figure 1. Vietnam Natural Statistics 2000 - 2024



Source: EM-DAT database, Author's calculations

Under the Shared Socio-economic Pathway 5-8.5 (SSP5-8.5) scenario, which models a trajectory characterised by continued fossil-fuel-driven development, high energy and resource consumption, and low environmental awareness, Vietnam is projected to experience a substantial warming trend with significant implications for its climate risk profile (Riahi et al., 2017; World Bank, 2021). The average temperatures in Vietnam are expected to increase markedly through each subsequent time period: 2020-2039, 2040-2059, 2060-2079, and 2080-2099, with the highest temperatures projected by the end of the century. This rising temperature trend underscores the urgency for robust climate adaptation and mitigation strategies to manage the escalating climate risks.

The broad spread of projected temperatures, particularly in the latter half of the century, highlights a significant degree of uncertainty, reflecting both the natural variability of the climate system and the range of possible future greenhouse gas emissions. This variability may challenge adaptation strategies, necessitating flexible and robust planning for a wide range of potential climate conditions (World Bank, 2021).

The anticipated temperature increase could profoundly affect Vietnam's agricultural productivity, water resources, and overall human health, exacerbating existing vulnerabilities. For instance, a consistent rise in temperature may alter crop phenology, potentially reducing yields of staple crops and threatening food security (Nguyen, 2002). The enhanced heat could also exacerbate the urban heat island effect in densely populated cities like Hanoi and Ho Chi Minh City, amplifying risks to human health and energy demand for cooling (Lelieveld et al., 2019).

3. Impact of climate change on revenue streams

Climate change impacts—manifesting primarily through higher and more variable temperatures and rising sea levels—are already disrupting economic activity and undermining growth in Vietnam. The World Bank has highlighted that Vietnam suffered a loss of approximately $10 billion in 2020, equating to 3.2% of its GDP due to climate-related impacts. If current trends continue without effective adaptation and mitigation strategies, it is estimated that climate change could cost Vietnam about 12% to 14.5% of its GDP annually by 2050. This could potentially push up to one million people into extreme poverty by 2030, exacerbating the fiscal strain on the government (World Bank, 2022a).

The evidence provided underscores the significant fiscal implications of climate change on countries, with Vietnam serving as a pertinent case study. The direct financial loss of approximately $10 billion in 2020, representing 3.2% of Vietnam's Gross Domestic Product (GDP) due to climate-related impacts, illustrates climate change's immediate and tangible effects on a nation's economy (World Bank, 2022a). This substantial loss affects the country's economic output and has broader implications for fiscal variables, including government revenue and expenditure.

The CGE model outcomes for Vietnam, as reported by the World Bank (2022b), indicate that incorporating climate change impacts significantly influences fiscal aggregates, including revenue and expenditures. The CGE model provides a comprehensive framework for evaluating the interactions between various economic sectors and the effects of policy interventions. Detailed information about the model, including its key assumptions, is provided in the Appendix (World Bank, 2022b).

While the baseline scenario, which disregards climate change, suggests that fiscal variables would likely follow a trajectory determined by existing economic structures and policies, scenarios that incorporate climate change demonstrate adjustments in these fiscal aggregates due to economic responses to climate-related shocks and policy interventions. The budget deficit is anticipated to widen in such scenarios, driven by the likelihood of expenditures rising more steeply than revenues. This divergence aligns with the broader literature, which argues that the fiscal costs of natural disasters—expected to become more frequent and severe with climate change—will strain public finances (Fankhauser & McDermott, 2014; Jones et al., 2013). However, it is crucial to recognise the limitations of the World Bank's model, such as its potential underestimation of indirect economic impacts and the uncertainty in climate impact projections, which could significantly influence fiscal analysis and policy planning (Behrens et al., 2008; Ekins & Speck, 2014).

The direct impact of climate change on government revenue is predominantly observed through its effects on productivity and economic output, particularly in sectors sensitive to environmental changes like agriculture. The reliance of rural incomes on agriculture directly influences government tax revenues from this sector. Changes in temperature and precipitation patterns can significantly disrupt agricultural output, thus affecting the livelihoods of those dependent on farming and the tax revenues derived from this sector (Ignaciuk et al., 2014; Mendelsohn et al., 2006). While the immediate fiscal impact of reduced agricultural productivity is evident, the broader fiscal implications, such as the need for government subsidies and investments in adaptive measures, complicate the financial outlook. Studies highlight the fiscal stress on governments to support adaptation strategies in agriculture, such as investments in irrigation systems and flood defences (Antle & Capalbo, 2010; Bui et al., 2014). However, these analyses often overlook the variability in local agricultural practices

and the adaptive capacities of rural communities, which can significantly moderate the fiscal impacts of climate variability. Furthermore, the inherent uncertainty in projecting climate impacts adds a layer of complexity to fiscal planning. This complexity necessitates a comprehensive understanding of potential outcomes such as altered tax bases due to shifts in productivity, increased public expenditure for disaster relief and adaptation infrastructure, and economic adjustments in response to changes in the global agricultural market (Antle & Capalbo, 2010; Ignaciuk et al., 2014; Qian et al., 2014).

The studies by Anh et al. (2023) and Van Huong et al. (2022) provide a nuanced understanding of how climate change impacts Vietnam's agricultural sector and, consequently, its government revenue. Increased temperatures and rainfall variability negatively impact agricultural output and economic performance, with a 1% increase in temperature leading to a 2.99% decrease in the agricultural production index (AGPI) (Anh et al., 2023). Interestingly, CO2 emissions have shown a positive impact on agricultural productivity, with a 0.37% increase in AGPI for every 1% rise in CO2 emissions due to enhanced photosynthesis (Anh et al., 2023). In contrast, a regional analysis of the Northwest region of Vietnam projects a 5-10% reduction in rice yields by 2050 due to increased temperatures and altered rainfall patterns, highlighting the broader economic implications such as decreased household incomes and increased food prices, which exacerbate poverty and food insecurity (Van Huong et al., 2022). The need for substantial government subsidies and investments in adaptive measures like improving irrigation infrastructure and adopting climate-resilient crop varieties is emphasised, reflecting significant fiscal stress (Van Huong et al., 2022).

Climate change influences government revenue indirectly by affecting economic stability and growth. Research has shown that rising temperatures negatively impact economic growth in regions with hotter climates, such as Vietnam. This leads to a shrinking tax base as both personal incomes and corporate profits diminish, thus limiting the resources available for public spending (Dell et al., 2012). The literature, however, suggests variability in these impacts, pointing out that different geographic and institutional frameworks can either mitigate or exacerbate these effects (Castells-Quintana et al., 2017).

In Vietnam, a region characterised by its hot climate, the adverse effects of increased temperatures on productivity are pronounced, particularly in outdoor and agriculture-related activities. Research indicates that heat stress significantly affects human health and work capacity, leading to lower productivity and reduced economic output (Kjellstrom et al., 2009). However, the precise quantification of such productivity declines and their broader economic ramifications remain elusive, complicating fiscal forecasting. These variations are attributed to differences in local adaptations and the resilience of economic sectors (Kjellstrom et al., 2009; Sahu et al., 2013).

Additionally, the need for cooling in response to higher temperatures drives up energy demand, which strains infrastructure and increases operational costs. These changes affect the profitability of businesses and, consequently, the amount of corporate tax revenue generated (Isaac & Van Vuuren, 2009). While the increased demand for energy highlights the urgent need for adaptive strategies and robust energy policies, the economic outcomes are dependent on how effectively these policies are implemented and the availability of sustainable energy solutions (Eboli et al., 2010).

The allocation of increased resources for adaptation strategies presents complex fiscal challenges, as governments may need to increase taxes or reallocate funds from other essential services. The financial burden of these investments, particularly in developing economies, is highlighted by existing studies, which emphasise the strain on public finances (Kahn et al., 2021). Nonetheless, it is important to consider the variability in these impacts. Some researchers argue that by incorporating fiscal impacts, efficient climate policy may enhance welfare benefits, potentially offsetting some financial burdens associated with climate change mitigation (Barrage, 2020). Moreover, the engagement of public finance in funding mitigation and adaptation efforts is seen as a pivotal strategy to address

budgetary dilemmas. However, this approach requires carefully balancing fiscal stability and climate responsiveness (Kutasi, 2015). Furthermore, replacing distortionary taxes with carbon pricing, as part of stringent climate mitigation efforts, could serve fiscal objectives by reallocating revenues to public investments, which might alleviate some fiscal challenges. However, the effectiveness of such strategies depends on the specific economic and institutional contexts, which can significantly influence their outcomes (Siegmeier et al., 2018).

The significant investment required for adaptation and mitigation strategies to combat the effects of climate change impacts fiscal variables considerably. Such investments demand substantial public funding, potentially necessitating the reallocation of resources from other critical areas or increasing public debt. Although recent estimates suggest that Vietnam's total incremental financing needs for these purposes could reach between $342 and $411 billion from 2022 to 2050, or about 4.5 to 5.4 per cent of GDP per year, these figures also underline a substantial gap between current expenditures and projected needs (World Bank, 2022b). While the current level of climate-related capital spending in Vietnam is significant, about 25 per cent of the government investment budget or 1.5 per cent of GDP, and public funding for disaster programs is around 0.3 per cent of GDP, the long-term fiscal sustainability could be jeopardised if costs continue to escalate without adequate international support and investment in sustainable development.

However, the literature suggests that integrating climate risks and adaptation costs into national frameworks could aid fiscal planning and ensure sustainability. For example, the IMF highlights the need for countries like Vietnam to effectively incorporate climate risks into their macro-fiscal planning to address these adaptation financing gaps (Bellon & Massetti, 2022). Moreover, innovative financing mechanisms and international support are essential to meet these extensive needs without compromising fiscal stability or economic growth (Le, 2023; Pham et al., 2020).

The financial implications of climate change adaptation and mitigation strategies are multifaceted, impacting more than just immediate fiscal health. They often require a strategic reallocation of resources from other vital areas or an increase in public debt, which could compromise the long-term fiscal sustainability of countries such as Vietnam. While substantial international support and investment are crucial to managing these costs, the literature suggests that the costs could escalate without careful integration of climate risks into national fiscal frameworks, posing severe challenges to economic stability and development efforts. For instance, studies highlight that the ability of developing countries to absorb and efficiently utilise large-scale financial inflows for climate adaptation remains a significant challenge, often limited by governance and institutional capacities (Bellon & Massetti, 2022; Le, 2023). Additionally, while international funding mechanisms are geared towards supporting climate change efforts, the adequacy and timeliness of this support remain contentious, often mired in geopolitical and economic considerations that can delay or dilute the effectiveness of the aid provided (McElwee, 2017; Pham et al., 2020).

Comparing the results from Vietnam with those of neighbouring countries provides valuable insights into the regional impact and responses to climate change. The study by Zhai et al. (2009) using a CGE model to analyse climate change's impact on agriculture in China reveals similar challenges. Like Vietnam, China faces significant reductions in agricultural productivity due to increased temperatures and changing precipitation patterns. The economic losses projected for China are substantial, with GDP expected to decrease by up to 3% under severe climate scenarios. This aligns with Vietnam's projected economic losses, indicating that both countries must prioritize investments in climate-resilient agricultural practices and infrastructure to mitigate these impacts. Similarly, Puttanapong (2013) using static and Monte-Carlo CGE models show that climate change will lead to substantial declines in crop yields in Thailand, particularly for rice. The economic repercussions in Thailand include higher food prices, reduced household incomes, and increased poverty levels, especially in rural areas.

These findings emphasise the need for Vietnam to implement adaptive measures, such as improved water management, advanced farming techniques, and sustainable agricultural policies.

Furthermore, Rajbhandari et al. (2019) examine the impact of different greenhouse gas (GHG) reduction scenarios on Thailand's economy and social welfare using a CGE model. The study highlights that while GHG reduction policies can entail short-term economic costs, they offer long-term benefits by reducing climate-related damages and improving social welfare. This underscores the importance of integrating GHG reduction strategies into Vietnam's national development plans. By promoting renewable energy, enhancing energy efficiency, and supporting sustainable agricultural practices, Vietnam can achieve both economic and environmental benefits. Learning from China's investment in agricultural research and development and Thailand's focus on better water management and sustainable farming practices, Vietnam can adopt these strategies to mitigate the adverse effects of climate change. Additionally, integrating climate policies into fiscal planning, such as creating incentives for renewable energy investments and implementing carbon pricing mechanisms, can help Vietnam achieve sustainable economic growth and improved social welfare.

4. High-Risk Sectors

4.1 Agricultural Sector

With its significant coastline, diverse ecosystems, and reliance on agriculture and aquaculture, Vietnam is particularly vulnerable to the adverse effects of climate change, including sea-level rise, increased frequency of extreme weather events, and temperature fluctuations. These environmental changes pose substantial risks to economic sectors beyond agriculture, affecting industrial production, tourism, and infrastructure development, which has implications for government revenue.

In Vietnam, agriculture plays a crucial role in the national economy, contributing significantly to GDP and employing a large portion of the population. The sector is susceptible to climate conditions, with temperature changes, precipitation variability, and extreme weather events directly affecting crop yields. The World Bank highlights that Vietnam is among the most vulnerable countries to climate change, seriously threatening its agricultural sector, food security, and economic growth (World Bank, 2022b). Climate change, for instance, increased temperatures and altered rainfall patterns, has led to decreased rice yields in the Mekong Delta region, a key agricultural area in Vietnam (Trinh et al., 2021; Van Huong et al., 2022). This reduction in yield affects farmers' income and impacts the broader economy, given the sector's contribution to national GDP and export revenues. Specific challenges include extreme weather events such as floods, storms, and droughts, which have already begun to affect the nation's agricultural output and threaten to contract Vietnam's GDP by 0.7% to 2.4% by 2050 (World Bank, 2022b).

Moreover, the agricultura; sector is a significant contributor to greenhouse gas emissions in Vietnam, mainly methane and nitrous oxide, which are more potent than CO2 and contribute to near-term warming. Mitigation strategies such as reducing fertiliser and pesticide use, improving livestock feed and breeding practices, and investing in reforestation are vital for decreasing these emissions. Decarbonisation requires substantial investment, estimated at $15.6 billion over the 2022-2040 (World Bank, 2022b).

The impact of climate change on agriculture extends beyond the sector itself, affecting the broader economy and government revenue. A decline in agricultural productivity can increase food prices, impacting inflation rates and purchasing power. The sector's vulnerability to climate change can significantly reduce crop yields through altered precipitation patterns, increased temperatures, and extreme weather events (Trinh et al., 2021; Van Huong et al., 2022). This reduction in agricultural output can lead to increased food prices, contributing to higher inflation rates. The escalation of food prices affects the purchasing power of consumers, particularly the lower-income segments of the population, which spend a larger proportion of their income on food. The resultant inflationary

pressure can lead to decreased consumer spending on non-essential goods and services, adversely affecting sectors beyond agriculture and reducing the overall economic growth rate (Anh et al., 2023). Increased food prices and inflation on consumer spending can significantly affect Vietnam's economic growth. Reduced consumer spending diminishes demand for goods and services, slowing economic activities across various sectors. This slowdown can further reduce the government's tax revenue from these sectors, straining public finances when additional resources are needed to combat the effects of climate change (Vien, 2011).

4.2 Tourism Sector

Vietnam's tourism sector thrives on its natural beauty, including beaches, deltas, and cultural heritage sites, which attract millions of tourists annually. However, climate change poses a significant threat to these attractions. Increased temperatures and heat waves can make outdoor activities uncomfortable or even dangerous, deterring tourists from visiting affected regions. Rising sea levels and increased frequency of extreme weather events, such as typhoons and floods, threaten coastal tourism infrastructure, including hotels, resorts, and beaches, and can lead to the loss of land and biodiversity, further reducing the attractiveness of these destinations (Scott et al., 2008).

The degradation of natural attractions, such as coral bleaching in marine parks and the loss of biodiversity in deltas and wetlands, directly impacts the appeal of these destinations to tourists. Pham et al. (2010) illustrate how climate change-induced alterations—such as increased sea temperatures leading to coral bleaching and altered salinity affecting the biodiversity of wetlands—compromise the attractiveness of regions like the Mekong Delta and coastal areas of Vietnam, potentially leading to a decline in tourism revenues. For example, coral bleaching not only diminishes the marine aesthetic vital for dive tourism but also affects the marine biodiversity that supports fishing activities—a key attraction for eco-tourists.

The decline in tourism due to environmental degradation, such as coral bleaching and biodiversity loss, triggers a significant domino effect across related sectors. In hospitality, for instance, hotels and resorts experience lower occupancy rates as the primary attractions that draw tourists deteriorate. This reduction in guests results in decreased demand for services like housekeeping, on-site dining, and event planning, directly affecting employment and revenue within these facilities. The impacts extend to the food and beverage sector, where local restaurants and bars, heavily reliant on tourist patronage, see a drop in customers, challenging their profitability and operational sustainability. These shifts are particularly pronounced in small, locally owned businesses, which are less equipped to absorb financial shocks, leading to broader economic repercussions in local economies (Pang et al., 2013; Pintassilgo et al., 2016).

Moreover, the transportation sector, which encompasses airlines, rental car services, local taxis, and buses, also feels the economic pinch. With fewer tourists, there is less demand for transportation, resulting in lower revenues. This decrease affects not just direct transportation services but also ancillary industries like vehicle maintenance, airport services, and local transit systems, which suffer from reduced usage and revenue. The ripple effects of reduced tourism due to environmental impacts are extensive, affecting employment levels, business profitability, and the overall economic health of the regions (Kayal, 2024; Leal Filho, 2022).

The vulnerability of the tourism sector to climate change has profound implications for public finances in Vietnam. Tourism is a substantial source of government revenue, contributing through taxes on income, profits from tourism-related businesses, and sales and service taxes. A downturn in tourism due to climate change can significantly reduce these tax revenues, straining fiscal resources. Additionally, the government may face increased pressure to invest in adaptation and mitigation strategies to protect and restore natural attractions and to develop more resilient tourism infrastructure. These investments, while necessary, require substantial public funding, which could otherwise be allocated to other critical areas of the economy or social welfare (Becken, 2013).

Moreover, the loss of tourism revenue can cascade to the economy, reducing income levels and employment opportunities in tourism-dependent communities. The reduction in income due to the decline in tourism significantly affects domestic spending, leading to a cascading effect on the broader economy (Hall, 2010). When tourism revenue decreases, job losses and reduced earnings in sectors directly related to tourism, such as hotels, restaurants, and local transport services, are inevitable. This loss of income results in diminished discretionary spending, crucial for the health of local economies. Such reductions can lead to decreased economic activity, reducing the volume of transactions contributing to gross domestic product (GDP). This contraction in GDP is particularly severe in regions where tourism is a substantial economic contributor, highlighting the dependency of local economies on tourist inflows (Gül, 2018; Seetanah et al., 2023).

Furthermore, the decline in economic activity directly affects the tax base from which governments draw revenue. Corporate and income tax revenues decrease with businesses earning less and employing fewer people. This reduction in tax revenues can strain public finances, posing challenges for governments in funding essential services and infrastructure projects without resorting to increased debt or taxes. The fiscal strain is exacerbated in scenarios where economic downturns trigger broader cuts in public spending, potentially leading to further economic slowdown. The need for robust fiscal policies to manage these effects is critical, as highlighted by the latest studies pointing to a weakened tax base leading to long-term financial issues for local and national governments (Njoya et al., 2022).

4.3 Manufacturing and Export Industries

The manufacturing and export sectors are particularly susceptible to the impacts of climate change due to their dependence on complex global supply chains and the concentration of industrial zones in coastal areas prone to extreme weather events. The geographical positioning of Vietnam's industrial infrastructure along coastlines exposes it to heightened risks of flooding and storm surges, which can damage facilities, disrupt logistics, and halt production processes (Adger et al., 2003).

The conceptual framework provided by Takara (2013) delineates the multifaceted nature of disaster risk, comprising hazards, exposure, vulnerability, and countermeasures, thereby offering a foundational perspective on flood risk management. This framework is instrumental in comprehending the extensive risks that floods and typhoons pose to industrial zones, particularly in Vietnam. The study highlights the devastating effects of such natural disasters across Asia, with significant implications for human safety, economic damage, and the disruption of industrial operations. The 2011 Flood in the Chao Phraya River, Thailand, is a stark reminder of the potential economic repercussions, emphasizing the necessity for effective flood plain management to mitigate exposure and disaster risk (Takara, 2013).

Focusing on the 2011 flood in the Chao Phraya River, Thailand, this event is a stark example of the consequences of inadequate flood plain management. Before the flood, the region relied on permanent and temporary flood barriers, controlled water release through spillways, and a network of canals and drainage systems designed to manage water flow (Osathanon, 2015). However, the unprecedented volume of water during the 2011 monsoon season overwhelmed these measures, leading to extensive flooding that covered millions of hectares, including key industrial areas around Bangkok (Bangkok Post, 2011).

The economic ramifications of this disaster were significant. The flood caused approximately $45.7 billion in economic damages, illustrating the profound impact on the national economy. The inundation severely disrupted operations in over 450 Japanese companies situated in the industrial parks around Bangkok, affecting critical sectors such as automotive and electronics and causing ripple effects across global supply chains (Takara, 2013; World Bank, 2012a). Additionally, local businesses across multiple sectors suffered extensive damages, resulting in substantial job losses and a decline in productivity, further straining the region's economic stability (ADB, 2013). The flooding halted

operations for months and led to widespread infrastructure and property damage, severely affecting the livelihoods and safety of local populations. This event vividly illustrates the critical need for effective floodplain management strategies to mitigate such devastating impacts in the future, emphasizing the flood's economic, social, and industrial vulnerabilities (Takara, 2013).

Moreover, the reliance on just-in-time production models exacerbates the vulnerability of these sectors to climate change. Such models, which minimise inventory and rely on timely supply chain operations, are particularly susceptible to delays and disruptions caused by extreme weather events. The resultant production delays and increased operational costs diminish the output and escalate the costs of goods, affecting competitiveness in international markets (Hallegatte, 2014).

The fiscal implications of vulnerabilities within the manufacturing and export sectors due to climate change are profound and multifaceted. These sectors are highly susceptible due to their reliance on complex global supply chains that can be disrupted by climate-induced events such as severe weather or resource scarcity. When these supply chains are disrupted, it leads to lower production output and increases operational costs, directly impacting government revenue through reduced corporate profits and value-added tax collections. Reducing production output diminishes export volumes, consequently lowering export revenues, which are critical components of national income (von Haldenwang et al., 2013). As exports constitute a significant portion of Vietnam's GDP, any disruption in this sector can substantially decrease national income, thereby reducing the tax base from which the government can draw its revenues (Bank, 2009).

Furthermore, the indirect economic impacts include job losses and reduced economic activity in related industries. These fiscal pressures are exacerbated by the need for increased government expenditure on adaptation and mitigation strategies, further straining public finances. This scenario underscores the importance of integrating climate resilience into fiscal and economic planning. Governments must develop adaptive strategies that minimise the economic impact of climate-related disruptions, ensuring sustained productivity and fiscal stability in the face of climate change (Morrissey et al., 2016).

Furthermore, the need for recovery and reconstruction following extreme weather events places additional strain on public finances. The government is often required to allocate significant resources towards rebuilding damaged infrastructure and supporting affected industries and communities. These expenditures can divert funds from other developmental or social welfare projects, potentially leading to increased public debt if the government seeks to borrow to cover these unforeseen costs (Mechler & Bouwer, 2015).

Additionally, the long-term competitiveness of Vietnam's manufacturing and export sectors may be compromised if recurrent climate-related disruptions lead to a perception of unreliability among international partners and investors. This perception can deter foreign direct investment, further affecting economic growth and, by extension, public finances through reduced investment-related tax revenues (Fankhauser & Tol, 2005).

5. Sovereign Debt

Climate-related events such as storms, floods, and droughts often compel governments, including Vietnam, to make significant, unplanned expenditures for immediate relief and long-term recovery efforts. These expenditures can strain public finances, mainly when fiscal space is limited, necessitating increased government borrowing and influencing sovereign debt levels (Fankhauser & McDermott, 2014). Furthermore, the broader economic impacts of climate change exert substantial shocks on aggregate supply and demand, posing challenges for sustained long-term growth and heightening sovereign risk. Te recurring climatic events in regions like Vietnam exemplify

governments' significant fiscal challenges, necessitating careful financial management and risk assessment (Volz et al., 2020).

5.1 Transmission Channels – Supply Shocks

Climate change inflicts supply shocks that affect economies by disrupting production and diminishing productive capacity. Extreme weather events cause immediate physical damage to capital stock and infrastructure, notably in sectors like agriculture and fishing, leading to a decline in output (Belasen & Polachek, 2009; Kirchberger, 2017). Gradual warming influences the productive capacity through effects on land use and labour productivity; for example, higher temperatures above certain thresholds reduce economic production, particularly in countries with already warm climates (Burke et al., 2015). As such events become more frequent, these physical impacts may transition from acute shocks to persistent features, affecting long-term growth projections and potentially leading to shifts in population distributions and labour markets. For instance, Vietnam's agricultural sector is highly susceptible to climate variability, with droughts and floods frequently reducing crop yields. This reduction in agricultural productivity translates to lower tax revenues and higher government spending on subsidies and disaster relief efforts, thereby straining public finances (Trinh et al., 2021; Van Huong et al., 2022).

Similarly, the tourism sector, a significant revenue source for Vietnam, faces substantial risks from climate change. Rising sea levels and extreme weather events can damage tourism infrastructure, leading to decreased tourist arrivals and revenues (Scott et al., 2008). The resulting lower public revenues and increased expenditures on infrastructure repairs and support programs highlight the fiscal vulnerabilities exacerbated by climate change (Becken, 2013; Pang et al., 2013).

The manufacturing and export sectors, concentrated in coastal areas and reliant on complex global supply chains, are particularly vulnerable to climate-induced disruptions. Extreme weather events can halt production and damage infrastructure, reducing industrial output and export revenues (Adger et al., 2003; Hallegatte, 2014). Such disruptions decrease corporate tax revenues and necessitate higher public spending on recovery measures, further impacting fiscal health (von Haldenwang et al., 2013).

The transition impacts of supply shocks stem from structural changes as economies adapt to mitigate climate change. Policies promoting a shift to low-carbon sectors can result in stranded assets and workers, mainly if skills are not transferable to emerging industries (Bos & Gupta, 2019). While the exact outcomes of climate policies on energy supply are uncertain, the shift could lead to either negative or positive supply shocks depending on how effectively economies manage the transition (Semieniuk et al., 2021). The success of these policies in mitigating long-term sovereign risk hinges on balancing the immediate costs of transition with the long-term benefits of a more sustainable and resilient economic structure.

5.2 Transmission Channels – Demand Shocks

Besides, climate change induces demand shocks, influencing household spending and corporate investment in various ways. Batten et al. (2016) highlight how extreme weather events can significantly reduce household income and wealth, dampening private consumption. Such events can also damage corporate balance sheets, leading to reduced investment. Despite this, post-disaster recovery can temporarily boost investment and consumption due to the rebuilding of infrastructure and production sites (IMF, 2016). However, the extent and duration of these positive effects can vary, and a prolonged negative demand shock is more likely when losses are largely uninsured (Batten et al., 2016).

In addition to immediate weather events, gradual shifts due to global warming can have structural impacts on economies, affecting aggregate demand through changes in household income, wealth (e.g., property prices), corporate balance sheets, and public finances. Climate change can also reshape investment patterns and trade volumes, influencing domestic and international demand for goods and

services. Transitioning to a low-carbon economy can lead to falling demand for carbon-intensive goods and services and alter private investment due to changing economic structures and a growing demand for sustainable investments. Stricter climate policies could also reduce investment in high-carbon sectors. In contrast, increased public investment in climate mitigation could influence both public and private investment, potentially crowding out private investments (Batten et al., 2020).

5.3 Long-run Growth and Sovereign Risk

Supply and demand shocks from climate change have profound implications for long-run growth and sovereign risk. Extreme weather events can lead to immediate fiscal strain, especially in smaller developing economies, and create persistent challenges for development and public finances (Klomp & Valckx, 2014). The supply-side and demand-side effects of gradual global warming and the necessary policy transitions can lead to fundamental changes in the structure of economies, affecting long-term productive capacity and potential output. These shifts may have significant ramifications for a country's public finances and debt sustainability, influencing the fiscal health and ability to service debt over the long term.

Moreover, beyond these structural shifts in the economy, financial vulnerabilities within the banking sector represent another critical pathway through which climate change can exacerbate sovereign risk. Climate-induced supply and demand shocks often lead to significant disruptions in financial systems, particularly through rising non-performing loans (NPLs), as businesses and households face income losses due to extreme weather events and longer-term changes in economic conditions (Feyen et al., 2020). The weakened capacity of borrowers to repay debts places pressure on banks' balance sheets, leading to tighter credit conditions, which can further depress economic activity and deepen the fiscal strain on governments. This dynamic particularly concerns countries with a high banking sector exposure to climate-sensitive industries, such as agriculture, real estate, and energy.

As the banking sector weakens, sovereigns are often forced to step in with bailouts or guarantees to stabilise financial markets, further adding to public debt (Acharya et al., 2014). The interconnectedness between financial institutions and public finance—often called the "doom loop"—means that fiscal distress in the sovereign can feed back into financial instability, creating a self-reinforcing cycle of economic vulnerability (Battiston et al., 2016). Network analyses have shown that climate-related financial shocks can propagate through direct exposures and indirect financial links, amplifying the overall impact on the sovereign (Battiston et al., 2017). As a result, managing these financial risks is paramount to ensuring both fiscal sustainability and financial stability in the face of climate change.

5.4 Mitigating Fiscal Risks

The transition risks associated with shifting away from fossil fuels present significant implications for financial stability, a dynamic that demands careful consideration within fiscal frameworks. As nations move towards low-carbon energy sources and infrastructures, traditional industries heavily reliant on fossil fuels may experience a substantial decline. This shift can lead to widespread economic disruptions, including job losses in the fossil fuel sector and a downturn in industries dependent on these energy sources. Such economic shifts often result in reduced corporate profits and lower tax revenues, which can strain public finances if not managed strategically (IMF, 2019).

The fiscal repercussions of these transition risks may necessitate increased government expenditure to mitigate the socioeconomic impacts on affected workers and regions. Governments might need to implement extensive public support programmes, increase social spending to act as automatic stabilisers, or even bail out key companies or sectors struggling with the transition. This situation could lead to wider fiscal deficits, potentially exacerbating sovereign debt issues if the new low-carbon industries and technologies do not quickly become profitable or generate sufficient tax revenues to offset the losses (Allen et al., 2018).

Moreover, while transitioning away from fossil fuels is critical for meeting international climate goals and can lead to long-term economic benefits, such as cost savings from reduced fossil fuel subsidies and revenues from carbon taxes, these benefits may take time to materialise. In the interim, governments need to craft robust economic and industrial policies that support the transition and stabilise financial systems during this volatile period. Ensuring a just transition that includes adequate funding, reskilling programs for workers, and support for innovation in new industries is vital for maintaining economic stability and achieving sustainable development goals (Allen et al., 2018; IMF, 2019).

The fiscal implications of climate mitigation policies for Vietnam involve substantial investment to meet the targets set by the Nationally Determined Contributions (NDCs) and to pursue more ambitious low-carbon action scenarios. The Asian Development Bank (ADB) identifies critical strategies for Southeast Asia to reduce greenhouse gas emissions, which include improving energy efficiency, halting deforestation, and increasing low-carbon energy investments (ADB, 2015). To meet the NDCs in the energy sector, Vietnam's estimated investment requirement stands at US$209 billion, with an additional US$194 billion needed for a more rigorous low-carbon action scenario, which anticipates a 12% reduction in power sector emissions. Interestingly, the cost of this enhanced scenario is projected to be lower than the NDCs, partly due to savings from improved energy efficiency (Volz et al., 2020).

The ADB has pointed out that the mitigation costs for ASEAN, including Vietnam, are lower than what is currently spent on fossil fuel subsidies, suggesting that reducing these subsidies could free up financial resources for mitigation efforts and signal a shift towards a low-carbon economy (Raitzer et al., 2015). However, transitioning away from fossil fuels poses a significant challenge, as it could impact governments relying on fossil fuel extraction revenues. For Vietnam, aligning fiscal policies with climate goals will be crucial to manage this transition effectively and to ensure fiscal stability amidst the shift to a sustainable energy paradigm.

Moreover, the recurring nature of climate disasters can initiate a cycle of continuous debt accumulation as governments strive to manage these events in the immediate aftermath and recovery phases. Over time, this can endanger debt sustainability, particularly if economic growth fails to keep pace with the rate of debt accumulation. The continual increase in debt without corresponding economic growth can result in a debt overhang, adversely affecting the nation’s overall economic health (Klomp & Valckx, 2014).

In Vietnam, the challenge is exacerbated by the country’s high exposure to climatic shocks, which demands immediate fiscal response and long-term investments in resilience and adaptation strategies. Without sustainable growth and effective debt management strategies, such cycles of debt accumulation can lead to fiscal crises, especially as climate change continues to pose long-term economic risks (Hallegatte, 2016).

Critically, while borrowing may provide a necessary immediate response to disaster impacts, it is not a sustainable long-term strategy unless coupled with measures that enhance economic resilience and sustainable growth. This perspective is supported by studies suggesting that investments in resilience, though costly, can mitigate future costs and help stabilise debt levels over time (Hallegatte et al., 2019).

Beirne et al. (2021) elucidate the impact of climate vulnerability on the higher cost of sovereign capital. Acute physical risks, like extreme weather events and chronic risks, such as worsening water stress or sea level rises, can directly damage operating assets and curtail the production outputs of borrowers. This sequence of events typically leads to a reduction in borrowers' operating margins and cash flows and a depreciation in the value of collateral assets, culminating in credit downgrades, an elevated probability of default, and a drop in the secondary market value of loans held by banks.

In severe cases, borrowers may fail to meet their debt service obligations, resulting in a higher incidence of nonperforming loans and increased losses given default due to the diminished value of collateral. This financial instability may necessitate public bailouts, potentially jeopardising government solvency and triggering a "doom loop." This loop involves worsening the sovereign risk profile and a subsequent decline in government bond prices, further deteriorating banks' balance sheets (Beirne et al., 2021).

Furthermore, climate change can influence sovereign risk through its impact on international trade and capital flows. These impacts are categorised into disruptions to trade from climate-related extreme events and disasters, long-term effects of global warming on resource endowments and production capabilities, and transition impacts related to shifts in international trade norms and practices (Dellink et al., 2017).

Moreover, studies indicate that strategic shifts towards sustainable practices, such as adopting renewable energy, can positively influence investor perceptions. Forward-looking simulations suggest that transitioning to renewable energy contributes to mitigating climate change and can shield economies from the financial repercussions associated with traditional energy sources, potentially leading to lower sovereign bond yields in regions that aggressively pursue these technologies (Battiston & Monasterolo, 2019). This indicates a dual benefit: reducing greenhouse gas emissions while enhancing fiscal stability through more favourable borrowing conditions.

In the context of Vietnam, the implications of these theoretical insights are particularly acute due to the country's high exposure to climate risks. The increased frequency of severe weather events has heightened Vietnam's climate vulnerability, which could lead to higher borrowing costs as perceived by investors and rating agencies. This relationship between climate risks and financial outcomes is evident in the potential for credit rating downgrades, which could significantly increase Vietnam's debt servicing costs (Klusak et al., 2023). As Vietnam continues to experience economic disruptions from climatic events, sustainable growth and effective debt management strategies are paramount to prevent fiscal crises (Hallegatte, 2016). These strategies are essential for immediate recovery efforts and long-term economic resilience in the face of ongoing climate challenges.

6. Leverage Fiscal Policy for Climate Goals

The fiscal policies implemented by Vietnam in response to climate change reflect a strategic approach to mitigating climate-related financial risks while promoting environmental sustainability. These policies aim to encourage environmentally friendly production and consumption practices through various tax incentives and penalties, thereby addressing the broader challenges of climate change and environmental degradation.

Vietnam's fiscal policies, mainly through the strategic adjustment of national budget revenue policies and the provision of tax incentives, are instrumental in fostering a sustainable economic model by incentivising environmentally friendly production and consumption. The government's deployment of preferential tax rates, exemptions, and reductions across corporate income tax (CIT), special consumption tax (SCT), and agriculture-related taxes is aimed at encouraging organisations, individuals, and businesses to partake in environmentally protective activities.

Special Consumption Tax (SCT) - Vietnam has progressively developed and implemented policies to promote green production and consumption, mainly through the strategic use of the Special Consumption Tax (SCT). Since the enforcement of the Law on Special Consumption Tax No. 27/2008/QH12, effective from April 1, 2009, Vietnam has applied lower SCT rates to electric vehicles and vehicles powered by biofuels than fossil fuels. This tax design aims to encourage the adoption of environmentally friendly transportation options by making them financially more attractive than their conventional counterparts.

For instance, under the law, vehicles with larger cylinder capacities that use fossil fuels are subject to higher SCT rates, which serves as a deterrent for their use and encourages the shift towards more fuel-efficient and environmentally friendly vehicles. Additionally, to further incentivise the use of electric vehicles, Law No. 106/2016/QH13, effective from July 1, 2016, introduced even lower SCT rates for electric vehicles and smaller-engined vehicles under 2000 cm3. Conversely, vehicles with engine capacities over 3000 cm3 saw increased SCT rates, aligning tax implications with environmental impact. Recently, to boost the adoption of battery-operated electric vehicles, the SCT for these vehicles was significantly reduced for five years (March 1, 2022, to February 28, 2027), setting the tax rate at 3% until 2027, after which it will rise to 11%. These tax adjustments make a substantial difference in the relative cost of electric vehicles compared to traditional fuel vehicles, thereby widening the gap in SCT rates between environmentally friendly vehicles and those with higher environmental impacts.

Special Consumption Tax (SCT) application in Vietnam has seen significant strategic adjustments to encourage environmentally favourable consumer behaviours, particularly in the automotive and fuel sectors. Researchers have suggested explicitly that the SCT rate for biofuels should be set at 50% of the rate for mineral fuels to establish a substantial price difference that incentivises biofuels over traditional fossil fuels. Additionally, maintaining and increasing the SCT rates on fossil-fuel-powered vehicles is recommended to curtail their consumption and encourage a shift towards more sustainable alternatives (H. Thoan, 2019).

While these policies are designed to reduce the environmental footprint of transportation and fuel consumption, they also warrant a discussion regarding the need for further action and the potential for unintended consequences. For instance, while higher SCT rates on fossil fuel vehicles can discourage their use, they may also place a disproportionate financial burden on lower-income households that cannot afford newer, more efficient vehicles. This could slow the transition to greener alternatives among the most economically vulnerable segments of the population.

Moreover, setting biofuels at a significantly lower tax rate might encourage their adoption. Still, it also necessitates ensuring that the production of biofuels does not lead to other environmental issues, such as deforestation or the diversion of crops from food production, which can occur with large-scale biofuel production. Additionally, while the suggestion to apply a 0% VAT rate on services related to the maintenance of zoos, gardens, parks, and public transportation is aimed at promoting public and environmental well-being, it requires careful implementation to ensure that it does not lead to fiscal shortfalls that could hinder broader environmental protection efforts (Duc Anh, 2016).

While the adjustments to SCT and VAT policies are steps in the right direction for promoting environmental sustainability, they highlight the need for a balanced approach that considers both the economic impact on various demographic groups and the broader environmental outcomes. As Vietnam continues to refine its tax policy in support of environmental objectives, closely monitoring these policies' effectiveness and unintended effects closely, adapting strategies will be necessary to ensure they achieve the intended environmental and social benefits, without detrimental side effects.

Corporate Income Tax (CIT) - In Vietnam, the government has detailed specific fiscal policies under Circular 212/2015/TT-BTC to facilitate corporate environmental responsibility through tax incentives to encourage environmentally protective activities. These incentives include preferential tax rates, exemptions, and corporate income tax (CIT) reductions for qualifying environmental projects. For example, projects that involve substantial investment in wastewater treatment facilities capable of handling at least 2,500 cubic meters per day in urban areas qualify for reduced tax rates. This tax reduction is designed to offset part of the capital and operational costs associated with installing and maintaining advanced wastewater treatment technologies, which are crucial for mitigating water pollution.

Further, the circular specifies tax incentives for businesses engaged in collecting, transporting, and processing solid waste, promoting adopting practices that contribute to effective waste management and recycling. Incentives are also provided to develop infrastructure that supports environmental protection within industrial zones, such as facilities for treating pollution and recycling industrial waste. Additionally, companies producing environmentally friendly products that receive the Vietnam Green Label or are involved in renewable energy production—such as solar, wind, or bio-energy—are eligible for tax benefits. These benefits are structured to lower the financial barriers to entry for companies investing in green technologies and sustainable practices, making it economically viable for businesses to transition towards more environmentally sustainable operations.

By reducing the tax burden for these targeted activities, the government's policy directly supports investments in technologies and practices with a positive environmental impact, encouraging industries to adopt more sustainable operational models. This approach facilitates Vietnam's ecological conservation efforts and aligns with broader economic development goals by fostering a greener economy.

While Vietnam's tax incentives are designed to stimulate environmentally protective activities, their implementation has revealed several barriers that could undermine their effectiveness. The lack of clarity regarding whether tax incentives apply to new projects or upgrades of existing ones poses significant challenges. The 2020 Environmental Protection Law (EPL) and its subsequent regulations, such as Decree 08/2022/ND-CP, outline incentives for business activities related to environmental protection but fail to specify applicability to new versus retrofit projects. This ambiguity makes it difficult for business owners to ascertain their eligibility for tax incentives, potentially deterring investment in environmental protection measures due to uncertainty and missed opportunities.

Moreover, inconsistencies in tax rate incentives create further complications. While the EPL mentions incentives, including tax exemptions and reductions, it does not explicitly offer a reduced corporate income tax (CIT) rate for environmental investments, which differs from the stipulations in Decree 08/2022/ND-CP that do suggest such reductions. This discrepancy between legislative documents may cause confusion and inefficiency in tax administration, complicating the implementation process for businesses and tax authorities. Additionally, the current CIT incentives, including a four-year tax exemption followed by a 50% reduction for the next nine years, may not be sufficient for small and medium enterprises (SMEs) that require substantial capital accumulation to expand green investments post-pandemic.

These issues highlight the need for a more coherent and detailed legislative framework that clearly defines the scope and applicability of tax incentives for environmental investments. Enhancing the specificity and consistency of tax laws could help encourage the intended economic behaviours without ambiguity or undue administrative burden. Furthermore, considering extended tax relief periods or additional measures such as deferred tax payments might provide the necessary support for businesses to invest confidently in environmental sustainability projects, thereby aligning economic growth with environmental conservation goals more effectively.

Agriculture-related taxes **-** Vietnam has developed specific agricultural tax incentives to promote environmentally sustainable practices. These incentives, which focus on the corporate income tax (CIT), value-added tax (VAT), and agricultural land use tax, are designed to encourage environmentally friendly agricultural activities.

For corporate income tax, Vietnam exempts income derived from key agricultural activities such as cultivation, livestock farming, aquaculture, agricultural produce processing, and salt production by cooperatives. Additionally, income earned from agricultural activities in economically or socially challenged areas is exempt, promoting investment in these regions (CSTC, 2019). This tax exemption

is particularly targeted at enhancing productivity while encouraging adopting sustainable practices that may otherwise be financially unfeasible for small and medium-sized enterprises in these areas.

The value-added tax (VAT) policies also support agricultural sustainability, with a 0% VAT rate applied to unprocessed or minimally processed agricultural products sold by producers or at the import stage. This includes seeds, breeding animals, and certain agricultural services like irrigation and land tilling, essential for sustainable farming practices. Moreover, services that reduce agricultural risk, such as crop and livestock insurance, are exempt from VAT, supporting farmers in adopting practices that might otherwise be considered financially risky (To, 2021). Low VAT rates are also applied to services that promote environmental sustainability, such as dredging and pond cleaning, which are crucial for maintaining the ecological balance within agricultural landscapes.

Furthermore, agricultural land use tax policies have been adapted to encourage productive and environmentally friendly agricultural practices. The National Assembly's resolutions, particularly Resolution 15/2003/QH11 and its extension in Resolution 55/2010/QH12, have provided tax relief by exempting agricultural land use taxes until 2020 (CSTC, 2019). This exemption aims to alleviate poverty and support farmers, encouraging them to invest more in sustainable farming practices without the burden of land tax.

These fiscal measures are designed to foster an immediate increase in agricultural productivity and encourage long-term investments in sustainable and environmentally friendly agricultural practices. While these changes are intended to promote investment in sustainable agricultural technologies, they could disadvantage smaller farmers who may struggle with the upfront costs of advanced, environmentally friendly machinery now subject to VAT. This highlights a potential need for measures that support all farmers, especially smallholders, to ensure that the transition towards sustainable agriculture does not exacerbate economic disparities within the sector.

Moreover, the introduction of incentives like extended land lease terms and reduced rates for clean agricultural practices is designed to facilitate access to sustainable agriculture. However, these incentives must be carefully monitored to prevent land speculation and ensure they do not lead to unintended consequences such as the over-concentration of land ownership. Additionally, policies aimed at discouraging the use of harmful agricultural chemicals through higher taxes need to be complemented by support measures such as training in alternative farming techniques to ensure farmers can transition without detriment to their livelihoods.

The significance of these incentives extends beyond immediate environmental benefits, playing a pivotal role in mitigating climate-related financial risks. By reducing the tax burden on activities that contribute to environmental protection and the reduction of greenhouse gas emissions, these policies support sustainable practices and foster innovation in green technology. This approach, corroborated by the literature, highlights fiscal incentives as practical tools for stimulating investment in clean technologies and sustainable practices, thereby contributing to long-term economic resilience (Bruvoll & Larsen, 2017; Lin & Li, 2011). Through these comprehensive fiscal strategies, Vietnam aims to bolster its economic stability while addressing the global challenge of climate change.

Conversely, Vietnam has implemented tax policies that impose higher tax rates on activities and products harmful to the environment. Taxes such as the environmental protection tax and resource tax are targeted at discouraging the exploitation of natural resources that lead to environmental pollution and degradation. By imposing higher taxes on the extraction of natural resources and products that negatively impact the environment, these policies aim to internalise the environmental costs of such activities, making them less financially attractive. This approach aligns with the "polluter pays" principle, ensuring that those responsible for causing environmental harm bear the costs of mitigation or prevention. This policy aligns with the findings of Fullerton et al. (2010), who argue that

environmental taxes can effectively reduce the negative externalities associated with pollution and resource depletion.

The combination of incentives for green practices and penalties for harmful activities significantly impacts Vietnam's climate-related financial risks. These fiscal policies encourage a transition towards a low-carbon economy and enhance the country's resilience to the impacts of climate change. By fostering a more sustainable economic structure, Vietnam can reduce its vulnerability to global market fluctuations, particularly in fossil fuel prices, and decrease its exposure to the physical risks of climate change (Hallegatte, 2014). Furthermore, these policies align Vietnam with international climate goals, potentially increasing access to international climate finance and support (Bank, 2009). Moreover, by promoting environmentally friendly practices and technologies, these policies contribute to reducing greenhouse gas emissions, a critical factor in mitigating global climate change. This, in turn, can have positive implications for Vietnam's compliance with international climate agreements and its ability to attract international climate finance, further bolstering the country's financial resilience against climate change.

Climate-Responsive Budgeting in Vietnam - Climate-responsive budgeting is a strategic approach that integrates climate considerations into fiscal policy and budgeting processes to ensure that adequate financial resources are allocated for climate adaptation and mitigation. In Vietnam, this approach has been pivotal in addressing climate-related financial risks and promoting sustainable development. Between 2016 and 2020, approximately 70% of Vietnam's climate budget was dedicated to adaptation measures, totalling around $6.5 billion (Minh, 2022). This significant investment underscores the Vietnamese government's commitment to tackling climate change through substantial public expenditure on critical infrastructure projects such as irrigation systems and road networks.

The Climate Public Expenditure and Investment Review (CPEIR) framework, adopted by Vietnam, plays a crucial role in aligning financial allocations with national and regional policy objectives. The framework involves a comprehensive review of climate-related expenditures across various ministries and provincial governments to ensure that funds are directed towards high-priority climate actions. This alignment is essential for operationalising policy goals into actionable and funded initiatives, as emphasized by the United Nations Development Programme (Shah et al., 2021).

In practice, climate-responsive budgeting has manifested in several key projects and initiatives across Vietnam. For instance, the Ministry of Agriculture and Rural Development (MARD) and the Ministry of Transportation have been the primary recipients of the climate budget, emphasising large-scale infrastructure projects like irrigation systems and road networks. These projects are designed to mitigate the direct impacts of climate change, such as flooding and disrupted transport routes, thereby enhancing the resilience of these critical sectors (UNDP, 2024; World Bank, 2020). For example, the Sustainable Agriculture Transformation Project, funded by the World Bank, focuses on improving irrigation infrastructure and promoting climate-smart agricultural practices across six provinces, directly benefiting around 250,000 farmers by increasing their resilience to climate impacts (World Bank, 2020).

Moreover, targeted investments in sustainable farming practices and climate-resilient crop varieties have significantly enhanced agricultural resilience. Initiatives such as the adoption of low-carbon rice farming and the integration of solar energy in shrimp farming have demonstrated substantial economic and environmental benefits. For instance, the Thanh Dat Seafood Cooperative in Bac Lieu province has successfully implemented solar-powered shrimp drying technology, which has improved product quality, reduced spoilage, and increased market competitiveness (UNDP, 2024). This shift not only mitigates the impacts of climate change but also supports the livelihoods of local communities.

Furthermore, the integration of climate considerations into Vietnam's public financial management system has involved the formulation of specific budget codes and guidelines to track climate-related

spending. This tracking mechanism enables the government to monitor the effectiveness of climate expenditures and make necessary adjustments to improve outcomes. Additionally, capacity-building initiatives, such as training programs for government officials, have been implemented to enhance the skills and knowledge required for effective climate-responsive budgeting (Minh, 2022).

Diversifying Public Revenue Streams - Diversifying public revenue streams is a critical strategy for enhancing Vietnam's fiscal resilience against climate change impacts. By reducing dependence on high-risk sectors such as agriculture, tourism, and manufacturing, which are vulnerable to climate variability and extreme weather events, Vietnam can mitigate financial vulnerabilities and ensure economic stability (World Bank, 2019). The strategic shift involves investing in more resilient sectors that provide stable revenue even under changing climatic conditions. This approach not only enhances economic stability but also aligns with Vietnam's broader goals of sustainable development and climate resilience (USAID, 2023).

The Vietnamese government has recognised the importance of diversifying its economic base to reduce fiscal risks associated with climate change. Current fiscal policies are aimed at reducing the economy's reliance on sectors that are most vulnerable to climate impacts (USAID, 2023). For example, Vietnam's National Power Development Plan focuses on increasing the share of renewable energy in the power mix, reducing dependency on traditional energy sources that are more susceptible to climate risks. This diversification is crucial for mitigating climate-related financial risks and ensuring a stable revenue base for the government (World Bank, 2019).

Vietnam's tourism sector, which thrives on natural beauty and cultural heritage, is also diversifying to enhance resilience against climate impacts. Climate change poses a substantial threat to tourism due to rising temperatures, increased frequency of extreme weather events, and sea-level rise, all of which affect natural attractions and tourism infrastructure. To address these challenges, Vietnam is investing in eco-tourism and sustainable tourism practices that emphasise environmental conservation and resilience. For example, the development of sustainable tourism infrastructure in the Mekong Delta and coastal areas aims to protect natural attractions from climate impacts while promoting eco-friendly tourism. These investments help maintain the sector's revenue-generating potential despite climatic challenges (UNDP, 2024).

The manufacturing and export sectors, concentrated in coastal areas and reliant on complex global supply chains, face significant risks from climate change. Extreme weather events can disrupt logistics and production processes, leading to economic losses. Vietnam is mitigating these risks by promoting industrial diversification and investing in resilient infrastructure. For instance, initiatives to enhance flood protection and improve supply chain resilience are critical for maintaining the competitiveness of Vietnam's manufacturing sector. These efforts not only protect the sector from climate impacts but also ensure stable revenue streams for the government (World Bank, 2019).

Disaster Risk Financing in Vietnam - Disaster risk financing is a critical component of Vietnam's strategy to manage the fiscal impacts of natural disasters. This approach includes various financial instruments and mechanisms such as disaster risk insurance, contingency funds, and other innovative financial solutions that help mitigate the financial burden of natural disasters on public finances. By adopting these tools, Vietnam aims to enhance its fiscal resilience and ensure that resources are available for prompt disaster response and recovery. The Vietnamese government has made significant strides in transitioning from an ad hoc approach to disaster response to a more systematic, proactive strategy. This shift is evident in the implementation of the Disaster Risk Finance and Insurance Program (DRFIP), which aims to manage disaster and climate risks more effectively. The revised Law on Public Asset Management, enacted in June 2017, mandates the integration of financial risk management measures, including insurance, for public assets highly exposed to natural disasters (World Bank, 2017). This legislation underscores Vietnam's commitment to strengthening its disaster risk financing framework.

In practice, Vietnam has adopted several key initiatives to enhance its disaster risk financing capabilities. For instance, the establishment of contingency funds has been crucial in providing immediate financial resources for disaster response. These funds enable the government to act swiftly in the aftermath of natural disasters, ensuring that critical infrastructure repairs and humanitarian assistance can be provided without delay. The effectiveness of contingency funds was demonstrated during the 2020 floods, where rapid disbursement of funds helped mitigate the immediate impacts on affected communities (World Bank, 2017).

Disaster risk insurance is another vital mechanism employed by Vietnam to manage fiscal risks. By transferring some of the financial risks to insurance markets, the government can reduce its direct fiscal exposure to natural disasters. This approach not only spreads the risk but also ensures that funds are available for rebuilding and recovery efforts. Vietnam has also participated in regional risk pooling mechanisms such as the Southeast Asia Disaster Risk Insurance Facility (SEADRIF), which provides additional financial protection against natural disasters (World Bank, 2012b).

Moreover, Vietnam's experience with typhoons, floods, and other climate-related events has highlighted the importance of a diversified approach to disaster risk financing. The government has been exploring various financial instruments, including catastrophe bonds and weather derivatives, to further diversify its risk management portfolio. These instruments can provide payouts based on predefined triggers such as the severity of a natural event, ensuring that funds are available when they are most needed (Rentschler et al., 2020).

7. Conclusions

In conclusion, the case study on Vietnam's fiscal policy in the face of climate change provides a comprehensive analysis of the multifaceted challenges and strategic responses required to navigate the economic and environmental impacts of global warming. This paper has elucidated Vietnam's substantial vulnerability to climate change, highlighting the significant risks posed by rising sea levels, increased frequency and intensity of extreme weather events, and their pervasive effects on the nation's socio-economic fabric and fiscal stability.

Key findings of the study underscore the imperative for Vietnam to implement robust fiscal policies and strategies to mitigate climate risks and foster economic resilience. Through the strategic use of fiscal incentives and environmental taxes, Vietnam seeks to encourage sustainable practices and deter activities detrimental to the environment. These fiscal measures are critical in steering the economy towards a greener and more sustainable model, enhancing the country's resilience to climate change impacts.

The study further identifies the sectors most at risk from climate change, notably agriculture and tourism, emphasising the need for targeted interventions to safeguard these crucial components of Vietnam's economy. Moreover, the analysis reveals the daunting financial requirements for climate adaptation and mitigation, projecting significant incremental financing needs that challenge fiscal sustainability.

Policymakers must prioritise several key areas to mitigate these risks effectively:

Firstly, integrating climate-responsive budgeting is essential. There is a crucial need for enhanced climate-responsive budgeting that not only allocates resources efficiently but also ensures that investments in climate resilience are effectively executed. Vietnam must adopt robust fiscal frameworks that systematically integrate climate considerations into the budgeting process. This approach requires the expansion and rigorous application of frameworks like the Climate Public Expenditure and Investment Review (CPEIR). The CPEIR framework allows for comprehensive monitoring and evaluation of climate-related expenditures, ensuring that financial resources are

directed towards high-priority adaptation and mitigation projects. By utilising this framework, policymakers can identify funding gaps, improve resource allocations, and enhance the overall impact of climate investments. Additionally, climate-responsive budgeting should incorporate adaptive management practices that allow for adjustments based on evolving climate data and impact assessments. This dynamic approach will enable Vietnam to remain resilient in the face of uncertain and changing climate conditions (Minh, 2022).

Secondly, diversifying public revenue streams is essential to reduce dependence on high-risk sectors like agriculture, tourism, and manufacturing, which are highly vulnerable to climate variability and extreme weather events. Policymakers should prioritise economic diversification to reduce dependence on vulnerable sectors. By supporting the growth of more resilient sectors, Vietnam can mitigate financial vulnerabilities and enhance economic stability. Economic diversification strategies should include promoting technological innovation, which can drive productivity and create new industries less affected by climatic variations. Additionally, supporting sustainable tourism can attract eco-conscious travelers and reduce the sector's carbon footprint while maintaining its economic contributions. Investing in renewable energy is another critical strategy, as it can provide a stable and sustainable energy supply, reduce greenhouse gas emissions, and create job opportunities. By diversifying its economy, Vietnam can build a more resilient economic foundation that can withstand the adverse effects of climate change (World Bank, 2021).

Strengthening institutional capacities is also vital for effectively implementing and sustaining climate-responsive fiscal strategies. Building capacity among governmental bodies and stakeholders is essential for implementing and sustaining these fiscal strategies. This involves comprehensive training programs to enhance the understanding and skills of government officials, ensuring they are well-equipped to integrate climate considerations into fiscal planning and management. Awareness programs are also crucial for educating stakeholders about the importance of climate resilience and the role of fiscal policies in achieving it. Strengthening institutions responsible for climate policy and fiscal management is vital for effective implementation. This includes enhancing the technical and operational capacities of these institutions, ensuring they have the necessary resources and expertise to manage climate-related risks effectively. By fostering a culture of continuous learning and adaptation, Vietnam can ensure that its institutional frameworks remain robust and responsive to the challenges posed by climate change (Rentschler et al., 2020).

Increased engagement and collaboration between government, the private sector, and international partners is essential to leverage expertise, technologies, and financial resources for climate resilience. Public-private partnerships (PPPs) can play a pivotal role in financing and implementing large-scale infrastructure projects that enhance resilience, such as flood defenses, sustainable urban development, and renewable energy installations. These partnerships allow for the sharing of risks and rewards, ensuring that both public and private entities are invested in the success of climate initiatives. Furthermore, international collaboration can provide access to advanced technologies, best practices, and additional funding sources. Engaging with global and regional organisations can also facilitate knowledge exchange and capacity building, helping Vietnam to stay abreast of the latest developments in climate science and policy. By fostering a collaborative approach, Vietnam can enhance its resilience to climate change and ensure sustainable economic development (World Bank, 2012b).

In synthesising these findings, it is evident that Vietnam's path towards economic resilience in climate change is contingent upon a strategic and integrated fiscal policy approach. This approach must address the immediate risks and challenges and anticipate future threats and opportunities in the context of global climate dynamics. The study advocates for enhanced domestic and international cooperation and financial support to enable Vietnam to effectively navigate the complex climate

change adaptation and mitigation landscape, thereby securing a sustainable and resilient economic future.

This case study contributes to the broader discourse on climate change and fiscal policy, offering insights and implications that extend beyond Vietnam's borders. It underscores the critical role of fiscal policy in addressing climate change and highlights the need for comprehensive strategies that balance economic development with environmental sustainability. As the global community grapples with the escalating challenges of climate change, the experiences and strategies of Vietnam offer valuable lessons and pathways for other nations confronting similar risks and uncertainties.

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Appendix A: The World Bank CGE Model and Assumptions

This Appendix briefly explains the World Bank (2022b) CGE model used in this analysis. The CGE model provides a quantitative framework to assess the economic impacts of climate-related policies across various sectors of the economy. The model integrates data from national accounts, trade statistics, and household surveys to simulate agents' behaviour in response to policy interventions. Key assumptions about labour mobility, sectoral productivity, and the responsiveness of investment are outlined below, along with the main features of the model structure.

World Bank (2022b) employs the Mitigation, Adaptation, and New Technologies Applied General Equilibrium (MANAGE) Model to investigate the interplay between economic activities, energy use, emissions, and climate change policies. This recursive dynamic CGE model incorporates complex production structures with capital, labour, energy substitution and fuel substitution capabilities among producers. MANAGE operates under neo-classical economic principles where labour supply is exogenous, and savings and investment decisions drive capital accumulation.

Key behavioural assumptions of the MANAGE model dictate that economic agents respond to alterations in prices, incomes, and taxation within a framework constrained by resource availability, assuming market flexibility for price adjustments to equilibrate supply and demand. The model simulates climate change impacts by modifying economic parameters to produce a baseline economic growth scenario that disregards climate impacts and an alternative scenario that incorporates climate change effects. Based on recent data and literature, the assumptions for estimating climate-related costs involve assigning economic values to physical damages, impacting factors such as total factor productivity in affected sectors, physical capital, labour productivity, agricultural output, and household energy demands for cooling. These modelled scenarios help delineate the potential economic trajectories under varying climate conditions, providing a robust policy analysis and decision-making tool.