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Australian Centre for International Agricultural Research

Final report

Small research and development activity

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1 Acknowledgments

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Author contribution statement:

Long Chu and Son Dang conceived the research idea and led the research team in Australia and Vietnam respectively. Long Chu devised the modelling framework. Khoi Dang collected and compiled data. Thai Nguyen, Quoc Anh Ho, and Thuy Do handled data processing and summarised literature. Long Chu, Son Dang, Khoi Dang, Duc Anh Dang, Chi Pho, and Thang Tran constructed business-as-usual projections. Son Dang and Long Chu constructed and formalised policy responses. Long Chu calibrated the model and simulated policy impacts. Long Chu, Son Dang, Khoi Dang, Thai Nguyen, Quoc Anh Ho wrote the report.

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2 Executive summary

2.1 Background of this project

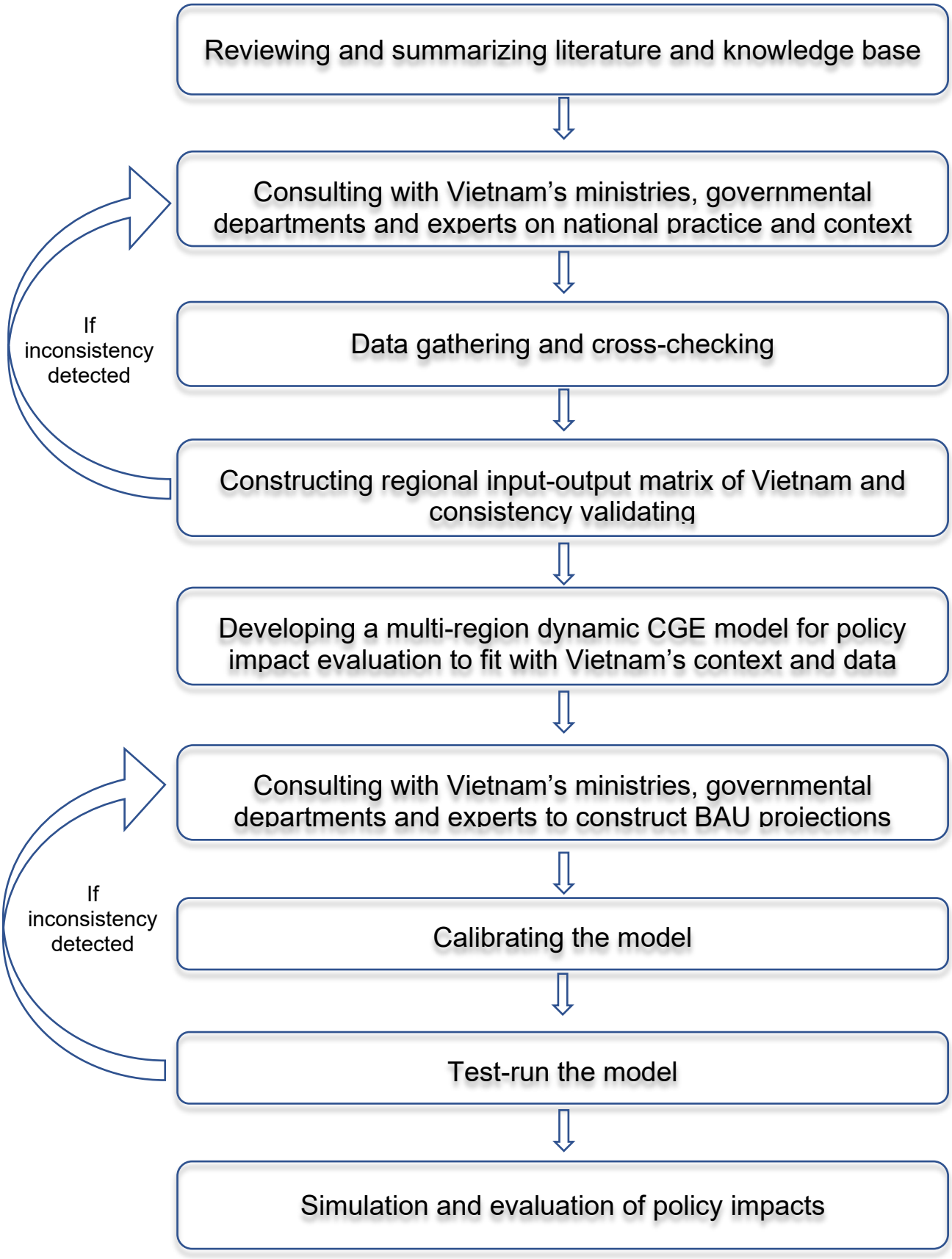
Rapid economic growth and escaping the middle-income trap are a top-priority objective of Vietnam. To achieve this objective, Vietnam has adopted the 'dual economy' model where some geographical regions and economic sectors have been prioritised, and they can have a higher level of development compared to the rest of the economy. These prioritised regions and sectors were expected to lead the growth process and support other regions and sectors to achieve overall prosperity. The dual economy model has focused on industrialisation and urbanisation process over the last 20 years. As a result, some geographical regions have attracted more investments and have been growing at a two-digit rate. Some businesses have better access to resources (e.g., state-owned enterprises and large-scale private companies with broad social connections), and they have more advantages in competing with other enterprises.

The dual economy model in Vietnam, while showing some initial success, has caused significant issues (Dapice, 2003; Pincus, 2016). The country has uneven socio-economic developments, some regions are much more advanced and active while others are backward and passive. Economic growth is mainly driven by natural resource exploitation and the exploitative growth has caused environmental problems. The contribution of high-quality labour and science remains limited. The income and social welfare gaps between rural and urban areas, and among geographical regions have widened. As a result, the economic growth has slowed down with no sign of improvements, while macroeconomic indicators are unstable with a large budget deficit and increasing public debt (Busch, 2017). This outcome is consistent with international lessons that the dual economy model, in most cases, will trap a country in a middle-income circle. Also, the dual economy model, with its consequences of uneven development, might be the underlying reason for socio-economic and environmental crisis or even political instability.

To address this challenge, the Central Ideology Theoretical Council of Vietnam (CITC) has been assigned responsibility for a new economic growth ideology model for Vietnam in the 2021-2030 decade. The objective of the new model is to help Vietnam successfully escape the middle-income trap and complete its industrialisation and urbanisation process. Experts of CITC has proposed an 'Inclusive Development Economy' model where the key policy is to prioritise investment in sectors with economic advantages in each region of the country (referred to as target-investment policy). Successful implementation of this policy on the national scale would be a crucial content in the Document of 13th Party Congress in early 2021, and they will form the direction for the economic development of the country in the next ten years.

To support decision-making, it is important to have a high-quality quantitative assessment of the possible economic outcomes in different scenarios. This ACIAR-funded research develops a modelling framework to quantitatively evaluate the outcome of the target-investment policy. In the past, some research was undertaken to estimate the impact of a particular policy in Vietnam (Giesecke *et al.*, 2013; Baker *et al.*, 2014). However, the analytical frameworks used in these previous studies are generic, not originally constructed for Vietnam and, as a result, they are unable to take into account some specific but essential contexts of the country. This research constructs a modelling framework to take into account country-specific conditions and evaluate the impact of the target-investment policy in considered growth scenarios.

2.2 What has been done in this project



2.3 Contribution of this project

Despite unprecedented challenges caused by the COVID-19, e.g., extra resources to ensure the consistency of data and information (see the above flow chart), the project has been completed on time, achieving all objectives, and fitting with a range of goals in the ACIAR – Vietnam research collaboration strategy. The research team has devised a general equilibrium model to evaluate the target-investment policy which is important given that overfocusing on industrialisation has resulted in economic inefficiency across regions of the country. The model has a multi-region feature which allow policys makers to evaluate the impact of the policy in each of the region in Vietnam's administrative system (see Figure ES.1).

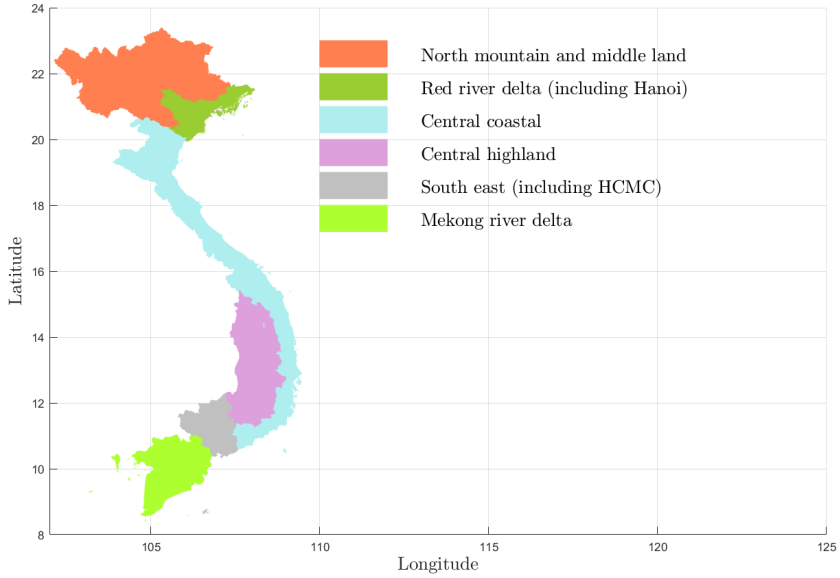


Figure ES.1: Regions of Vietnam (Decree 92/2006 ND-CP, clause 15)

The research contributes to food security, poverty reduction, and improvement of human health and nutrition in Vietnam. While the current growth model overfocuses on industrialisation and downplays the role of the agricultural sector, this research directly supports the transformation to a more balanced growth; and the research findings actually benefit food-producing farmers, especially women and children – the majority of the agricultural labour force. The outcome of this research would provide evidence for informed decision-making to improve the value chain and the links across economic sectors.

This research also contributes to the long-term international partnership in research and technology development between Vietnam and Australia (Goal 1) and improves the capacity of Vietnam researchers (Goal 2). The participation of ANU in this influential research further highlights the reputation and standing of this national university in the public policy territory in Vietnam. With the technical support and in-kind contribution of ANU, research expertise has been transferred to Vietnamese colleagues who can apply to their future works. Furthermore, this project is a successful collaboration of Australian alumni to promote the research relationship between the two countries, with contributions from Australian-trained experts who are now holding important positions in Vietnam. The research findings directly assist policy-making and improve the resource use efficiency in Vietnam (Goals 9 and 10).

This project fits with the research focus of ACIAR in the period of 2017-2027 in terms of geographical foci. As shown in the result section, the research findings benefit agricultural

hubs in Vietnam, i.e., Mekong River Delta, Red River Delta, and Central Highlands by improving the livelihood and income of farmers with better market access and engagement (Goal 3). The income gain can help improve human health and nutrition (Goal 4) as well as the performance of agricultural value chains (Goal 6).

2.4 Summary of key findings

The research team, in consultations with experts in ministries in Vietnam, has constructed projections of the Business-As-Usual scenario (BAU) and evaluate the impact of the target-investment policy in Vietnam during the 2021-2030 decade. The results show that the target investment policy would generate a significant gain. Figure ES.2 compares the country's real GDP in the two scenarios where numbers are converted to billion USD at the constant price of the year 2018. The figure shows that the real GDP would increase by about $205 billion, from $279 billion in 2020 to $484 billion in 2030 in the BAU scenario. In the target investment policy, the real GDP would increase by about $255 billion to $534 billion by 2030. In other words, the gain would be around $50 billion in 2030, i.e., on average $5 billion for each year during the 10-year period, or the economy would be 10 per cent larger compared to the BAU scenario.

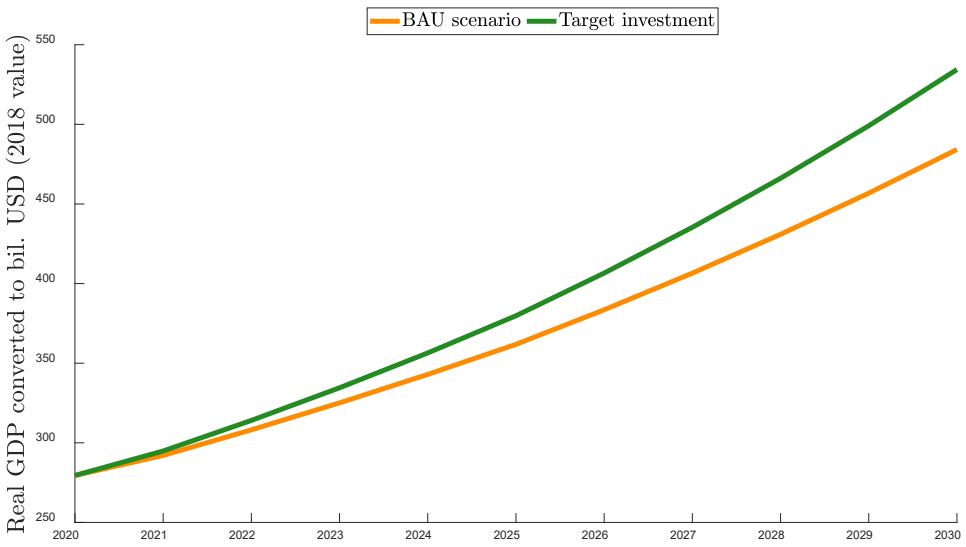


Figure ES.2: Comparison of real GDP

Figure ES.3 summarises the gain of the target investment policy in terms of GDP growth rate. Overall, the target investment policy would generate an additional 1 per cent GDP growth rate. This gain results from two main reasons. First, the target investment policy would allocate resources to where they are more productive, improving allocative efficiency. In other words, the target investment policy would increase the overall productivity of the entire economy, generating higher production output with the same amount of input. Second, there would be a dynamic impact of the policy. Higher outputs would increase capital investment, which in turn increases the capital stock and higher outputs in subsequent years.

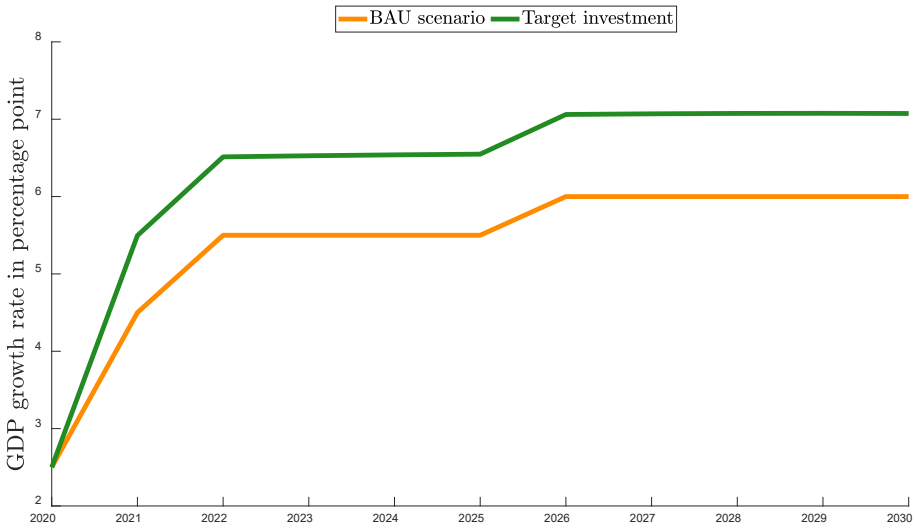


Figure ES.3: Comparison of GDP growth rates

Figure ES.4 summarises the model-generated projection of per-capita GDP during the 2021-2030 period. The projection is calculated at current-value USD, assuming US inflation rate of 2 per cent per annum. The figure shows that Vietnam's per-capita GDP would increase faster in the target investment scenario, and the gap in per-capita GDP between the two scenarios would increase over time. In the BAU per capita scenario, Vietnam's per-capita GDP would increase by 87 per cent, from $3,189 in 2021 to $5,968 in 2030. In the target investment policy, per-capita GDP would increase by 105 per cent, i.e., more than double, from $3,219 in 2021 to $6,588 in 2030. In other words, Vietnam would be close to an upper-middle-income country by 2030 in the target investment scenario.

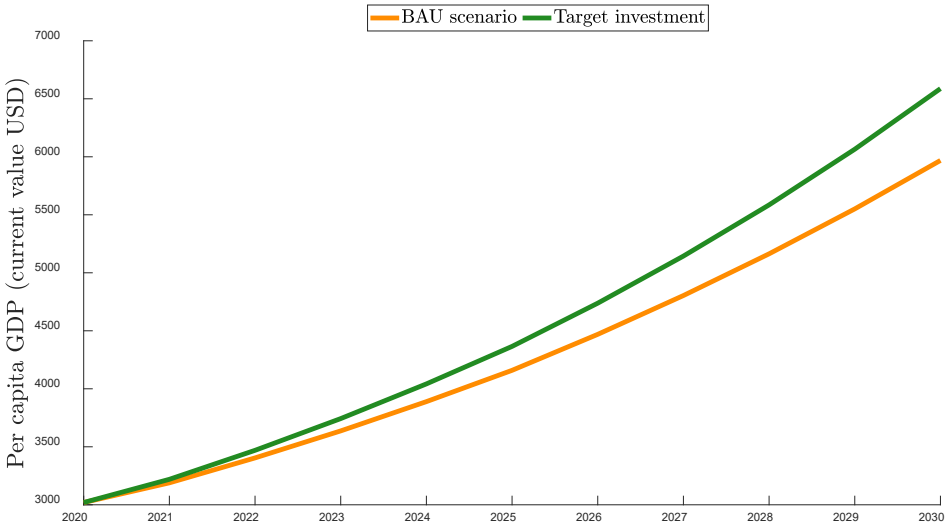


Figure ES.4: Current-value per-capita GDP under the US inflation rate of 2 per cent per annum

Figure ES.5 summarises the impact of the target investment policy across three broad sectors of economy, namely, agriculture, industry, and services. All three panels show a general trend that the policy would generate positive impacts on the growth of the three

sectors, where the gain in agriculture is slightly higher than in the other two sectors. The agricultural sector would grow by an average growth rate of 3.36 per cent a year during the time horizon with the target-investment policy, though specific annual growth rates vary across years. This growth rate is around 1.2 per cent higher than the average growth rate in the BAU scenario, and it shows a significant gain given the fact that the growth rate of the agricultural sector was only around 2 per cent in recent years. This positive impact is likely because the structural adjustment of investment focusing on regions with advantages in agricultural production could help reduce bottlenecks in infrastructure, processing and manufacturing, transport, and energy. The adjustment might also help improve the supply chain and the connection between the agricultural sector and other sectors, allowing rural workforce to be relocated to where they are more productive.

In the industry sector, the target investment policy would also generate positive impacts. Industry would be the fastest growing sector in the economy in both scenarios, but the target investment policy would further increase its growth rate to 7.6 per cent during the time horizon, compared to an average of 6.6 per cent in the BAU scenario. This gain in the industry sector would probably play an important role in Vietnam's industrial restructuring process for a more sustainable development. The service sector would also benefit from the target-investment policy. The sector is projected to grow, on average, by 6.6 per cent a year during the decade in the target-investment scenario, compared to an average of 5.6 percent in the BAU scenario. The target-investment policy would encourage efficient economic activities in each region and promote suitable service functions to maintain healthy growth for this sector.

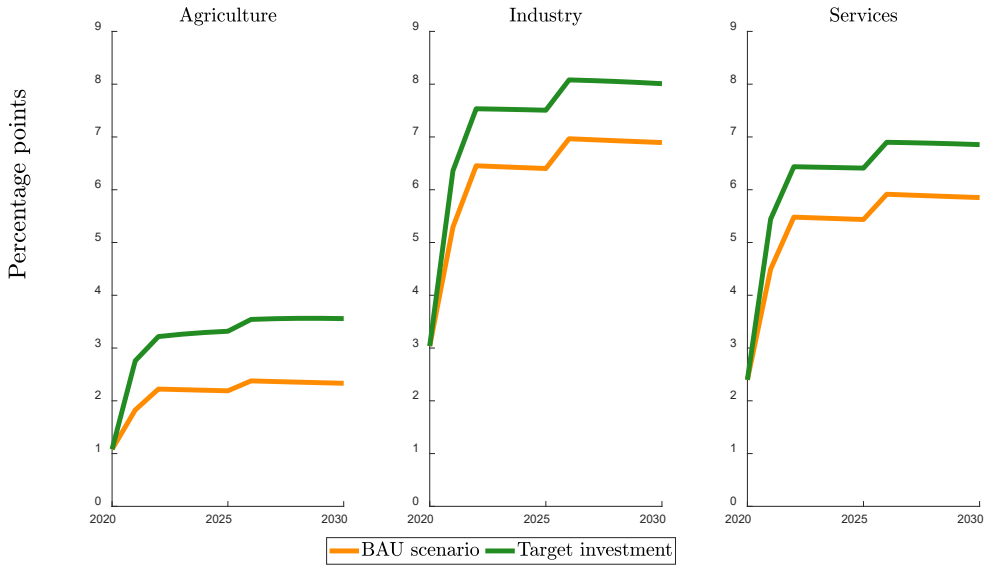


Figure ES.5: Sectoral annual growth rates

The target investment policy is expected to generate positive impacts on regional economies in Vietnam. Prioritising regional sectors with economic advantage belongs to the so-called supply policy, and all regions would benefit thanks to an increase in the overall production capacity of the economy. This is unlike demand-side policies which usually involved a trade-off between sectors, i.e., there are losers and winners. In particular, all regions would have a higher economic growth compared to the BAU scenario.

Table ES.1 summarises the gain in terms of GDP growth rates for all regions. It turns out that the gain ranges from 0.4 to 1.8 per cent across all regions. The gain is similar between

the first and the second half of the decade, though specific numbers vary. The result in Table ES.1 also shows that the target investment policy would have some implications in narrowing the economic gaps across regions. While all regions are winners, the biggest gain belongs to Central Highlands and North Mountain and Middle Land. These are regions with a significant proportion of indigenous people and some social disadvantages. The gain in terms of economic growth rate would imply a contribution to mitigate labour migration from these regions to economic pillars, HCMC and Hanoi, and hence reducing pressures on social concerns such as overpopulation in large cities and family separation in rural areas. Thus, the target investment policy would be an opportunity for these regions to improve their social conditions and catch up with the rest of the country.

Table ES.1: Regional gain in GDP growth rate

Unit: percentage points	BAU annual average GDP growth rates and gain in brackets	
	2020-2025	2025-2030
North mountain	6.5 (+1.0)	6.5 (+1.5)
North middle land	6.7 (+1.2)	6.8 (+1.3)
Red river delta provinces	5.7 (+1.1)	5.8 (+1.0)
Hanoi	6.9 (+0.7)	6.9 (+0.9)
North central coastal	5.5 (+0.7)	5.6 (+0.9)
South central coastal	5.8 (+0.4)	5.9 (+0.4)
Central highlands	7.1 (+1.8)	7.2 (+1.8)
Southeast province	5.9 (+0.4)	6.0 (+0.4)
HCMC	6.4 (+1.2)	6.5 (+1.2)
Mekong river delta	7.0 (+1.1)	7.1 (+1.1)

The target-investment policy would have profound impacts on the agricultural sector of Vietnam. Figure ES.6 summarises the impact on domestic consumption of agricultural products, agricultural exports and imports. In the target investment scenario, domestic consumption of agricultural products would grow, on average, by 5.8 per cent a year during the decade which is approximately 1 per cent higher than the growth rate in the BAU scenario. In both scenarios, the growth rate of domestic consumption would by far exceed the population growth rate. This implies that per-capita consumption would increase and food security would be improved.

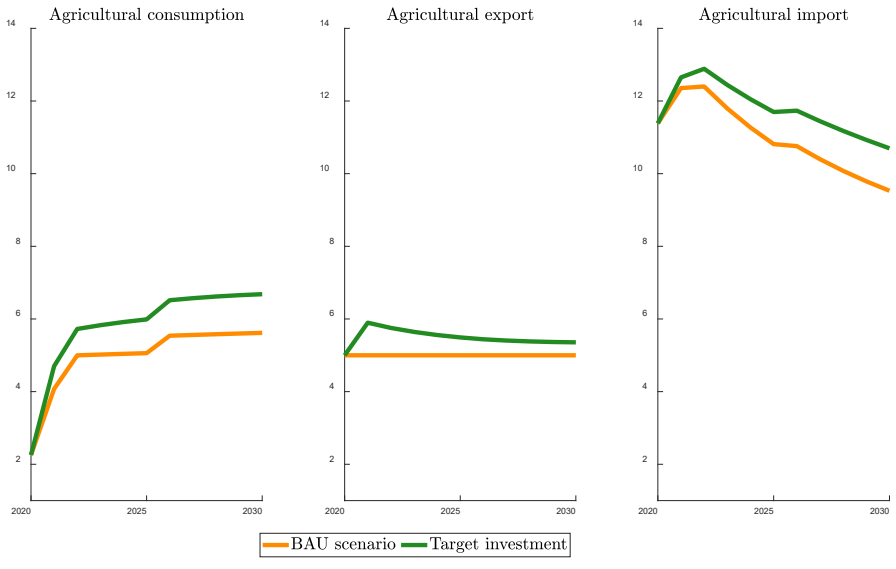


Figure ES.6: Impacts on the agricultural sector

In terms of international trade, the target-investment policy would increase both export and import of agricultural products. The export would grow at an average rate of around 5.5 per cent compared to an approximately 5 per cent growth rate in the BAU scenario. This increase in export is mainly because resource allocation would be more efficient and the production capacity would increase. Agricultural import would grow, on average, by 11.4 per cent a year in the target investment policy while the growth rate would be around 9.5 per cent in the BAU scenario. It is important to note that agricultural import is only a small fraction of export, and while the import would grow faster, the absolute value would still be lower than export, keeping Vietnam as a net exporter of agricultural products. The fast-growing import simply implies an increase in the demand for imported products as caused by the growth in living standard.

To provide a more detailed picture of the impact on the living standard, we plot - in Figure ES.7 - the growth rate of real labour income (at constant price) in three agricultural hubs of Vietnam. These agricultural hubs are the Red River Delta, the Central Highlands, and the Mekong River Delta. The figure shows that the target investment policy would generate a higher growth rate of income in all regions. The gain in the Red River Delta would be the largest while the gain in the other two regions would be similar. This result is probably because the Red River Delta workforce have better qualifications and skills, so when capital allocation has been prioritised to high-end sectors, workers can meet employment requirements and, hence, have a higher salary. The increase in real wage of labourers in agricultural hubs shows the feasibility of the development strategy 'Moving out of agriculture but still living in hometown' [*In Vietnamese: Ly nông không ly hương*] as South Korea and Taiwan did in the past.

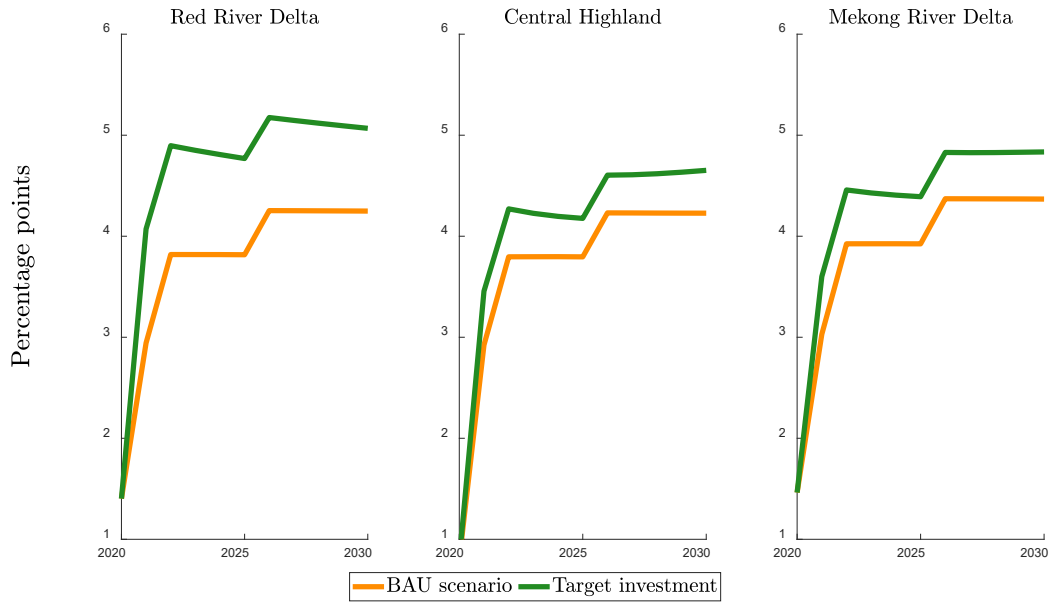


Figure ES.7: Average real growth rate of salary in three agricultural hubs

Land is one of the most important factors in agricultural production, and we plot the growth rate of the value-add of agricultural land in the three agricultural hubs in Figure ES.8. The figure shows that the target investment policy would increase the value-add of agricultural land. In the Red River Delta, the average annual growth rate of the value-add of agricultural land would be around 3.8 per cent in the policy scenario in the decade, compared to 1.8 per cent in the BAU scenario. The gain of 2 per cent in the growth rate would be a remarkable achievement given the fact that this region has a small, fragmented agricultural land area with high population density. In the meantime, the Central Highlands and Mekong River

Delta would have a higher impact. In these two regions, traffic congestion and the lack of agricultural supporting infrastructure (industrial-commercial clusters and logistic systems) have been the most significant barriers to increasing agricultural value-add in recent years. Thus, the adjustment of capital resources which could help remove these bottlenecks would probably be an important supporting factor in the increase in agricultural land's added value.

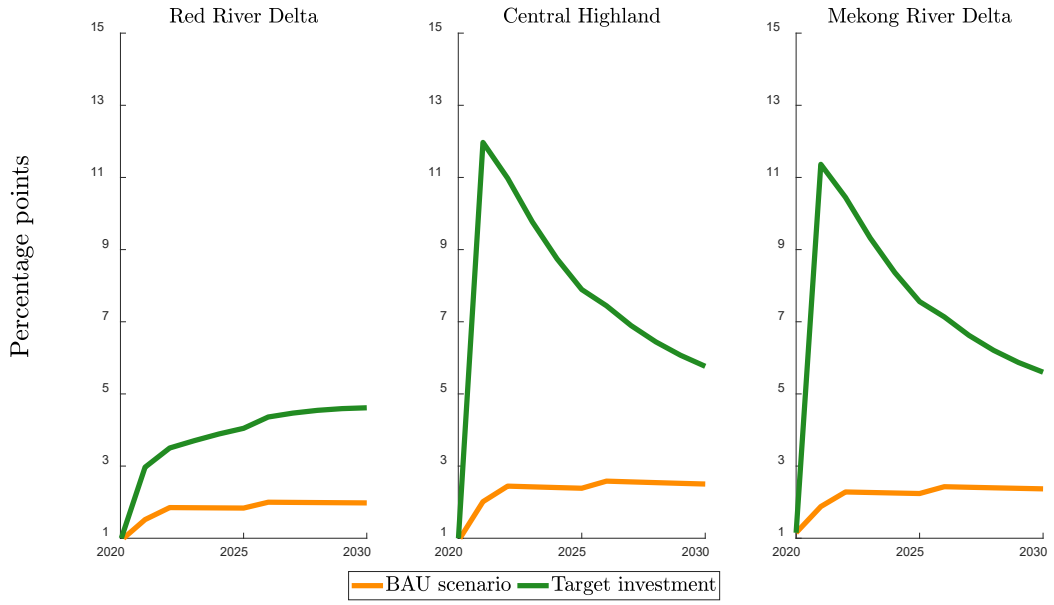


Figure ES.8: Average growth rate of the value-add of agricultural land in three agricultural hubs

2.5 Policy implications and vision beyond 2030

Our analysis shows significant positive impacts of the target investment policy in Vietnam on its economic performance. We acknowledge that specific results might depend on contextual factors, unpredicted events, and uncertainties. However, our analysis provides preliminary evidence for the effectiveness of the policy and offer a number of policy implications that could be taken into account during the decision-making process.

First, the target investment policy would help allocate resources to where they are more productive and generate substantial economic gains. The policy would increase the overall productivity of the economy, and the entire economy would grow faster in relation to agriculture, industry, and services. At the end of the 2021-2030 decade, the size of the economy and the per capita GDP would be significantly larger if this policy is successfully implemented.

Second, economic gain would be long-lasting rather than one-off impacts. The economic gain would be first generated by resource reallocation and also fuelled by higher investment in subsequent years. As a result, the capital stock in the economy would increase which generates higher economic outputs. This is illustrated in all graphs where the implementation of the target investment policy is simulated only until 2030, but the expected gain from the policy would not fade out at the end of the decade. In other words, the target investment policy would help put the economy in good shape for future development after 2030.

Third, prioritising investment to sectors with advantages is a supply-side policy and it does not necessarily involve trade-offs between regions. This supply-side policy would increase the overall productivity of the economy and it would benefit all regional economies. All regions would have better economic growth, though the gain may vary from one region to another. In other words, there are no losers, at least at the regional scale, because each region would be able to focus on what they could produce most efficiently. This is a key difference from a demand-side policy (e.g., tax or subsidy) where there were always winners and losers.

Fourth, in addition to the economic gain, the target investment policy would also have some social impacts. By increasing the growth rate of income, the policy would contribute to poverty reduction objectives, especially in rural and poor regions. Results show that the policy would benefit agricultural hubs and farmers, especially women and children – the majority of the agricultural labour force. Moreover, when regions can produce what they are efficient at, there would be less contribution to mitigate labour migration from poor regions to large cities, and reducing pressures on social concerns such as overpopulation in cities and family separation in rural areas.

Fifth, it is important to note that the gains of the policy are not automatic. Complementary and preparatory policies must be considered for the potential benefits to be fully realised. One of the keys to success is to prepare the labour force where education and training play a vital role. The quality of the workforce is important as professional specialisation would require workers to have better qualifications, working discipline, and better physical health to meet merging. Currently, vocational training programs in Vietnam mainly follow a 'top-down' approach that has not been able to provide updated working skills for trainees. In short and medium terms, the government may consider reforming some programs with more participation of the business sector in curriculum design and training. A long-term objective is to develop a dynamic labour market with greater employment formality while avoiding over-regulation.

Sixth, a policy that further promotes the application of science and technology would complement the target investment policy. Science and technology would be instrumental to a successful implementation of resource reallocation. There are relatively weak links between private business and the government with the knowledge-generating sectors such as universities and research institutes. The government may strengthen these links by encouraging businesses to invest in applied science and technology, knowledge transfer, talent-hunting or research programs. It is important that the intellectual property rights system must be properly constructed and maintained for a healthy development of the science and research sector.

Seventh, it is important that Vietnam would maintain market-economy principles during the implementation of the target investment policy. As Vietnam aspires to be recognised as a full-fledged market economy, administrative command-and-control approaches should be avoided. The Vietnamese government may consider developing a clear and transparent transition roadmap built on broad consultations with stakeholders in different sectors. The transformation solutions should be 'soft' disarmament based on market-economy principles such as supporting credit interest rates and the investment promotion package for each region's advantageous industries. In addition, the government might establish appropriate incentive policies to mobilize the domestic and foreign capital resources. Specific measures include encouraging public-private partnership (PPP) mechanisms, attracting the private sector to participate in providing public services via building - operating - transfer (BOT) and other similar models, encouraging businesses to invest in sustainable value chains, improving the coherence between international development aids with strategic national programs. The long-term objective is to provide a mechanism for fair and just competition.

Eighth, while the target investment policy would help increase income, it might put more pressure on social security. The social security system may need to be strengthened to meet the demand of a higher-income population, especially an emerging middle class. A critical challenge in terms of social security in Vietnam is to sustainably expand pension coverage when the share of the old-age population grows rapidly. This expansion may be achieved by diversifying access to pensions, reforming the existing public pension system, and gradually increasing pension saving. In addition, complementary policies may be required to address a higher demand for aged and long-term care. This is particularly important after the COVID-19 pandemic has raised many concerns in terms of health care accessibility, capacity and quality in many places in the world, including developed countries. Extra income generated by the target investment policy may provide resources to address these concerns in the health care system.

Finally, an important factor for the success of the policy is an effective institutional reform and determination of political leaders. The transition from overfocusing on industrialization and urbanization to recognising regional advantages would likely be a long process, possibly lasting more than 10 years. During this time, conflicts of interest and rent seeking may arise, e.g., lobbying from inefficient state-owned enterprises, and mishandling these issues might result in socio-economic crisis or even political instability. For this reason, a strong political determination would be essential to build an institutional system that ensures inclusiveness and transparency. In particular, Vietnam would need a more transparent responsibility of the public sector, especially between the central and provincial governments, together with clear regulations about allocated expenditures. The government would also need to ensure that regulatory authorities must not get involved in business decisions. Regulations should be applied equally without double standard, and transparent communication with citizens about economic development plans and outcomes would contribute to greater accountability.

3 Introduction

Rapid economic growth and escaping the middle-income trap are a top-priority objective of Vietnam. To achieve this objective, Vietnam has adopted the 'dual economy' model where some geographical regions and economic sectors have been prioritised, and they can have a higher level of development compared to the rest of the economy. These prioritised regions and sectors were expected to lead the growth process and support other regions and sectors to achieve overall prosperity. The dual economy model has focused on industrialisation and urbanisation process over the last 20 years. As a result, some geographical regions have attracted more investments and have been growing at a two-digit rate. Some businesses have better access to resources (e.g., state-owned enterprises and large-scale private companies with broad social connections), and they have more advantages in competing with other enterprises.

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CITC, often referred to as the Central Theory Council (http://hdll.vn/), is a think-tank of the Communist Party of Vietnam (CPV). It was established in 1996 to provide advice on political and theoretical foundations for policy-making to the Politburo, the Central Executive Committee, and the Secretary Committee of CPV. The head of CITC is a designated member of the Politburo, i.e., the top decision-making group of politicians in Vietnam[1]. CITC is responsible for undertaking studies assigned by the Party's Politburo and the Central Executive Committee. These studies can be performed by CITC members or by contracting

[1] The current designated member of the Politburo is on leave due to health reasons, and CITC is currently led by the head of the Party's Political Academy (http://hdll.vn/vi/thuong-truc-hoi-dong/thuong-truc-hoi-dong-ly-luan-trung-uong--nhiem-ky-2016-2021.html).

and joining with external research institutes. CITC is also responsible for assessing recommendations and proposals submitted to these decision-making agencies for approval. Since CPV is the single ruling party in Vietnam, CITC is the most influential think-tank organisation in the country, providing scientific inputs for shaping development directions and policies.

To evaluate the impact of the target-investment policy, CITC has been approved by CPV leaders to undertake a study entitled "Research on scientific and practical background for transforming the national economic growth model in Vietnam for the new period". This study is led by Dr. Son Dang, a member of the CITC, with the participation of experts from various ministerial organisations such as the Ministry of Planning and Investment, the Ministry of Agriculture and Rural Development, and the Vietnam Academy of Social Science. The study aims to provide CPV leaders with solid theoretical and practical foundations in formulating economic development directions for Vietnam in the 2021-2030 decade. To support CITC's study, it is important to have a high-quality quantitative assessment of the possible economic outcomes in different scenarios for informed decision-making.

This ACIAR-funded research develops a modelling framework to quantitatively evaluate the outcome of the target-investment policy. In the past, some research was undertaken to estimate the impact of a particular policy in Vietnam (Giesecke *et al.*, 2013; Baker *et al.*, 2014). However, the analytical frameworks used in these previous studies are generic, not originally constructed for Vietnam and, as a result, they are unable to take into account some specific but essential contexts of the country. This research constructs a modelling framework to take into account country-specific conditions and evaluate the impact of the policy in all considered growth scenarios.

The remainder of this report is organised as follows. Section 4 summarises the objectives of this research project and its policy impacts in relation to ACIAR goals. Section 5 describes the impact of the unprecedented COVID-19 pandemic on the project implementation. Section 6 reviews previous studies on policy evaluation methodology. Section 7 provides a non-technical summary of the analytical methodology developed in this research for brevity, with mathematical supplements in the appendix. Section 8 describes Vietnam's economy in the reference year as a technical context of the impact evaluation. Section 9 delineates Business-as-Usual (BAU) scenario and the target-investment scenario. Section 10 presents the results. Section 11 discusses policy implications and visions beyond 2030. Section 12 concludes with some recommendations for future research.

4 Summary of project objectives and policy impacts in relation to ACIAR goals

The main objective of this research is to quantitatively evaluate the possible outcomes of the target-investment policy in Vietnam during the 2021-2030. The quantitative analytic framework has been developed by a group of researchers at the Australian National University the Central Ideology Theory Council (Vietnam), the Ministry of Planning and Investment (Vietnam), the Ministry of Agriculture and Rural Development (Vietnam), after consultations with experts from various governmental departments of Vietnam. The research result will be integrated into the next Party Congress Document, and it would be an important input for the theoretical background of Vietnam's economic development strategy in the 2021-2030 decade.

This research also fits with a range of goals in the ACIAR – Vietnam research collaboration strategy. The research contributes to food security, poverty reduction, and improvement of human health and nutrition in Vietnam. While the current growth model overfocuses on industrialisation and downplays the role of the agricultural sector, this research directly supports the transformation to a more balanced growth; and the research findings actually benefit food-producing farmers, especially women and children – the majority of the agricultural labour force. The outcome of this research would provide evidence for informed decision-making to improve the value chain and the links across economic sectors.

This research also contributes to the long-term international partnership in research and technology development between Vietnam and Australia (Goal 1) and improves the capacity of Vietnam researchers (Goal 2). The participation of ANU in this influential research further highlights the reputation and standing of this national university in the public policy territory in Vietnam. With the technical support and in-kind contribution of ANU, research expertise has been transferred to Vietnamese colleagues who can apply to their future works. Furthermore, this project is a successful collaboration of Australian alumni to promote the research relationship between the two countries, with contributions from Australian-trained experts who are now holding important positions in Vietnam. The research findings directly assist policy-making and improve the resource use efficiency in Vietnam (Goals 9 and 10).

Finally, this project fits with the research focus of ACIAR in the period of 2017-2027 in terms of geographical foci. As shown in the result section, the research findings benefit agricultural hubs in Vietnam, i.e., Mekong River Delta, Red River Delta, and Central Highlands by improving the livelihood and income of farmers with better market access and engagement (Goal 3). The income gain can help improve human health and nutrition (Goal 4) as well as the performance of agricultural value chains (Goal 6).

5 Impact of COVID-19 on the research project

This research project has been undertaken during the COVID-19 pandemic. To be able to complete the research on time and achieve all objectives, the research team must overcome unprecedented challenges, without which the outcome could be better.

The travel ban caused by the pandemic has impacted deliverable #3 (presentations and technical workshops on research methodology and results). Due to the travel ban, the modelling team in Canberra was not able to travel to Vietnam for face-to-face meetings for this deliverable. As suggested by ACIAR's Research Program Manager in Agribusiness, the team has decided to move resources around to keep the project to plan. Presentations and technical workshops have been done via remote platforms instead of face-to-face, and the team in Canberra has devoted more time to make sure the quality of the presentation was not compromised.

In addition, this research required a substantial cooperation between the modelling team in Canberra with collaborators in Vietnam, and the lack of face-to-face interaction has resulted in some challenges in the exchange of information. The team in Canberra has allocated more resources in organising (online) consultations with Vietnam's ministries, governmental departments, and experts. In some situations, consultations must be organised in multiple rounds to ensure the consistency of data and information (see page 7).

6 Methodological review on quantitative impact evaluation

Decision-makers and researchers evaluate policy impacts in a number of approaches. These approaches can be classified into two broad groups, namely, microeconomic and macroeconomic models, depending on the objectives of the policy and research. Microeconomic models have been used to measure the policy impact at the household and firm levels with the main focus on distributional issues. The most prominent feature of microeconomic models is that it takes into account heterogeneity between agents such as individuals, households, and firms (Labandeira *et al.*, 2009). Some examples of microeconomic models are the Almost Ideal Demand System and its related frameworks (Minot, 1998; Brännlund & Nordström, 2004; Verde & Tol, 2009; Nikodinoska & Schröder, 2016; Tiezzi & Verde, 2016; Renner *et al.*, 2018), discrete choice model (Dalyab *et al.*, 2008; Labeaga *et al.*, 2008; Givord *et al.*, 2018). While microeconomic models are common in the evaluation of the distributional impact of a policy, they usually do not capture the endogeneity of prices and the economy-wide impacts (Labandeira *et al.*, 2009).

The second group, macroeconomic models, are often used to forecast and analyse short- and medium-term policies. Many of these models are based on Keynesian theory (Capros *et al.*, 1990). They use aggregate, national or regional data, including government revenue, investment, debt, and net foreign asset to examine policy impacts. Some studies have constructed macroeconomic models to specifically incorporate the socio-economic context of a country to evaluate policy impacts and support real-life decision-making (e.g., Hilaire *et al.*, 1990; Christodoulakis & Kalyvitis, 1998; Garratt *et al.*, 2003; Dreger & Marcellino, 2007; Hassan & Shahzad, 2011; Hammersland & Træe, 2014).

One branch of macroeconomics models uses econometric techniques on time series for forecasting and policy impact evaluation. The most common frameworks of this type are Vector of Autoregression (VAR) and Structural Vector of Autoregression (SVAR). With a relatively small number of variables and parameters, these models can explain and predict the values of different variables using historical data. The VAR model is simpler since it only uses information contained in the data (Alvarez-De-Toledo *et al.*, 2008). The model can be employed to evaluate the impacts of fiscal and monetary policy (Bagliano & Favero, 1998; De Castro, 2006; Jääskelä & Jennings, 2011). The SVAR model, however, allows the use of theoretical information to construct contemporary relations between endogenous variables in the model (Alvarez-De-Toledo *et al.*, 2008). Many researchers have applied the SVAR model for impact evaluation in national and regional scales (van Aarle *et al.*, 2003; Sousa & Zaghini, 2007; Mertens & Ravn, 2010; Afonso & Sousa, 2011; Parkyn & Vehbi, 2014).

The branches of macroeconomic models that allow researchers to evaluate economy-wide impacts include, in the order of increasing complexity, Input-Output (IO) model, Social Accounting Matrix (SAM), and computational general equilibrium (CGE). IO models focus on the interaction of production sectors, often less data demanding because most required data can be provided by statistics offices, and they have been used for policy impact evaluation (Midmore, 1993; Metcalf, 2007; Llop, 2008; Llop & Pié, 2008; Choi *et al.*, 2010; Chen *et al.*, 2015; Choi *et al.*, 2016; Rocco *et al.*, 2020). However, IO models have some constraints in capturing the responses of firms and enterprises to external factors during production process (Karkacier & Gokalp Goktolga, 2005), and these models are more appropriate for very short-term analysis with an upper bound estimate for the policy impact (Feng *et al.*, 2018).

SAM is an extended formulation of IO models which cover all sectors of an economy, including production, consumptions, tax, international trade, commodity market. SAM provides a snapshot of the circular flow across all sectors of an economy (Fathurrahman *et al.*, 2017). SAM is instrumental to estimating how a policy focusing on one sector can impact all other sectors and the entire economy (Gallardo & Mardones, 2013; Shigetomi *et al.*, 2014; Verma & Pal, 2018; Morrissey *et al.*, 2019). However, the results of SAM models should be interpreted with care due to its restrictive assumptions such as no price changes and unlimited resources. Thus, the results should focus on magnitudes, directions, and distribution rather than particular numbers (Fathurrahman *et al.*, 2017).

CGE has been one of the most powerful instruments to evaluate policy impacts and shocks to an economy. CGE models are usually used for medium and long-term analyses in many areas including international trade, agriculture, public finance, structural policies, and even income distribution (Devarajan & Robinson, 2002). The original CGE has been utilized to predict the impacts of exogenous changes from new policies or uncontrolled shocks on reallocation of resources between different sectors of an economy. Many versions have been extended from this original model such as multi-region, multi-country, global, dynamic models or the combination of them (Garbaccio *et al.*, 1999; Wendner, 2001; Bchir *et al.*, 2003; Lemelin, 2008; Perera *et al.*, 2014). While multi-region CGE models capture more detailed interactions between various regions in a country, multi-country and global CGE models provide an analysis of many economies. Dynamic CGE models attempt to incorporate the time dimension. However, CGE modelling is data demanding, technically complicated (Burfisher *et al.*, 2003), and to obtain their best benefits, the complexity in nonlinear structures and dynamics (Buiter, 2009; Kocherlakota, 2010) should be attended in the model specification, which often requires advanced modelling skills and good understanding of the economy from modelers.

7 Non-technical summary of the modelling framework

The research team has developed a dynamic one-country-multi-region CGE model to quantitatively evaluate the outcome of the target-investment policy during the 2021-2030 decade. As mentioned in section 4, previous studies show that CGE modelling is among the most powerful tools in economics for policy impact evaluation. CGE models are capable of quantifying economy-wide impacts in a wide range of domains, including development policies, international trade, public finance, agriculture promotion, and income distribution policies (Devarajan and Robinson, 2002). If combined with adequate and reliable data, CGE models can provide coherent answers to any policy questions in a systematic way (Borges, 1986).

The data availability and reliability in Vietnam, however, cannot always support highly ambitious CGE models. Data are scant, and in many cases, inconsistent if double-checked from different sources. There are significant discrepancies in data published by various government departments, and especially in data published by local and central governments. For this reason, the research team must use modelling expertise to overcome the data quality issue when developing a model that can address the policy question.

The CGE model in this research is particularly developed to adapt to the practical context in Vietnam. The model broadly regionalises Vietnam's economy into six geographical areas following Vietnam's regionalisation practice. As shown in Figure 1, these broad six geographical areas are (i) North Mountain and Middle Land, (ii) Red River Delta, (ii) Central Coast, (iv) Central Highlands, (v) Southeast, and (vi) Mekong River Delta. The list of provinces in each geographical area is provided in Appendix A1.

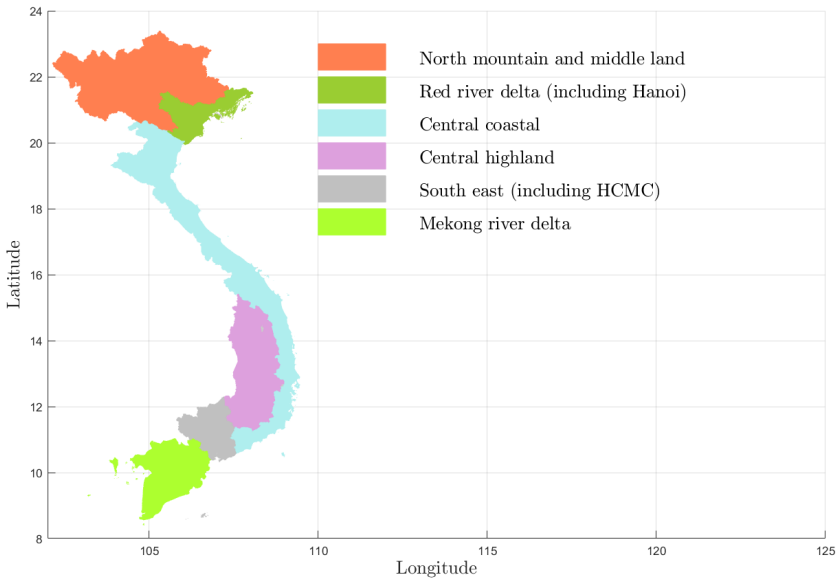

Figure 1: Regions of Vietnam (Decree 92/2006 ND-CP, clause 15)

To be able to model the role of key economic pillars which are part of a geographical area, some of the six geographical areas are further divided into sub-areas. For example, the Red-River-Delta area is divided into Hanoi (the capital city of Vietnam) and other provinces in the Red River Delta. The Southeast area is divided into HCMC (the largest city of Vietnam) and other provinces. The North-Mountain-and-Middle-Land area is divided into

North Mountain and North Middle Land, and the Central Coast is divided into North Central Coast and South-Central Coast. In total, there are ten regions in the model, including areas and sub-areas, namely, (i) region of North Mountain provinces, (ii) region of North Middle Land provinces, (iii) region of Red River Delta provinces, (iv) region of Hanoi, (v) region of North Central Coast provinces, (vi), region of South-Central Coast provinces, (vii) region of Central Highlands provinces, (viii) region of Southeast provinces, (ix) region of HCMC, and (x) region of Mekong River Delta provinces.

Each of the ten regions of Vietnam can produce agricultural, industrial, and service outputs. The output can be classified into eleven categories using the sectorisation criteria in Vietnam's statistics yearbooks which are published by Vietnam's General Statistics Office. In particular, the eleven categories of outputs are (i) agricultural, fisheries and forestry, (ii) mining, (iii) manufacturing, (iv) energy, (v) water, (vi) construction, (vii) transportation, (viii) financial, banking, insurance, and real estates, (ix) health care, education, and research, (x) administration and communication, and (xi) tourism, restaurants, and other services. These categories of output are referred to as *production sectors* hereafter. The first production sector is agriculture, the next five production sectors belong to industry, and the last five production sectors are services.

The ten regions with 11 production sectors combined make up for the 110 *regional production sectors* of Vietnam's economy. A regional sector with (economic) comparative advantage is considered as being able to produce more output with the same level of input, or in a plain term, the rate of return would be higher if resources were invested there. Comparative advantages are classified into four incremental levels, namely, (i) some advantages, (ii) significant advantages, (iii) strong advantages, and (iv) very strong advantages. The research team, in consultation with governmental departments, decision-makers, and experts, have managed to determine the comparative advantages for each of the 110 regional sectors as summarised in Table 1.

The output of each regional production sector is produced from inputs. There are two types of inputs, namely, intermediate inputs and factors of productions. The intermediate inputs of a regional production sector are those that have been produced by other sectors. In other words, intermediate inputs are the direct links across all production sectors when the output of a sector can be used as the input of others. Thus, the impact of any policies does not usually limit to a single sector, but it may spread throughout the entire economy.

The factors of production include labour, capital, and possibly other factors such as land and natural resources. However, reliable statistical data that have been published only allow the research team to estimate the quantity labour and capital in the production process. In terms of land, the research team has managed to quantify land use, but only in agricultural sectors (in all ten regions). Thus, the factors of production include labour, capital for all production sectors, and land for agricultural sectors.

The regional production sectors are a supply source of commodity markets where their outputs are traded. Another supply source is foreign countries, i.e., imports. Commodities which are supplied in the markets can be purchased by other production sectors as immediate inputs. They can be purchased by households as consumption goods, or by the government as fiscal expenditure. The market commodities can also be purchased as investment goods or exported to the rest of the world.

The CGE model developed in this research reflects the key economic principle of market price signals. The model structure captures substitution effects (i.e., higher price, lower demand) in competition between domestic products and imports, and between exported products and products produced by other countries. The model structure also reflects the substitutability in consumption behaviour, i.e., domestic consumers can switch across

different categories of products, and across production factors, i.e., producers can substitute one input by another at a certain level in response to price changes.

The CGE model in this research can capture a wide range of dynamic factors, i.e., factors that change over the planning period 2021-2030. Apparent dynamic factors that are incorporated in a typical dynamic model include labour force and capital stock. The CGE model developed in this research is also able to capture and reflect other dynamic factors in Vietnam's context, including total factor productivity, consumer preference, and competitiveness of export. The mathematical details of the CGE model are provided in Appendix A2.

Table 1. Mapping of regional economic advantages

Some | Significant | Strong | Very strong

		North mountain & middle land		Red river delta		Central coastal		Central highlands	Southeast		Mekong river delta
		Mountain	Middle land	Provinces	Hanoi	North central	South central		Provinces	HCMC	
Agriculture											
Industry	Mining										
	Manufacturing										
	Energy										
	Water										
	Construction										
Services	Transportation										
	Financial, banking, insurance, real estates										
	Health care, education, research										
	Administration and communication										
	Tourism, restaurants and other services										

Notes: Blank cells mean possible production for local consumption

8 Overview of Vietnam's regional economies

One of the major policies contributing to the rapid economic growth of Vietnam during the last over 20 years is the prioritisation of the development of some key geographical regions and localities. These prioritised areas were expected to pioneer and support the development of the rest of the country. As a result, some of the regions have achieved overwhelmingly high economic performance, but this region-focused policy has resulted in a large disparity in socio-economic development among regions. This section summarises the key characteristics of regional economic performance in Vietnam. A detailed description of economic sectors is provided in Appendix A1 and Appendix A3.

8.1 Regional economic performance by output

The most economically developed regions of Vietnam are the Red River Delta, Southeast, and Mekong River Delta. These three regions account for the largest shares of the total income, 20.2 per cent, 26.6 per cent and 11.7 per cent respectively. The dominance of the Southeast and the Red River Delta is partly attributed to metropolitan cities, i.e., Hanoi – the capital city in the Red River delta, and HCMC – the largest city of the country in the Southeast region. On the other end, the rural areas of North Mountain and Middle Land and Central Highlands are the least developed regions, contributing less than 3 per cent to the total value-added of the entire economy.

Industry and service sectors are among the sources for the regional economic disparity. The Southeast region accounts for the largest proportion of sectoral GDP, 40.1 per cent and 35.6 per cent in terms of industry and services, respectively. The Red River Delta region ranks second, with 28.6 per cent in industry sector and 27.4 per cent in services. The share of the Mekong River Delta region in industry and services are 9.4 per cent and 14 per cent. Meanwhile, the combined shares of the North Mountain and Middle Land and the Central Highlands regions in sectoral GDP are only 9.3 per cent in terms of industry and 9.5 per cent in terms of services.

There are a number of underlying factors contributing to the higher performance of the Southeast and Red River Delta regions. They include better social and physical infrastructure, ease of access to resources and information, large market size, more favourable geographical conditions and business environment for attracting investment in these sectors. In addition, these regions have benefited from a rapid urbanisation process with a strong labour movement from the agricultural sector to the non-agricultural sector, they have become home to nearly 60 per cent of the country's urban population. The number of households engaged in agricultural production in the Southeast region decreased remarkably from 53.3 per cent in 1992 to 30.7 per cent in 2016, while the figure in the Red River Delta region decreased from 83.8 per cent to 56.3 per cent in the same period (Liu *et al.*, 2020). This is an inevitable trend of the economic structural transition from low value-added agriculture to higher value-added industry and services. In other agrarian regions such as North Mountain and Middle Land, Central Coast, and Central Highlands, the share of farming households has remained at 75 per cent or more.

The Mekong River Delta is the most important agricultural hub of Vietnam, with advantages in land, surface water, and warm weather condition. This region is the key producer of food, fruits,

and aquatic products, and it plays a vital role in the national food security and agricultural exports of the entire economy (Decision 939/QD-TTg, 2012). The Mekong River Delta accounts for 34.1 per cent of the agricultural GDP when 57 per cent of rice (the main staple of the Vietnamese population) is produced in this region (Paik *et al.*, 2020)

The other two important agricultural hubs of Vietnam are the Central Highlands and the Red River Delta. The Central Highlands, with 18 per cent of the total agricultural land, is the main producers of high-value agricultural products such as coffee, cashew nuts and pepper. The Red River Delta, though undergoing a transition towards an industrial and service-oriented economy, still plays an important role in agriculture. This region is the second-largest food producer in Vietnam, accounting for 13.4 per cent of agricultural GDP, and has relatively better utilization of agricultural land in spite of the least agricultural land area (5.2 per cent of the whole country). Agricultural production in the Red River Delta is mainly irrigated activities with an intense river system and a long coastal line of over 400 km.

8.2 Regional allocation of production factors

Production factors include mainly labour, capital, and land in some cases; and these production factors are not evenly distributed across regions. In terms of labour, the Red River Delta has the highest proportion of the country's labour force with 21.8 per cent, and the Southeast region ranks second with 17.1 per cent of the labour force. In terms of capital, the Southeast region has the largest share of capital with 39.3 per cent, the Red River Delta ranks second with 36.8 per cent. These two regions attract more than 70 per cent of the country's cumulative registered FDI capital (MPI, 2018). Thus, the concentration of labour and capital in the Red River Delta and the Southeast regions are the underlying reasons for their economic outperformance.

The agricultural hub Mekong River Delta only has a small proportion of capital of 5.5 per cent, but this is a land and labour-intensive region. The region accounts for nearly 20 per cent of the labour force and 12.5 per cent of the agricultural land area. The broad region of Central Coast, although having a large share of labour force (21.3 per cent) and agricultural land area (29.5 per cent), only attracts 11.7 per cent of the country's total capital. Therefore, the contribution of this region to the total value-added of the country is limited at 10.9 per cent. Similarly, due to the low level of labour and capital, less income is generated in the North Mountain and Middle Land and Central Highlands.

8.3 Labour income, rental rate, and agricultural land value

In 2018, the national average of the income of a 15+yo person is US$3,416, and labour income varies greatly across. The highest average income is recorded in the Southeast with US$6,111 million per 15+yo person. The second highest is the Red River Delta with US$5,181 per 15+yo person. Other regions have lower labour income than the national average. For example, the average income of a 15+yo in the Mekong River Delta is US$2,049, a little higher than the average income of the South-Central Coast (US$1,978) and the North Middle Land (US$1,850). The North Central Coast and Central Highlands regions have their average income of just below US$1,600 per 15+yo person. The North Mountain region is where the average labour income is lowest, only US$1,179 per 15+yo person.

Rental rates (or prices of capital) are determined by the ratio of capital income (or value-added of capital) to the capital stock. Statistics shows that the average rental rate is highest in the

Mekong River Delta with a rate of 0.37 while the average rate of the whole economy is estimated at 0.21. The relatively high rental rate is also found in the rural areas such as the North Mountain (0.29), Central Highlands (0.26), and the South-Central Coast (0.23). On the other hand, more industrial regions, such as the Southeast and the Red River Delta, have the lowest rental rate, with only 0.16 for the former and 0.12 for the latter. These numbers imply the ease of access to capital in these regions compared to the other regions.

The national average of income from agricultural land was $US232 per hectare in 2018. Mekong River Delta is the region where the average income from agricultural land is highest, with US$617 per hectare, and consequently, the Mekong River Delta contributed 33.2 per cent to the total income from agricultural land of the entire country. In the Red River Delta and the Southeast regions, the average income of agricultural land was above the national average, but a little lower compared to the Mekong River Delta, US$583 per hectare and US$360 per hectare, respectively. On the other hand, the North Mountain region has the lowest average income from agricultural land, with US$60 per hectare in 2018, which is nearly four times lower than the average. As a result, this region contributed only 5.9 per cent to the total income from agricultural land of the entire country despite having the largest agricultural land area.

9 Policy scenarios

9.1 Business-As-Usual scenario

The first step in calibrating the CGE model is to construct a Business-As-Usual (BAU) scenario. The BAU scenario describes what would happen if there were no intervention policies in question. The research team managed to consult with various ministries, governmental departments, and experts to project the BAU scenario for Vietnam's economy during the 2021-2030 period. The BAU projection includes three main indicators, namely, the dynamics of labour force, the dynamics of capital stock, and the projection of GDP growth rates in each region.

The research team projects the dynamics of labour force using regional population. The projected growth rate of population for each region is taken from MPI and reported in Table 2. The population growth rates vary across years and regions; but in most cases, they are around 0.7 - 1.3 per cent and show a general decreasing trend over time.

Table 2. Forecasted regional population growth rates

Unit: %	**North mountain & middle land**	**Red river delta (including Hanoi)**	**Central coastal**	**Central highlands**	**Southeast (including HCMC)**	**Mekong river delta**
2019	0.93	0.83	0.87	1.36	1.83	0.72
2020	0.86	0.76	0.92	1.37	1.41	0.74
2021	0.92	0.76	0.89	1.31	1.26	0.69
2022	0.90	0.69	0.79	1.16	1.09	0.56
2023	0.85	0.61	0.70	1.01	0.94	0.47
2024	0.77	0.52	0.61	0.89	0.84	0.40
2025	0.80	0.56	0.58	0.99	0.74	0.42
2026	0.72	0.49	0.61	1.00	0.77	0.42
2027	0.65	0.43	0.61	0.99	0.77	0.40
2028	0.61	0.41	0.63	1.03	0.80	0.39
2029	0.57	0.37	0.63	1.03	0.81	0.37
2030	0.63	0.35	0.58	1.01	0.70	0.41

Source: Ministry of Planning and Investment

The dynamic of capital stock is projected in a conventional way, i.e., increases in capital stock are equal to investment net depreciation. Depreciation rate is assumed to be 8 per cent/year as taken from the Penn World Table version 9.1 (https://knoema.com/PWT2019/penn-world-table-9-1?tsId=1069900). In the BAU scenario, the allocation of investment each year to each regional sector is based on the size of the sector, i.e., larger sectors are allocated with more investment, and smaller sectors have less allocation.

The GDP growth rates in the BAU scenarios are based on the actual data and projection of the Ministry of Planning and Investment. In 2019, the entire economy grew at 7 per cent. In 2020, the growth rate is nowcasted to be around 2.5 per cent due to the impact of the COVID-19 pandemic. In 2021, the projected growth rate for the entire economy is 4.5 per cent. The economy is projected to grow at 5.5 per cent a year between 2021 and 2025, and

at 6 per cent a year from 2026-2030. In each region, the GDP growth rate is estimated using data provided by MPI to match the national level. The regional GDP growth rates are reported in Table 3.

Table 3. BAU regional GDP growth rates

Unit: %	North mountain & middle land		Red river delta (Hanoi in brackets)	Central coastal		Central highlands	Southeast (HCMC in bracket)	Mekong river delta
	Mountain	Middle land		North central	South central			
2019	7.58	6.21	6.77 (6.79)	7.31	6.68	6.68	7.58 (7.42)	6.42
2020	3.42	3.42	2.75 (2.00)	2.94	2.94	2.1	3.32 (2.56)	2.84
2021	6.06	6.32	5.37 (6.02)	6.43	5.14	5.45	6.68 (6.55)	5.53
2022	6.56	6.84	5.81 (6.52)	6.96	5.57	5.9	7.24 (7.09)	5.98
2023	6.55	6.84	5.81 (6.52)	6.96	5.56	5.9	7.24 (7.08)	5.98
2024	6.55	6.84	5.81 (6.52)	6.95	5.56	5.89	7.23 (7.08)	5.98
2025	6.55	6.83	5.80 (6.51)	6.95	5.56	5.89	7.23 (7.08)	5.97
2026	6.54	6.83	5.80 (6.51)	6.94	5.56	5.89	7.22 (7.07)	5.97
2027	6.54	6.82	5.80 (6.51)	6.94	5.55	5.89	7.22 (7.07)	5.97
2028	6.54	6.82	5.80 (6.50)	6.94	5.55	5.88	7.22 (7.07)	5.97
2029	6.53	6.82	5.79 (6.50)	6.93	5.55	5.88	7.21 (7.06)	5.96
2030	6.53	6.81	5.79 (6.50)	6.93	5.54	5.88	7.21 (7.06)	5.96

Sources: Adapted from MPI data

9.2 Target-investment policy

Under the target-investment policy, annual investment would be allocated to prioritise regional sector with comparative advantages as described in Table 1. This prioritisation process is implemented as a smooth transformation to avoid unexpected disruption of the economy in each region. In other words, prioritised sectors, which are currently small, will expand; and non-prioritised sectors can gradually crowd-out over the 2021-2030 period.

Allocation of annual investment is no longer to maintain the relative share of region/sector. Instead, prioritisation process assigns higher priority weights prioritised sectors/regions, so the investment every year in each sector/region depends on (i) the current size of the sector and (ii) the priority weights of the sector.

To evaluate the gain of the target-investment policy, we need to quantify the priority weights. For concrete results, the research team specifies at 1 for non-priority sectors, 1.25 for sector/region with 'some' advantages, 1.5 for those with significant advantages, 1.75 for those with strong advantages, and 2 for those with very strong advantages (see Table **1**).

10 Results

10.1 Impacts on real GDP

The target investment policy would generate a significant gain for Vietnam. Figure 2 compares the country's real GDP in the two scenarios during the 2021-2030 period, namely, Business-As-Usual and with the target investment policy. Numbers are converted to billion USD at the constant price of the year 2018. The figure shows that the real GDP would increase by about $205 billion, from $279 billion in 2020 to $484 billion in 2030 in the BAU scenario. In the target investment policy, the real GDP would increase by about $255 billion to $534 billion by 2030. In other words, the gain would be around $50 billion in 2030, i.e., on average $5 billion for each year during the 10-year period, or the economy would be 10 per cent larger compared to the BAU scenario.

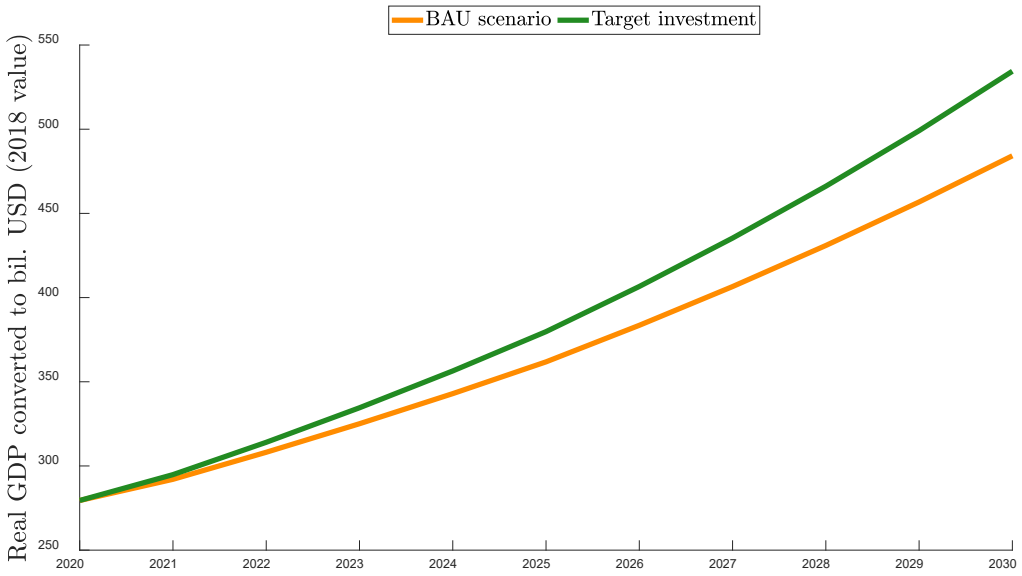

Figure 2: Comparison of real GDP

Figure **3** summarises the gain of the target investment policy in terms of GDP growth rate. Overall, the target investment policy would generate an additional 1 per cent GDP growth rate. This gain results from two main reasons. First, the target investment policy would allocate resources to where they are more productive, improving allocative efficiency. In other words, the target investment policy would increase the overall productivity of the entire economy, generating higher production output with the same amount of input. Second, there would be a dynamic impact of the policy. Higher outputs would increase capital investment, which in turn increases the capital stock and higher outputs in subsequent years.

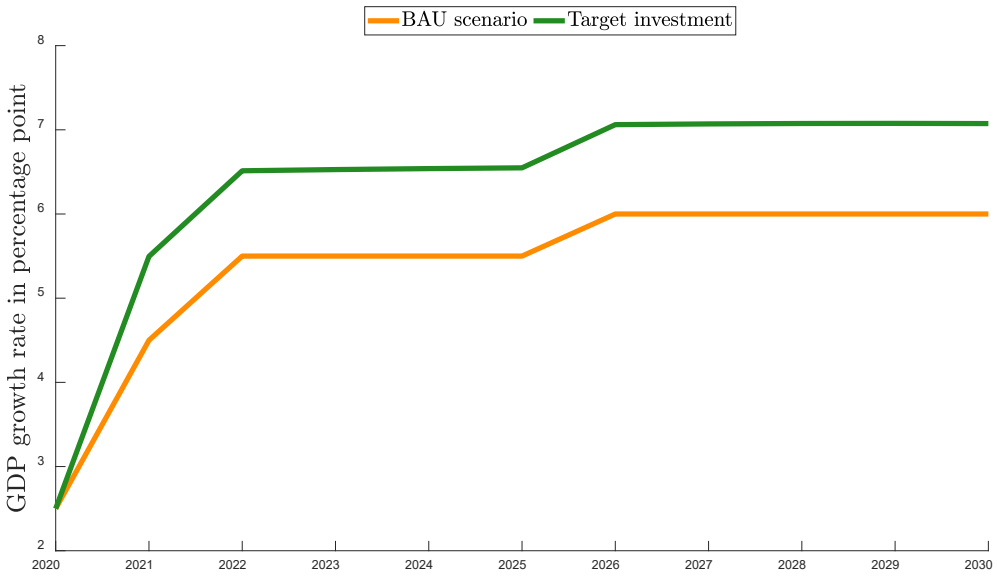

Figure 3: Comparison of GDP growth rates

The target investment policy would improve the economic efficiency of capital resources and their contribution to the GDP growth rate as reported in Table 4. In 2020, the increase in capital stocks is expected to contribute 2.16 per cent, and due to the enormous impact of the COVID-19 pandemic, the total factor productivity (TFP) is estimated to reduce Vietnam's GDP growth by 0.87 per cent. Assuming the COVID pandemic would be effectively controlled by 2021 when the target investment policy becomes effective, the economy would gradually recover in the subsequent years. The capital contribution to the economic growth in the target investment policy scenario would increase rapidly by 0.39 percentage point from 2.01 per cent in 2021 to 2.40 per cent in 2030, compared to an increase of 0.12 percentage point in the BAU scenario during the same period. In addition, the policy would generate a positive spill-over effect of TFP. The contribution of TFP to economic growth would increase to 3.52 per cent, as compared to the 2.66 per cent in the BAU scenario in 2030.

Table 4. Contribution of production factors to GDP growth rate

Unit: %	**BAU scenario**			**Target investment**		
	Labour	Capital	Other (TPF)	Labour	Capital	Other (TFP)
2020	1.21	2.16	-0.87	1.21	2.16	-0.87
2021	1.21	2.01	1.27	1.21	2.01	2.28
2022	1.21	1.99	2.30	1.21	2.01	3.29
2023	1.21	2.00	2.29	1.21	2.05	3.26
2024	1.21	2.01	2.28	1.21	2.09	3.23
2025	1.21	2.02	2.27	1.21	2.13	3.20
2026	1.21	2.03	2.76	1.21	2.18	3.67
2027	1.21	2.06	2.73	1.21	2.24	3.62
2028	1.21	2.09	2.70	1.21	2.29	3.57
2029	1.21	2.11	2.68	1.21	2.35	3.52
2030	1.21	2.13	2.66	1.21	2.40	3.46

Source: Calculated by authors

Figure **4** summarises the model-generated projection of per capita GDP during the 2021-2030 period. The projection is calculated at current-value USD, assuming US inflation rate of 2 per cent per annum. The figure shows that Vietnam's per-capita GDP would increase faster in the target investment scenario, and the gap in per-capita GDP between the two scenarios

would increase over time. In the BAU per capita scenario, Vietnam's per-capita GDP would increase by 87 per cent, from $3,189 in 2021 to $5,968 in 2030. In the target investment policy, per-capita GDP would increase by 105 per cent, i.e., more than double, from $3,219 in 2021 to $6,588. In other words, Vietnam would be close to an upper-middle-income country by 2030 in the target investment scenario.

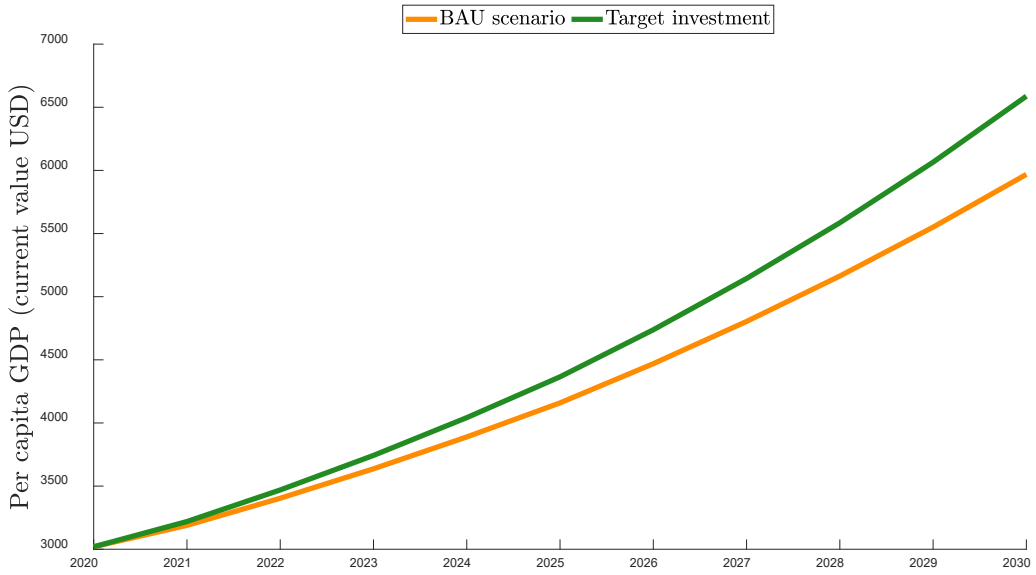

Figure 4: Current-value per-capita GDP under the US inflation rate of 2 per cent per annum

10.2 Impacts on sectoral growth

Figure **5** summarises the impact of the target investment policy across three broad sectors of economy, namely, agriculture, industry, and services. The gaps between the two curves in three panels of the figure represent the impact of the policy. All three panels show a general trend that the policy would generate positive impacts on the growth of the three sectors, where the gain in agriculture is slightly higher than in the other two sectors.

The agricultural sector would grow by an average growth rate of 3.36 per cent a year during the time horizon, though specific annual growth rates vary across years. This growth rate is around 1.2 per cent higher than the average growth rate in the BAU scenario, and it shows a significant gain given the fact that the growth rate of the agricultural sector was only around 2 per cent in recent years. This positive impact is likely because the structural adjustment of investment focusing on regions with advantages in agricultural production could help reduce bottlenecks in infrastructure, processing and manufacturing, transport, and energy. The adjustment might also help improve the supply chain and the connection between the agricultural sector and other sectors, allowing rural workforce to be relocated to where they are more productive.

In the industry sector, the target investment policy would also generate positive impacts. Industry would be the fastest growing sector in the economy in both scenarios, but the target investment policy would further increase its growth rate to 7.6 per cent during the time horizon, compared to an average of 6.6 per cent in the BAU scenario. This gain in the industry sector would probably play an important role in Vietnam's industrial restructuring process for a more sustainable development. Vietnam's industry sector has been growing fast recently, but this

growth was mainly driven by resource-intensive mining and construction subsectors. As a result, this growth has already caused consequences in relation to natural resource depletion, oversupply of residential apartment complexes, and severe pollution in major urban areas. The target investment policy would provide an opportunity for Vietnam to make effective structural adjustment towards a more sustainable development.

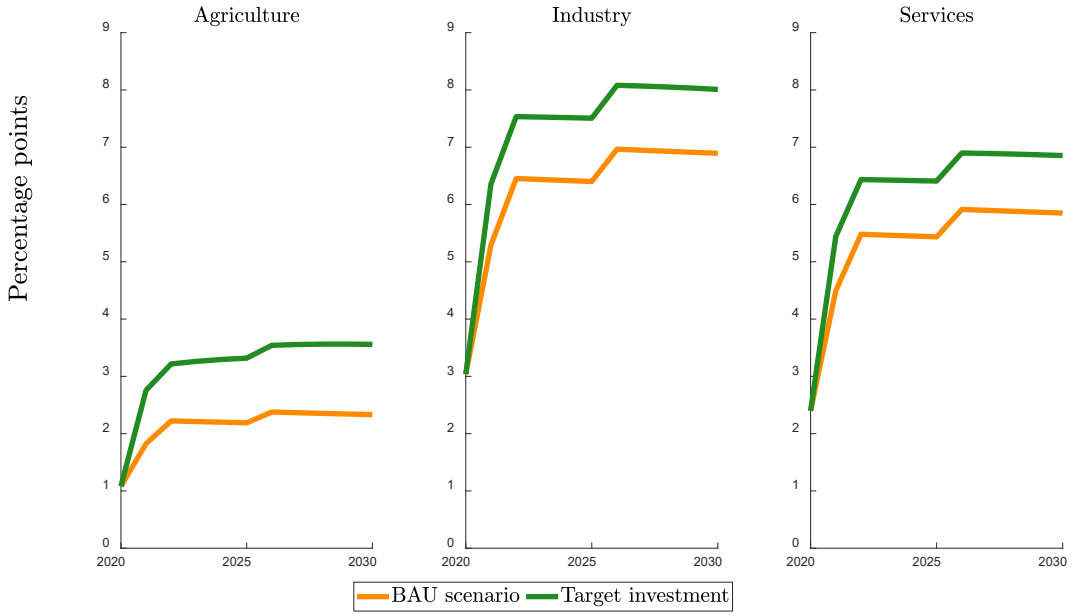

Figure 5: Sectoral annual growth rates

The service sector would also benefit from the target-investment policy. The sector is projected to grow, on average, by 6.6 per cent a year during the decade in the target-investment scenario, compared to an average of 5.6 per cent in the BAU scenario. The target-investment policy would encourage efficient economic activities in each region and promote suitable service functions to maintain healthy growth for this sector.

10.3 Impact on regional economies

The target investment policy is expected to generate positive impacts on regional economies in Vietnam. Prioritising regional sectors with economic advantage belongs to the so-called supply policy, and all regions would benefit thanks to an increase in the overall production capacity of the economy. This is unlike demand-side policies which usually involved a trade-off between sectors, i.e., there are losers and winners. In particular, all regions would have a higher economic growth compared to the BAU scenario. Table 5 summarises the gain in terms of GDP growth rates for all regions. It turns out that the gain ranges from 0.4 to 1.8 per cent across all regions. The gain is similar between the first and the second half of the decade, though specific numbers vary.

The result in Table 5 also shows that the target investment policy would have some implications in narrowing the economic gaps across regions. While all regions are winners, the biggest gain belongs to Central Highlands and North Mountain and Middle Land. These are regions with a significant proportion of indigenous people and some social disadvantages. The gain in terms of economic growth rate would imply a contribution to mitigate labour migration from these regions to economic pillars, HCMC and Hanoi, and hence reducing pressures on social concerns such as overpopulation in large cities and family separation in rural areas.

Thus, the target investment policy would be an opportunity for these regions to improve their social conditions and catch up with the rest of the country.

Table 5. Regional gain in GDP growth rate

Unit: percentage points	**BAU annual average GDP growth rates and gain in brackets**	
	2020 - 2025	2025 - 2030
North mountain	6.5 (+1.0)	6.5 (+1.5)
North middle land	6.7 (+1.2)	6.8 (+1.3)
Red river delta provinces	5.7 (+1.1)	5.8 (+1.0)
Hanoi	6.9 (+0.7)	6.9 (+0.9)
North central coastal	5.5 (+0.7)	5.6 (+0.9)
South central coastal	5.8 (+0.4)	5.9 (+0.4)
Central highlands	7.1 (+1.8)	7.2 (+1.8)
Southeast province	5.9 (+0.4)	6.0 (+0.4)
HCMC	6.4 (+1.2)	6.5 (+1.2)
Mekong river delta	7.0 (+1.1)	7.1 (+1.1)

10.4 Impacts on the agricultural sector

The target investment policy would have profound impacts on the agricultural sector of Vietnam, and we elaborate these impacts in this subsection. Figure 6 summarises the impact on domestic consumption of agricultural products, agricultural exports and imports. In the target investment scenario, domestic consumption of agricultural products would grow, on average, by 5.8 per cent a year during the decade which is approximately 1 per cent higher than the growth rate in the BAU scenario. In both scenarios, the growth rate of domestic consumption would by far exceed the population growth rate. This implies that per-capita consumption would increase and food security would be improved.

In terms of international trade, the target investment would increase both export and import of agricultural products. The export would grow at an average rate of around 5.5 per cent compared to an approximately 5 per cent growth rate in the BAU scenario. This increase in export is mainly because resource allocation would be more efficient and the production capacity would increase. Agricultural import would grow, on average, by 11.4 per cent a year in the target investment policy while the growth rate would be around 9.5 per cent in the BAU scenario. It is important to note that agricultural import is only a small fraction of export, and while the import would grow faster, the absolute value would still be lower than export, keeping Vietnam as a net exporter of agricultural products. The fast-growing import simply implies an increase in the demand for imported products as caused by the growth in living standard.

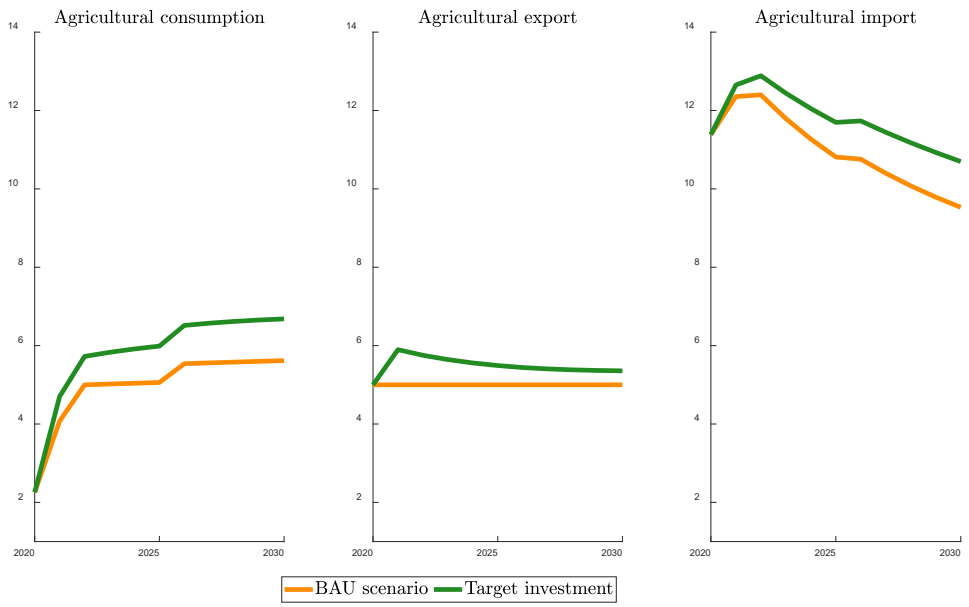

Figure 6: Impacts on the agricultural sector

To provide a more detailed picture of the impact on the living standard, we plot - in Figure 7 - the growth rate of real labour income (at constant price) in three agricultural hubs of Vietnam. These agricultural hubs are the Red River Delta, the Central Highlands, and the Mekong River Delta. The figure shows that the target investment policy would generate a higher growth rate of income in all regions. The gain in the Red River Delta would be the largest while the gain in the other two regions would be similar. This result is probably because the Red River Delta workforce have better qualifications and skills, so when capital allocation has been prioritised to high-end sectors, workers can meet employment requirements and, hence, have a higher salary. The increase in real wage of labourers in agricultural hubs shows the feasibility of the development strategy 'Moving out of agriculture but still living in hometown' [*In Vietnamese: Ly nông không ly hương*] as Korea and Taiwan did in the past.

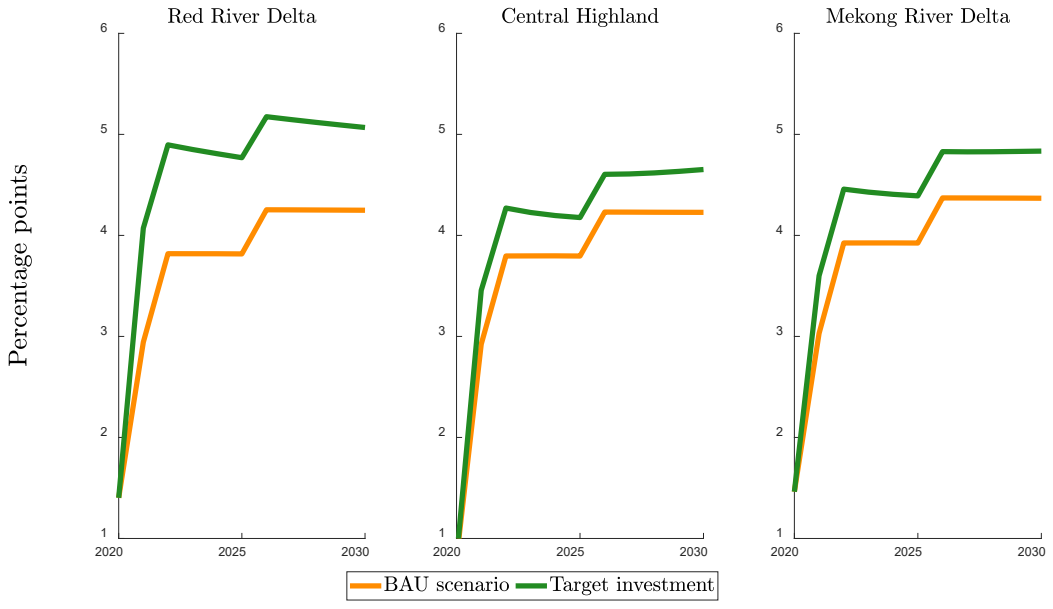

Figure 7: Average real growth rate of salary in three agricultural hubs

Land is one of the most important factors in agricultural production, and we plot the growth rate of the value-add of agricultural land in the three agricultural hubs in Figure 8. The figure shows that the target investment policy would increase the value-add of agricultural land. In the Red River Delta, the average annual growth rate of the value-add of agricultural land would be around 3.8 per cent in the policy scenario in the decade, compared to 1.8 per cent in the BAU scenario. The gain of 2 per cent in the growth rate would be a remarkable achievement given the fact that this region has a small, fragmented agricultural land area with high population density. In the meantime, the Central Highlands and Mekong River Delta would have a higher impact. In these two regions, traffic congestion and the lack of agricultural supporting infrastructure (industrial-commercial clusters and logistic systems) have been the most significant barriers to increasing agricultural value-add in recent years. Thus, the adjustment of capital resources which could help remove these bottlenecks would probably be an important supporting factor in the increase in agricultural land's added value.

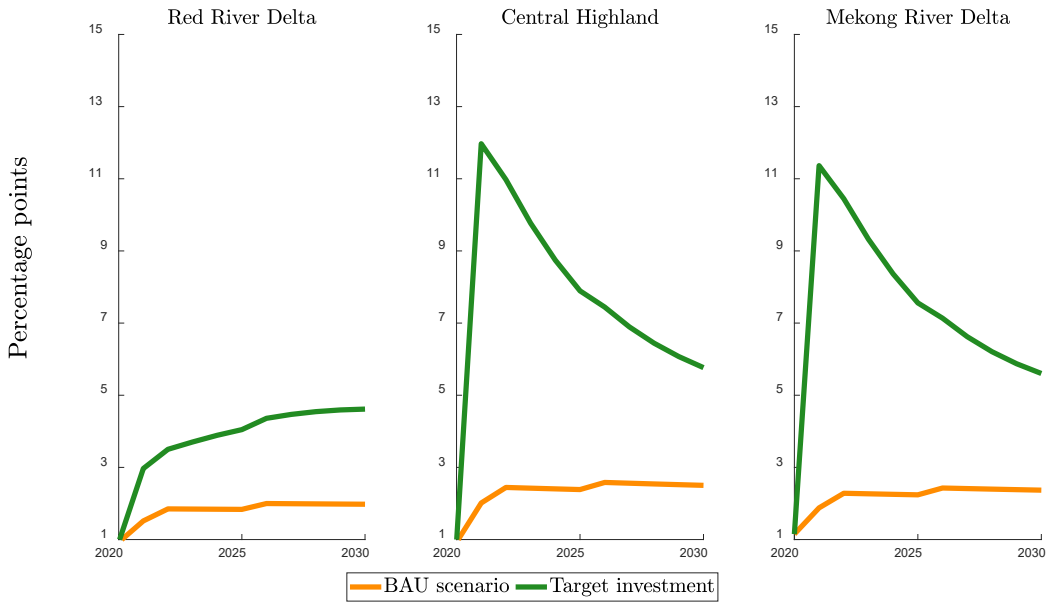

Figure 8: Average growth rate of the value-add of agricultural land in three agricultural hubs

11 Policy implications and visions beyond 2030

Our analysis shows significant positive impacts of the target investment policy in Vietnam on its economic performance. We acknowledge that specific results might depend on contextual factors, unpredicted events, and uncertainties. However, our analysis provides preliminary evidence for the effectiveness of the policy and offer a number of policy implications that could be taken into account during the decision-making process.

First, the target investment policy would help allocate resources to where they are more productive and generate substantial economic gains. The policy would increase the overall productivity of the economy, and the entire economy would grow faster in relation to agriculture, industry, and services. At the end of the 2021-2030 decade, the size of the economy and the per capita GDP would be significantly larger if this policy is successfully implemented.

Second, economic gain would be long-lasting rather than one-off impacts. The economic gain would be first generated by resource reallocation and also fuelled by higher investment in subsequent years. As a result, the capital stock in the economy would increase which generates higher economic outputs. This is illustrated in all graphs where the implementation of the target investment policy is simulated only until 2030, but the expected gain from the policy would not fade out at the end of the decade. In other words, the target investment policy would help put the economy in good shape for future development after 2030.

Third, prioritising investment to sectors with advantages is a supply-side policy and it does not necessarily involve trade-offs between regions. This supply-side policy would increase the overall productivity of the economy and it would benefit all regional economies. All regions would have better economic growth, though the gain may vary from one region to another. In other words, there are no losers, at least at the regional scale, because each region would be able to focus on what they could produce most efficiently. This is a key difference from a demand-side policy (e.g., tax or subsidy) where there were always winners and losers.

Fourth, in addition to the economic gain, the target investment policy would also have some social impacts. By increasing the growth rate of income, the policy would contribute to poverty reduction objectives, especially in rural and poor regions. Results show that the policy would benefit agricultural hubs and farmers, especially women and children – the majority of the agricultural labour force. Moreover, when regions can produce what they are efficient at, there would be less contribution to mitigate labour migration from poor regions to large cities, and reducing pressures on social concerns such as overpopulation in cities and family separation in rural areas.

Fifth, it is important to note that the gains of the policy are not automatic. Complementary and preparatory policies must be considered for the potential benefits to be fully realised. One of the keys to success is to prepare the labour force where education and training play a vital role. The quality of the workforce is important as professional specialisation would require workers to have better qualifications, working discipline, and better physical health to meet merging. Currently, vocational training programs in Vietnam mainly follow a 'top-down' approach that has not been able to provide updated working skills for trainees. In short and medium terms, the government may consider reforming some programs with more participation of the business sector in curriculum design and training. A long-term objective is to develop a dynamic labour market with greater employment formality while avoiding over-regulation.

Sixth, a policy that further promotes the application of science and technology would complement the target investment policy. Science and technology would be instrumental to a successful implementation of resource reallocation. There are relatively weak links between

private business and the government with the knowledge-generating sectors such as universities and research institutes. The government may strengthen these links by encouraging businesses to invest in applied science and technology, knowledge transfer, talent-hunting or research programs. It is important that the intellectual property rights system must be properly constructed and maintained for a healthy development of the science and research sector.

Seventh, it is important that Vietnam would maintain market-economy principles during the implementation of the target investment policy. As Vietnam aspires to be recognised as a full-fledged market economy, administrative command-and-control approaches should be avoided. The Vietnamese government may consider developing a clear and transparent transition roadmap built on broad consultations with stakeholders in different sectors. The transformation solutions should be 'soft' disarmament based on market-economy principles such as supporting credit interest rates and the investment promotion package for each region's advantageous industries. In addition, the government might establish appropriate incentive policies to mobilize the domestic and foreign capital resources. Specific measures include encouraging public-private partnership (PPP) mechanisms, attracting the private sector to participate in providing public services via building - operating - transfer (BOT) and other similar models, encouraging businesses to invest in sustainable value chains, improving the coherence between international development aids with strategic national programs. The long-term objective is to provide a mechanism for fair and just competition.

Eighth, while the target investment policy would help increase income, it might put more pressure on social security. The social security system may need to be strengthened to meet the demand of a higher-income population, especially an emerging middle class. A critical challenge in terms of social security in Vietnam is to sustainably expand pension coverage when the share of the old-age population grows rapidly. This expansion may be achieved by diversifying access to pensions, reforming the existing public pension system, and gradually increasing pension saving. In addition, complementary policies may be required to address a higher demand for aged and long-term care. This is particularly important after the COVID-19 pandemic has raised many concerns in terms of health care accessibility, capacity and quality in many places in the world, including developed countries. Extra income generated by the target investment policy may provide resources to address these concerns in the health care system.

Finally, an important factor for the success of the policy is an effective institutional reform and determination of political leaders. The transition from overfocusing on industrialization and urbanization to recognising regional advantages would likely be a long process, possibly lasting more than 10 years. During this time, conflicts of interest and rent seeking may arise, e.g., lobbying from inefficient state-owned enterprises, and mishandling these issues might result in socio-economic crisis or even political instability. For this reason, a strong political determination would be essential to build an institutional system that ensures inclusiveness and transparency. In particular, Vietnam would need a more transparent responsibility of the public sector, especially between the central and provincial governments, together with clear regulations about allocated expenditures. The government would also need to ensure that regulatory authorities must not get involved in business decisions. Regulations should be applied equally without double standard, and transparent communication with citizens about economic development plans and outcomes would contribute to greater accountability.

12 Conclusions and recommendations for future research

Sustainable economic growth is an important and on-going objective in many countries, including Vietnam. Improving the overall productivity provides a means to maintain and support economic growth. To do so, it would be important that economic resources are allocated to where they are most efficient.

We devise a general equilibrium model to evaluate a policy in Vietnam where regional production sectors with economic advantages are prioritised in terms of capital investment. This policy is important when overfocusing on industrialisation has resulted in economic inefficiency across regions of the country. The model allows us to evaluate the economy-wide impact of the policy on GDP, regional and sectoral distribution as well as the income of production factors.

Our results show that prioritising regional production sectors with economic advantages would generate a substantial gain in Vietnam during the 2021-2030 decade. The gain could amount to dozens of billion dollars in terms of real GDP. Further, this supply-side policy does not involve economic trade-off, at least in the regional scale, and all regions would be able to benefit from a faster economic growth. The policy would have positive impacts on Vietnam's agricultural hubs with higher income for agricultural land and labour.

Our study provides evidence of how research could support decision-making. Though some previous studies have employed general equilibrium modelling to evaluate policy impacts in Vietnam, our model is the first multi-region dynamic framework, to the best of our knowledge, which has been specifically constructed to fit with the practical context and data availability in the country. This modelling approach could be extended to address other policy questions arising from climate change and mitigation measures (e.g., the nationally determined commitments under the Paris Accord), green growth and low-carbon agriculture, agricultural infrastructure extension, as well as epidemics and disease control.

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14 Appendixes

14.1 Appendix A1: List of sectors and regions

Table A 1. List of economic sectors

#	Names	Description
1	Agricultural, fisheries and forestry	Agricultural, fisheries, and forestry
2	Mining	Mining and quarrying
3	Manufacturing	Manufacturing
4	Energy	Electricity, gas, steam, and air conditioning supply
5	Water	Water supply, sewerage, waste management, and remediation activities
6	Construction	Construction
7	Transportation	Transportation, storage, wholesale and retail trade; repair of motor vehicles and motorcycles
8	Financial, banking, insurance, and real estates	Financial, banking and insurance, real estate
9	Health care, education, and research	Human health and social work activities, Education and training, Professional, scientific and technical activities
10	Administration and communication	Administrative and support services; Information and communication, Activities of Communist Party, socio-political organisations; Public administration and defence; compulsory security
11	Tourism, restaurants, and other services	Accommodation and food service activities; Arts, entertainment and recreation; Activities of households as employers; undifferentiated goods and services-producing activities of households for own use; Other service activities

Table A 2. List of provinces in each region

#	Region	Provinces
1	North Mountain	Ha Giang, Cao Bang, Lao Cai, Bac Kan, Lang Son, Yen Bai, Dien Bien, Lai Chau, Son La, Tuyen Quang
2	North Middle Land	Hoa Binh, Thai Nguyen, Phu Tho, Bac Giang
3	Red River Delta Provinces	Hai Phong, Hai Duong, Hung Yen, Ninh Binh, Thai Binh, Ha Nam, Nam Dinh, Bac Ninh, Vinh Phuc, Quang Ninh
4	North Central Coast	Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue
5	South Central Coast	Da Nang, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan
6	Central Highlands	Kon Tum, Gia Lai, Dak Lak, Dak Nong, Lam Dong
7	Southeast Provinces	Tay Ninh, Binh Phuoc, Binh Duong, Dong Nai, Ba Ria-Vung Tau.
8	Mekong River Delta	Long An, Ben Tre, Tien Giang, Dong Thap, Kien Giang, An Giang, Vinh Long, Tra Vinh, Can Tho, Hau Giang, Soc Trang, Bac Lieu, Ca Mau
9	Hanoi	Hanoi City
10	HCMC	Ho Chi Minh City

14.2 Appendix A2: Mathematical specification of the Computable General Equilibrium model

14.2.1 Production sectors

There are ten regions, each having 11 production sectors, which combine to result in 110 regional production sectors of Vietnam's economy. We denote $R = 1..10$, $S = 1..11$ to refer to regions and sectors as listed in Table A 1 and Table A 2, respectively. Thus, $R \times S$ would be the set of 110 regional production sectors. We use $t = 2018..2030$ to refer to time.

Regional production sectors use two different sets of inputs, namely, intermediate inputs and production factors. Intermediate inputs consist of 11 types of commodities in Table A 1. Production factors include labour, capital, and land in agricultural sectors; and they are represented by an element in set $F = 1..3$.

Production functions vary across sectors and regions, taking a nested Leontief functional form. In this nested function form, the production factors are allowed to be substitutes in production process with the Constant Elasticity of Substitution (CES) function. The production function can be formalised in a compact format in equation (1) and the conditional input demand function can be represented in equation (2)

$$q_{R\times S\times t}^{output} = \min\left[\alpha_{R\times S\times t}^{ImmeInput} q_{R\times S\times t}^{ImmeInput}, \sum_F \left(\alpha_{R\times S\times F\times t}^{Factor} (q_{R\times S\times F\times t}^{Factor})^{\frac{\sigma_{R\times S\times F\times t}^{Factor}-1}{\sigma_{R\times S\times F\times t}^{Factor}}}\right)^{\frac{\sigma_{R\times S\times F\times t}^{Factor}}{\sigma_{R\times S\times F\times t}^{Factor}-1}}\right] \quad (1)$$

$$\left[q_{R\times S\times t}^{ImmeInput}, q_{R\times F\times t}^{Factor}\right] = \underset{<q_{R\times S\times t}^{ImmeInput}, q_{R\times F\times t}^{Factor}>}{\operatorname{argmin}} w_{R\times S\times t}^{ImmeInput} q_{R\times S\times t}^{ImmeInput} + w_{R\times S\times t}^{Factor} q_{R\times S\times t}^{Factor} \; subject\ to\ (1) \qquad (2)$$

where q stands for quantities; w stands for prices; $w_{S\times t}^{market}$ represents the market prices; α stands for parameters; superscript $output$ stands for production outputs; superscript $ImmeInput$ stands for immediate inputs; and superscript $Factor$ stands for factors of production.

The regional production sectors have a zero-profit condition in equation (3) where superscript $ProdTaxRate$ represents the production tax rate applied to the production sectors if any.

$$w_{S\times t}^{output} q_{R\times S\times t}^{output} = \left(w_{S\times t}^{market} q_{R\times S\times t}^{ImmeInput} + w_{R\times S\times t}^{Factor} q_{R\times S\times t}^{Factor}\right) \times \left(1 + \alpha_{R\times S\times t}^{ProdTaxRate}\right) \qquad (3)$$

14.2.2 Market supply

Production outputs and imported products constitute the market supply in equation (4) where $\alpha_{R\times S\times S\times t}^{Transformation}$ represents the transformation from firm outputs to market supply and the substitution between imports and domestic products follows a CES function in equation (5). The supply price is the weighted average from all sources as in equation (6).

$$q_{S\times t}^{supply} = \sum_R q_{R\times S\times t}^{output} \alpha_{R\times S\times S\times t}^{Transformation} + q_{S\times t}^{impo} \qquad (4)$$

$$\frac{q_{S\times t}^{impo}}{\sum_R q_{R\times S\times t}^{output}} = \left(\frac{w_{S\times t}^{impo}}{w_{S\times t}^{output}}\right)^{-\alpha_{S\times t}^{impo}} \qquad (5)$$

$$w_{S\times t}^{supply} = \frac{w_{S\times t}^{output} \sum_R q_{R\times S\times t}^{output} \alpha_{R\times S\times S\times t}^{Transformation} + w_{S\times t}^{impo} q_{S\times t}^{impo}}{q_{S\times t}^{supply}} \qquad (6)$$

14.2.3 Consumption sectors

The consumer preference is specified to be a constant difference of elasticities (CDE) function with the (implicit) expenditure function defined in equation (7). In this equation, superscript $hous$ stands for household; e stands for expenditure; U stands for utility; $\alpha_{S\times t}^{houspref}$ represents household preference parameters; $\alpha_{S\times t}^{houssubs}$ represents household substitution parameters; $\alpha_{S\times t}^{housexpe}$ represents household expansion parameters in the CDE function.

$$\sum_S \alpha_{S\times t}^{houspref} \left(U_t^{hous}\right)^{\alpha_{S\times t}^{houssubs} \alpha_{S\times t}^{housexpe}} \left(w_{S\times t}^{market}\right)^{\alpha_{S\times t}^{houssubs}} \left(e_t^{hous}\right)^{-\alpha_{S\times t}^{houssubs}} = 1 \qquad (7)$$

The implicit indirect utility function can be derived in equation (8) where m stands for total expenditure.

$$v(w_{S\times t}^{market}, m_t^{hous}) \equiv \left| \sum_S \alpha_{S\times t}^{houspref} U^{\alpha_{S\times t}^{houssubs} \alpha_{S\times t}^{housexpe}} (w_{S\times t}^{market})^{\alpha_{S\times t}^{houssubs}} (M_t^{hous})^{-\alpha_{S\times t}^{houssubs}} = 1 \right. \qquad (8)$$

The Marshallian demand for commodities by households can be derived using consumer duality theory in equation (9) where M_t^{hous} is the after-tax income of household; and $\alpha_t^{houssave}$ represents the saving rate.

$$q_{S\times t}^{hous}\left(w_{S\times t}^{market}, M_t^{hous}\right) = \left.\frac{\partial e_t^{hous}}{\partial w_{S\times t}^{market}}\right|_{\substack{e_t^{hous} = M_t^{hous}\left(1-\alpha_t^{houssave}\right) \\ U_t^{hous} = v\left(w_{S\times t}^{hous}, M_t^{hous}\right)}} \qquad (9)$$

The after-tax income of household is formalised in equation (10) where $\alpha_{R\times S\times t}^{facthou}$ represents the fraction of factor income that belongs to household, $\alpha_{R\times S\times t}^{houstax}$ represents the tax rate applied on household; $V_t^{govehous}$, $V_t^{entrhous}$, and $V_t^{forehous}$ represent the value of transfers from government, enterprises, and abroad to households.

$$M_t^{hous} = \sum_{R\times S} w_{R\times S\times t}^{Factor} q_{R\times S\times t}^{Factor} \alpha_{R\times S\times t}^{facthou}\left(1-\alpha_{R\times S\times t}^{houstax}\right) + V_t^{govehous} + V_t^{entrhous} + V_t^{forehous} \quad (10)$$

14.2.4 Investment demand

Investment demand for each commodity, if any, is calculated using equation (11). In this equation, V stands for value; superscript $inve$ stands for investment; $\alpha_{S\times t}^{inve}$ is the share in each commodity in the total investment such that $\sum_S \alpha_{S\times t}^{inve} = 1$.

$$q_{S\times t}^{inve} = V_t^{inve} \times \frac{\alpha_{S\times t}^{inve}}{w_{S\times t}^{market}} \quad (11)$$

14.2.5 Export demand

The demand for export, if any, is calculated using equation (12) using the CES function. In this equation, V stands for value; superscript $inve$ stands for investment; $w_{S\times t}^{world}$ represents the world prices; $\alpha_{S\times t}^{inve}$ is the share in each commodity in the total investment such that $\sum_S \alpha_{S\times t}^{inve} = 1$.

$$q_{S\times t}^{expo} = \alpha_{S\times t}^{expo}\left(\frac{w_{S\times t}^{market}}{w_{S\times t}^{world}}\right)^{-\alpha_{S\times t}^{expo}} \quad (12)$$

14.2.6 Equilibrium

The final group of equations specify the market clearing condition. Equations (13) and (14) specify the total supply equal to the total demand at the market price which includes commodity tax. Equations (15) and (16) specify that the total demand for production factors equal to available resources, assuming the mobility of labour within a region in a year.

$$q_{S\times t}^{supply} = \sum_R q_{R\times S\times t}^{ImmeInput} + q_{S\times t}^{hous} + q_{S\times t}^{gove} + q_{S\times t}^{inve} + q_{S\times t}^{expo} \quad (13)$$

$$w_{S\times t}^{market} = w_{S\times t}^{supply}(1+\alpha_{S\times t}^{commtax}) \quad (14)$$

$$\sum_S q_{R\times S\times F(1)\times t}^{Factor} = q_{R\times F(1)\times t}^{Available} \quad (15)$$

$$q_{R\times S\times F(2,3)\times t}^{Factor} = q_{R\times F(2,3)\times t}^{Available} \quad (16)$$

14.2.7 Dynamics

The model assumes that the size of agricultural land remains unchanged. The regional labour force would grow at the population growth rate. The capital stock in each regional production sectors would increase or decrease depending on depreciation and investment. These dynamics are formalised in equations (17) and (18).

$$q_{R\times F(1)\times t}^{Available}\big|_{t+1} = q_{R\times F(1)\times t}^{Available}\big|_t \times \left(1+\alpha_{R\times t}^{popgrowthrate}\big|_{t+1}\right) \quad (17)$$

$$q_{R\times F(2)\times t}^{Available}\big|_{t+1} = q_{R\times F(2)\times t}^{Available}\big|_t - \alpha_{R\times t}^{depreciation}\big|_t \times q_{R\times F(2)\times t}^{Available}\big|_t + I_{R\times t}^{Investment}\big|_t \quad (18)$$

14.3 Appendix A3: Overview of Vietnam economic sectors in the base year 2018

GDP of Vietnam in 2018 increased by 7.1 per cent compared to the previous year, which has been the highest rate since 2008 (GSO). Table A 3 summarises key information on sectoral structure of GDP and gross output. The GDP was reported at around $US255 billion, of which the industrial and service sector had the highest contribution. In particular, the GDP of manufacturing sector accounted for the largest part at 26.7 per cent, followed by transportation (16.8 per cent) and agriculture (13.0 per cent). The contribution of sectors in gross output was different. Out of $US541 billion, transportation had the highest share at 32.9 per cent, while the manufacturing sector and agriculture accounted for only 22.8 per cent and 10.5 per cent.

Table A 3. Sectoral share of gross output and GDP in 2018 (%)

Sector	GDP	Gross output
Agricultural, fisheries, and forestry	13.02	10.50
Mining	4.73	4.04
Manufacturing	26.72	22.77
Energy	2.81	1.38
Water	0.59	0.33
Construction	6.40	8.26
Transportation	16.77	32.93
Financial, banking, insurance, and real estates	9.81	4.39
Health care, education, and research	7.31	3.90
Administration and communication	7.52	3.98
Tourism, restaurants, and other services	4.32	7.51

The total value of intermediate inputs in the production process in 2018 was $US310 billion. Inputs from manufacturing sector accounted for the largest share in intermediate inputs of most sectors such as mining (85.9 per cent), construction (83.0 per cent), agriculture (79.5 per cent), water (53.5 per cent), and manufacturing (49.5 per cent). However, the financial, banking, insurance, and real estate sectors made the largest contribution in the intermediate inputs of tourism, restaurants, and other services sectors with 84.4 per cent. The gross output of one sector was not only sold in the domestic market of that commodity but also in other markets. For example, agricultural products are mainly supplied to the agricultural market (99.4 per cent) and partly to manufacturing one (0.6 per cent). The total domestic supply was equal to the sum of gross output across all sectors at producer prices.

Vietnam's economy is mostly dominated by labour-intensive industries. In general, labour is the main contributor to value-added of all industries. The added value from labour factor in the construction sector was the highest at 84.0 per cent, followed by health care, education, and research sectors (77.2 per cent), administration and communication (69.7 per cent) and agriculture (69.3 per cent). Also, only agriculture has value-added from land and natural resources at 19.6 per cent. In contrast, capital factor accounted for the largest share in value-added of the energy sector at about 75 per cent. The mining and financial, banking, insurance, and real estate sector have similar contributions from capital and labour in their added values.

In terms of international trade, Vietnam recorded a trade surplus in 2018 with total exports of $US259.5 billion compared to imports of $US251.3 billion. Table A 4 presents the export and import structure of Vietnam in 2018. There were trade surpluses in some sectors, such as mining, transportation, and tourism, restaurants, and other services. Besides, the commodities in manufacturing sector contributed the most to total exports and imports (68.4 per cent and

82.1 per cent, respectively), followed by agricultural products (15.4 per cent and 8.3 per cent), and mining products (9.1 per cent and 3.1 per cent). It can be observed that export and import shares were considerable in the manufacturing and the agricultural sectors.

Table A 4. Export and import structure in 2018 (%)

Sector	Export	Import
Agricultural, fisheries, and forestry	15.42	8.34
Mining	9.14	3.13
Manufacturing	68.41	82.06
Energy	0.02	0.12
Water	0	0
Construction	0	0
Transportation	1.91	0.71
Financial, banking, insurance, and real estates	0.59	2.54
Health care, education, and research	0.62	1.64
Administration and communication	0.29	0.57
Tourism, restaurants, and other services	3.60	0.89

Moreover, the total government taxes and fees revenue in 2018 was $US47.3 billion. Taxes include activity taxes, commodity taxes, factor taxes, and direct taxes (i.e., personal income taxes and corporate income taxes). The highest activity and commodity tax rates were reported in financial, banking, insurance, and real estate sectors at 7.5 per cent and 17.1 per cent, respectively. Besides, factor taxes on capital and land/natural resources were charged at 1.3 per cent and 0.1 per cent.

Regarding institutions, enterprises were an essential agent in the economic structure of Vietnam. Enterprises earned income from capital factor (70.9 per cent) and received subsidies from the government (29.1 per cent). In contrast, their spending included dividends to households (41.0 per cent), corporate income taxes (18.2 per cent), other non-tax payments to the government (20.0 per cent), retained profits (11.3 per cent), and transfers to abroad (9.5 per cent). The dividends were also the indirect income that households received from capital factor.

Household income is summarised in Table A 5. Payments from production factors were the primary source which accounted for nearly three-fourths of the total income, followed by dividends from enterprises (15.1 per cent), remittances from overseas (7.4 per cent) and subsidy from the government (3.3 per cent). Households allocated their expenditure on final consumption (77.4 per cent), savings (20.8 per cent), and personal income tax payment (1.8 per cent). In terms of structure of households' final consumption, a representative household spent the largest share on manufacturing commodities at 39.2 per cent, followed by tourism, restaurants, and other services at 19.6 per cent. Only 15.6 per cent of their final consumption were spent on agricultural products.

Table A 5. Structure of household income by source in 2018

	Value (billion USD)	Share (%)
Factor payments	158.74	74.15
Dividend	32.38	15.13
Social transfers from government	7.07	3.30
Remittances	15.90	7.43
Total	214.09	100

Another final demand in the economy was from the government. The total government income in 2018 was $US63.3 billion. Taxes and other fees were the main sources of revenue for the government, contributing 74.8 per cent, followed by other non-tax revenues from enterprises (25.0 per cent). The share of transfers from abroad was fairly negligible, at nearly 0.3 per cent. In contrast, transfers from the government to other institutions (enterprises and households) accounted for nearly half of its total expenditure. The final demand from the government contributed 25.1 per cent, of which the government spent mainly on administration and communication sector as well as health care, education, and research sector with a proportion of about 95 per cent. The remainder after allocation of revenues and expenditures was government savings which reflected the fiscal balance of the government. The positive value implies that in 2018 the government had a budget surplus.

Finally, gross domestic savings consisted of enterprises, households, and government savings. Investment account included inventory changes, in which investment in construction sector accounted for the largest share, at 58.7 per cent, followed by the manufacturing sector (33.8 per cent), and agriculture (5.8 per cent). The difference between gross domestic savings and total investment was the current account balance. The positive value indicates that Vietnam had a current account surplus. This number shows an improvement in the country's net lending position vis a vis the rest of the world as Vietnam reported a current account deficit in 2017 (State Bank of Vietnam, 2019).