

Industrial Policy and Green Growth in a Small Island Economy: The Case of Singapore

Saim Karabulut^a

^aProject Development and Management Office, OSTIM Technical University, Ankara, Türkiye, 0000-0002-4435-1780

Abstract

This article analyses how Singapore has managed to achieve a successful development process despite its limited natural resources and how it has achieved environmental sustainability through green growth strategies. Singapore's industrial policies and green growth strategies offer significant lessons for other economies and set an important example for achieving sustainable development. The paper considers the leading role of the state, leadership and commitment to national/international commitments as determinants of Singapore's development success. Efforts such as the Green Growth Plan and participation in the carbon market are proving the effectiveness of integrated policy approaches and contributing to social welfare while enhancing national competitiveness. Overall, Singapore's experience offers important lessons for economies seeking sustainable growth and contributes to the development economics research literature. And non-state actors' governing pathways to enhance land productivity and foster comprehensive agro-development.

Article History

Received September 30, 2024

Accepted November 19, 2024

Keywords

Developmental Economics, Industrial Policy, Sustainable Development, Singapore, Green Economy

JEL Codes

O2, O4

1. Introduction

The concept of economic development, which is based on sustaining a welfare worthy of human dignity, has an important place in academic studies. In short, development economics, a branch of science that examines the processes of increasing the economic welfare of low and middle income countries, focuses on some fundamental questions. It focuses on basic problems such as the disparity in levels of development between countries or the state's role in development processes. This discipline has become even more important in the last hundred years. In other words, it no longer focuses only on increasing the level of welfare, but also on how to achieve and sustain environmentally sound growth. But can social welfare be increased without harming the

environment, can major growth imbalances between countries be brought to a more equitable position, as well as promoting a way of life worthy of human dignity? Environmentally sensitive development has now moved from theory to practice. These practices have gone beyond voluntary efforts and continue to evolve into mandatory regulations day by day. The best example of this is the gradual transition to carbon emissions management by mandatory mechanisms based on the idea that voluntary mechanisms are insufficient. Sustainable economic policies are becoming increasingly important within these limits, revealing the necessity of development without conflicting with nature. Industrial policies are considered as an important instrument of

economic development. Countries in transition from an agricultural to a post-industrial economy have implemented selective government policies. The importance of these policies was realized especially after the Second World War where they were used to repair war damages.

Dani Rodrick argues that the government's support for certain economic activities more than others indicates the implementation of industrial policies. Yülek (1991), on the other hand, defines these policies as incentives applied in countries' priority industrial areas. In the 1980s, with the rise of neo liberal economics, state intervention was tried to be reduced, but in the 1990s, the mainstream economy again turned towards industrial policies. During this period, general effective horizontal industrial policies were preferred. However, further research has revealed the importance of extensive state intervention in the success of East Asian countries. In 2000s, the need for active industrial policies for late industrializing countries was highlighted. Nowadays, the issue of how to design and implement industrial policy has become important. The global economy is experiencing a transformation with the paradigm of sustainability and green growth emerging. The transformation brings significant opportunities alongside its challenges for countries. At this point, the study examines Singapore as a case study, which is an excellent lesson for countries at all stages of development that take advantage of the opportunities of green economic transformation.

Singapore's development journey serves as a significant example in development economics. Despite limited natural resources and geographic constraints, Singapore has achieved notable success through innovative industrial policies and green growth strategies. By analysing Singapore's economic development, policies, and strategies, this study aims to provide valuable insights for other economies. Singapore's experience highlights key lessons for achieving sustainable growth and implementing green industrial policies, focusing on leadership, state involvement, and adherence to national and international commitments. Through both quantitative and qualitative analysis, the study illustrates Singapore's successful development since its independence in the 1960s, highlighting its management of green policies within the context of green growth. The analysis is based on a case study, compiled and evaluated through literature studies and key indicators included in the scope. This article is extracted from my master's thesis entitled "Industrial Policy and Green Growth in a Small Island Economy: The Case of Singapore," supervised by Prof. Dr. Murat Ali Yülek, completed in 2024 (Master's Thesis, OSTİM Technical University, Ankara, Turkey, 2024).

2. Methodology

Given the context of development economics, this study aims to analyse Singapore's sustainable economic development processes. It analyses the effects of green industrial policies on green growth through case studies. Qualitative and quantitative descriptive analysis method is

used to demonstrate how Singapore's development journey has been successful since its independence in the 1960s and how it has recently displayed the same success in sustainable development in terms of green growth. In this case study, topics such as development economics, industrial policies, green industrial policies are also explained and related matters are also analysed. In order to cover the scope of the research topic, qualitative and quantitative data were collected from the literature and the data were compiled in the light of important indicators and analysed through a descriptive case study.

3. Literature Review and Discussion

3.1. Development Economics, and Economic Growth

While the development economy began as a focus on the growth of third world countries, it has expanded in scope and impact over time. Early debates about the field centered on its definitional limitations. The basic principles of development economics, as noted, were shaped after the Second World War to understand and foster the development of the Third World. Todaro and Smith (2020) note these principles as crucial to the design of future economic development policies. The historical context and ongoing debates continue to shape the way Development Economics addresses global development challenges. Though there is no consensus on definitions, J. Edward Taylor and Travis J. Lybbert (2020) define development economics broadly as follows; "Seeking to understand the economic aspects of the development process in low income countries. Economic development entails far reaching changes in the structure of economies, technologies, societies, and political systems. Development economics is the study of economies that do not fit many of the basic assumptions underpinning economic analysis in high income countries, including well-functioning markets, perfect information, and low transaction costs". The 1950s saw significant debates in development economics, particularly between balanced and unbalanced growth theories. Key figures such as Albert Hirschman and Paul Rosenstein-Rodan championed different strategies; Rosenstein-Rodan advocated for broad based investments (the Big Push), while Hirschman supported targeted investments in key sectors to stimulate growth. W. Arthur Lewis introduced the dual sector model, focusing on the shift from agriculture to industry, which has greatly influenced modern economic development policies.

The Bretton Woods Conference, held after World War II, significantly changed the concept of development by emphasizing the importance of supporting underdeveloped nations to ensure global economic growth. The conference aimed to establish a fixed exchange rate regime and enhance international trade, marking the start of a new era in global economic policy and development. Economic development is driven by enhancing work skills and intelligence, coupled with technological advancements that transform traditional societies. It involves the use of capital to improve productivity, generate wealth, and increase national income, while also incorporating social and cultural changes. Effective

economic development depends on a mix of labor, capital, and institutional, cultural, and technological factors, leading to innovation, urban specialization, and sustainable prosperity through improved capabilities and responsible practices (Frenken and Boschma, 2007; Feldman et al., 2016).

Economic growth, according to Freyssinet (1985) and Özgüven (1988), is the measurable increase in an economy's productive capacity over time, improving societal well-being and income. This aligns with Adam Smith's concept of expanding production, illustrated by the outward shift of the production possibility frontier (PPF) as resources and technology advance. This change reflects the increase in an economy's capacity to produce goods and services with existing resources and technology, essentially the essence of economic growth. The Production Possibility Frontier (PPF) is a crucial tool in understanding economic growth and represents the maximum production level achievable with current resources and technology. An increase in resources or their quality causes the PPF to expand, indicating economic growth, which is measured by the annual growth rate of national income or per capita income. Economic growth and development have been defined in various ways by key economists. Denison measures it through GNP and GDP, while Sen emphasizes personal freedom and expanding capabilities. The UNDP uses the Human Development Index, and Kuznets' hypothesis links income inequality with economic growth in an "inverted U" curve (Denison, 1962; Rostow, 1960; UNDP; Kuznets, 1955).

3.2. Economic Growth Theories

A better comprehension of development processes becomes even more meaningful when considered in the perspective of the historical development of economic growth theories. This section will focus on economic growth theories. Firstly, pre classical growth theories, such as mercantilism and physiocracy, provide the foundations of economic growth. Merkantilism claimed economic power could be increased through foreign trade and the accumulation of precious metals between the 16th and 18th centuries (Özgüven, 1988), while physiocracy argued that the main source of prosperity was agricultural production and that state intervention should be minimal by adopting the *laissez-faire* principle (Aksu, 2018). Classical growth theories appeared in the late 1800s and analyzed the role of the market in economic growth. On the other hand, Keynesian growth theories criticized classical economic theories and considered government intervention essential for the recovery of the economy. Keynes (1936/2017) maintained that demand is the main determinant of employment and income levels in the economy and argued that investments should be increased. Later on, this view was made more dynamic within the framework of sustainable growth with the efforts of Harrod and Domar (Greenlaw and Shapiro, 2011; Greenwald and Stiglitz, 1987).

Neoclassical growth theories emphasize sustainable economic growth through the interaction of labor, capital and technological progress (Spencer, 2008). These theories have

been at the center of economic growth research, especially after the Second World War. Robert Solow's Nobel Prize winning "Solow Model" and the Mankiw-Romer-Weil model are important contributions to this theoretical framework. These models are based on the assumption that the market is competitive and an increase in production inputs leads directly to an increase in output (Kose, Prasad, Rogoff, and Wei, 2010). Milton Friedman's monetarist growth theory advocates for tight monetary policy to stimulate economic growth, suggesting a short-term balance between inflation and unemployment, but none in the long run (Greenlaw and Shapiro, 2011). In contrast, endogenous growth theories highlight technological progress and human capital as internal drivers of growth. Models by Rebelo (1991), Romer (1986), Aghion and Howitt (1992), and Lucas (1988) stress the importance of skills, knowledge, and public investment in shaping long-term economic growth.

3.3. Total Factor Productivity

The theory of total factor productivity (TFP) argues that economic growth relies not just on more inputs but crucially on technological advancements. Solow's (1957) work laid the foundation for using TFP to assess productivity's impact on growth, particularly in the US (Shackleton, 2013). TFP has demonstrated that productivity growth, particularly within the manufacturing sector, is a pivotal factor in economic development (Balakrishnan and Pushpangadan, 1994). As a principal catalyst for economic expansion, TFP possesses the potential to enhance efficiency in capital and labor through enhanced managerial techniques and reduced production costs (Yülek, 2018; UNDP, 2018).

3.4 Industrialization, Industrial Policy and Deindustrialization

As posited by Kaldor, industrialization is becoming an increasingly pivotal concept within the academic community, serving as the primary catalyst for economic growth. In light of these considerations, it is imperative to examine industrial policies in conjunction with the industrialization process. The Industrial Revolution, which emerged in the 18th century, constituted a radical transformation of economic, technological, and social structures. The transition from economies based on agriculture and manual labor to systems based on industry and mechanization resulted in significant changes to production processes. Cities developed at a rapid pace, the middle class grew, and working conditions and labor rights underwent significant transformations. This process established the foundations of modern industrial economies and significantly contributed to the current structure of the global economy (Hartwell, 1990).

Yülek (2017) views industrialization as a capacity building process involving stages from machinery introduction to new product development, emphasizing skills and technical competencies. The process isn't always linear, with some countries potentially stalling at certain stages, leading to middle income or technology traps. The three critical factors

for successful industrialization are skills, technical progress, and capabilities. Industrial policy plays a crucial role in the industrialization process, shaped by historical shifts like Britain's transition in the 18th century and evolving through phases: pre-1970 import substitution, 1980s liberalization, and recent digital development and SME support. Modern policies focus on sustainable growth, technical capacity, and public private partnerships (Aiginger and Rodrik, 2020). Successful policies integrate macroeconomic and social elements, as demonstrated by East Asian Tigers, which used strategic state interventions to foster development beyond neoliberal models. Deindustrialization, a decline in manufacturing output and employment, must also be considered in this context. It is often associated with the rise of the service sector in advanced economies. This process serves to reinforce the significance of industrial policies in ensuring economic stability, fostering innovation, and promoting exports (Tregenna, 2010; Rowthorn and Wells, 1987). Industrialization and industrial policies represent the fundamental dynamics of economic growth and sustainable development. The function of industrial policies in economic development is not merely to rectify market failures; it is also to reinvigorate “forgotten regions,” thereby contributing to the greater social good. One of the most significant elements of contemporary industrial policies is their emphasis on technological innovation and the capacity of developing economies to reconcile imitation and innovation strategies (Rodrik, 2004).

Observed variables that are linked with the latent construct of agro-production, while another latent variable, local agro-governance, is characterized by four observed variables, and land productivity serves as an endogenous variable (Figure 3).

3.5 Green Economy and Green Growth

Green economy dates back to the recognition of sustainable development as a global policy goal. It was emerged from the search for environmental awareness and sustainable development. Rachel Carson's “Silent Spring” (1962) and the Club of Rome's “The Limits to Growth” (1972) contributed to the acceleration of this debate by drawing attention to the consequences of environmental degradation and limited natural resources. Sustainable development was formalized with the Brundtland Report published in 1987 and transformed into the concept of green economy. According to UNEP (2011), green economy is defined as “an economy that significantly reduces environmental risks and ecological scarcities while improving human well being and social equity”. UNEP's 2009 Global Green New Deal (GGND) proposes key policies to reduce carbon emissions and protect ecosystems, advocating for economic models like carbon trading and payments for ecosystem services. The green economy comprises elements such as cleaner production, resource efficiency, circular economy, and nature-based solutions, aiming for efficient resource use and sustainable cycles (Louseau et al., 2016). However, critics like Kosoy and Corbera (2010) argue that commodifying nature as “ecosystem services” oversimplifies complex ecological

dynamics and marginalizes vulnerable communities. Green growth is an economic model within sustainable development, addressing environmental, economic, social, and ecological challenges (Bowen, 2012). It complements sustainable development, integrating the dual focus on environmental sustainability and economic progress (Kuşat, 2013). Seçgel (2007) states that green growth is an integrated approach that includes concepts such as sustainable urban management, emission control, green employment, low carbon economy and clean product design. Green growth functions as an economic policy and development strategy and is considered as a potential tool in finding solutions to global problems (Arlı Yılmaz, 2014).

3.6 Essential Terms in Green Growth

3.6.1 Low carbon economy, carbon footprint and ecological footprint

Low carbon economy is a solution to address climate change that carries not only an environmental but also a social and economic dimension. This transition requires the development and implementation of low carbon technologies to achieve countries' goals of reducing greenhouse gas emissions and lowering their carbon footprint low carbon economy especially after the 2008 global financial crisis has been adopted as a critical solution and aims to reduce the carbon dependency of economic activities in order to reduce greenhouse gas emissions. The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol have played an important role in the adoption of the low carbon economy concept at the international level, setting specific targets for managing and reducing greenhouse gas emissions (Lütken et al., 2011). Copenhagen Summit in 2009 was recognized as an important milestone in global climate policies and raised climate change awareness in developing countries. Studies show that measures to reduce greenhouse gas emissions have the potential to prevent economic losses and be financially profitable. After the 2008 economic crisis, several countries integrated low-carbon measures into their stimulus packages, enhancing the adoption of a green economy model. Since the 1970s, unsustainable resource use has led to environmental crises. The 2022 WWF Living Planet Report highlights drastic biodiversity loss, with wildlife populations declining by 69% globally since 1970, underscoring the need for urgent change. Tools like carbon and ecological footprints have been developed to measure human impact on natural resources. The carbon footprint measures greenhouse gas emissions from activities, playing a critical role in climate change mitigation, as supported by international agreements like the Paris Climate Agreement. The ecological footprint, introduced by Wackernagel and Rees in the 1990s, assesses whether consumption exceeds the planet's regenerative capacity. Both metrics are essential for understanding and reducing our environmental impact (WWF, 2022).

3.6.2 *Global warming, climate change, and the greenhouse effect*

Global warming refers to the rise in Earth's average surface temperature due to natural processes and human activities, primarily driven by the greenhouse effect involving gases like carbon dioxide and methane (Hansen et al., 2010). Fossil fuel combustion and deforestation are significant contributors to global warming, particularly since the Industrial Revolution. The UNFCCC defines climate change as alterations in atmospheric composition caused by human actions (UNFCCC, 2002). The IPCC's 2023 Sixth Assessment Report confirms human activities, especially greenhouse gas emissions, as the primary cause of global warming. It highlights that global temperatures rose by 1.1°C between 2011-2020 compared to 1850-1900, with CO₂ and methane levels significantly elevated. The report calls for urgent actions, such as reducing fossil fuel use, transitioning to renewable energy, and protecting forests.

3.7. *International Regulations Green Growth*

3.7.1 *The Paris Agreement*

The United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 at the United Nations Conference on Environment and Development to address climate change and reduce greenhouse gas emissions. Annual Conferences of the Parties (COP) are held to discuss emission reduction and environmental protection. Under the UNFCCC, key agreements like the Kyoto Protocol (1997) and the Paris Agreement (2015) were signed to set formal emission reduction targets. The Paris Agreement represents a new international legal regime to strengthen the fight against global climate change. This agreement replaces the Kyoto Protocol, providing flexibility for all countries to commit to emission reductions regardless of their development status. Kyoto Protocol only imposed obligations on developed countries, and the US non ratification and rising emissions in developing countries showed that this approach was insufficient. 2009 Copenhagen Conference and the Durban Platform laid the groundwork for the Paris Agreement and established that a new all party agreement should be in place by 2015. Paris Agreement provides for countries to submit their nationally determined contributions (NDCs) and for these contributions to be monitored based on transparency and collective assessment mechanisms (according to the transparency and accountability rules adopted at COP24). The Agreement adopts a bottom up approach based on the principle of “common but differentiated responsibilities and relative capabilities”. It also renews the commitment of developed countries to provide \$100 billion in financial support to developing countries each year, proposes new mechanisms to allow international trading of emission reductions, and aims to support vulnerable countries, such as small island states, which are most affected by climate change. The Paris Agreement was the first agreement to demand

serious efforts from all parties to combat climate change and remains at the center of global efforts in this area.

3.7.2 *Sustainable development goals*

The concept of sustainable development originated with the United Nations Charter for Nature in 1982 and was elaborated in the 1987 “Our Common Future” report and the 1992 Earth Summit. Sustainable development seeks to balance economic growth with environmental conservation. The integration of social development as a “third pillar” was highlighted in subsequent summits, such as the 1995 Copenhagen and 2002 Johannesburg Summits (Hak et al, 2016). In 2015, the United Nations adopted the Sustainable Development Goals (SDGs), building on the Millennium Development Goals (MDGs) to address broader issues, including poverty reduction, environmental sustainability, and social inclusion. The 2023 SDG Report indicates that only 15% of the assessed targets are on track for 2030, with nearly half significantly deviating from the intended path. Over a third have seen no progress or have regressed since 2015, underscoring the need for urgent and intensified efforts. Key challenges include economic growth and green economy targets, which have been affected by the COVID-19 pandemic, climate change, and growing inequalities. Accelerating the green economy transition and reforming international financial systems are crucial to achieving sustainable development (United Nations, 2023).

3.8. *Regional Regulations*

3.8.1 *European Union Green Deal*

The European Green Deal (EGD) is a strategic plan to turn environmental challenges into opportunities, aiming to align the EU's economy with sustainability while ensuring a fair and inclusive transition (Claeys et al., 2019). The EGD seeks a resource independent growth model, targeting net zero greenhouse gas emissions by 2050. It includes investments in clean technology, industrial innovation, clean transport, energy sector decarbonization, and improved energy efficiency in buildings. It also focuses on biodiversity protection and pollution reduction, impacting sectors like energy, construction, transport, and finance. According to the European Parliament, the goal of climate neutrality requires significant changes in economic growth and sectoral production. Within the scope of the EGD, the EU has aimed to accelerate the green transition through various initiatives. In this regard, initiatives such as zero emission city buses target by 2030, renewable hydrogen rules and Green Deal Industrial Plan have been developed. In addition, the renewable energy target was set at 42.5% by 2030 and an 11.7% improvement in energy efficiency was targeted. Social Climate Fund launched to support vulnerable households and small businesses to reduce the cost of the green transition. EU's Carbon Border Adjustment Mechanism (CBAM), which aims to prevent carbon leakage in international trade, aims to internalize the carbon footprint of imported products and provide a climate friendly perspective on international trade. CBAM came into force in 2023 and a carbon fee based on the

carbon emissions of imported products will be charged from 2026.

CBAM aims to offset the carbon costs of imported and domestic products by implementing rules in line with the EU's emissions trading system (EU ETS) (European Commission, 2023; Perdana and Vielle, 2023). The European Green Deal (EGD) adopts a multidimensional strategy that focuses on decarbonization while also enhancing Europe's long-term economic growth and international competitiveness. It aims to revitalize Europe's industrial potential, turning the transition into an industrial opportunity, particularly amidst rising competition from China and other major economies (Claeys et al., 2019; Fetting, 2020).

4. Green Industrial Policies

Green Industrial Policies seek to align economic growth with environmental sustainability by integrating innovation and enhancing industrial competitiveness. In developing countries, green growth forms part of broader sustainable development strategies (Borel et al., 2013). Unlike traditional industrial policies, green industrial policies differ in terms of government intervention scale, policy duration, and the complexity of performance-based evaluation (Petrashko, 2017). Dani Rodrik (2014) analyzes the theoretical strength and practical uncertainties of green industrial policies, arguing that government support is necessary to address market failures in innovative technologies. Rodrik highlights how positive externalities arising from the development of new technologies, inaccuracies in carbon pricing and competitive incentives lead to the need for government intervention. Green industrial policies support these “baby” industries by appropriately pricing environmental externalities in the market (Morris, Nivola and Schultze, 2012). Such policies address not only environmental but also other challenges faced by conventional industries. Moreover, the promotion of local innovation is another important element of green industrial policies. Policies aim to advance low carbon energy technologies, energy storage solutions and green cars. However, it is argued that these policies have the potential to disrupt international trade and investment flows, creating legal issues under WTO laws (International Institute for Sustainable Development and United Nations Environment Programme, 2014). Whereas traditional industrial policy focuses on short term competition and economic growth, the new industrial policy aims for long term societal benefits and overall social welfare (Ambroziak, 2017; Rodrik, 2014, 2020). Rodrik's (2014) proposal advocates a collaborative effort between the public and private sectors to create an economy that provides quality job opportunities.

The European Green Deal highlights the relationship between the social welfare objectives of industrial policies and the decarbonization objectives of climate policy. This provides a dual focus that distinguishes the GIP from both climate policy and industrial policy: decarbonization and enhancing social welfare. However, if these objectives conflict, resolving this contradiction and, if necessary,

developing new policy instruments is one of the main challenges of the GIP. Besides classical market failures, Green Industrial Policy also addresses specific problems, such as greenhouse gas externalities specific to climate change. Although carbon pricing has been proposed to correct such externalities, in the absence of an effective carbon price, alternative methods, such as regulations or public investments, may be required (Tagliapietra and Veugelers, 2020). GIP should contain different and complementary policy instruments in addition to traditional industrial and climate policies, and these instruments should be compatible with existing mechanisms such as carbon pricing. Public funding for innovation and R&D is emphasized for developed countries, while technology transfer and capacity building are prioritized for developing countries. Carbon pricing, public private partnerships and green market creation measures are emphasized in both developed and developing countries. This shows that the GIP sits at the intersection of climate policy (decarbonisation) and industrial policy (social welfare). The challenge of the GIP is that these two objectives need to be realized simultaneously. While carbon pricing is preferable to reduce carbon emissions, second order interventions may be required when it is not sufficient. Therefore, the GIP should integrate specific instruments to support the transition to a low carbon economy and align with climate and industrial policies (Tagliapietra and Veugelers, 2020).

5. Industrial Policy and Green Growth in A Small Island Economy: The Case of Singapore

Singapore's transformation from a classic British trading center to a high income country in the 1960s is a striking example of successful strategic public policy and economic planning (Heng, 2015; Yülek, 1998). Soon and Tan (1993) noted that Singapore implemented only one five year development plan in its development process, the Singapore Development Plan 1960-64, and thereafter did not continue with fixed term planning. Economic independence of Singapore gained a major push when it gained political independence from Malaysia in 1965, and the country's economic orientation shifted from import substitution to export oriented industrialization. This new approach aimed to make the most efficient use of Singapore's strategic location between Eastern and Western markets. In the period that followed, Singapore became a center for trade and investment, attracting global investment in key sectors such as financial services, information technology, medical services, electronics, aviation, and education, leading to a huge increase in its Gross Domestic Product (GDP). Yülek (1998) emphasizes these policies as flexible, rational and effective. Unlike Hong Kong, which has a similar structure, Singapore is characterized by intensive and significant state interventions in the economy; these interventions are targeted towards the development of specific sectors. The model, where the state plays an active role in the economy, supported by public institutions and enterprises, is seen as a key driver of success in the development process. Sectoral focus of the state has

accelerated and sustained economic growth by directing public investment and resource allocation to priority areas for development.

Since 1959, Singapore started its economic transformation with inward oriented development policies (Phase 1: 1959-1967). During this period, an import substitution industrialization strategy adopted against rising unemployment and changes in global trade patterns, and tariffs and quotas were implemented. However, the limited domestic market and inefficiencies in the local manufacturing sector prevented the success of this strategy (Yülek, 1998). After its separation from Malaysia in 1965, Singapore became more open to foreign investment and embarked on an export oriented industrialization process. Such transformation was supported by the establishment of institutions such as the Economic Development Board (EDB) and investments in strategic sectors. However, foreign investments did not reach the expected level and this situation increased Singapore's difficulties in economic transformation (Yülek, 1998; Mun Heng, 2015). In the period 1968-1978, Singapore adopted an outward oriented development policy and shifted to an export oriented strategy (Phase 2: 1968-1978). Foreign investment and exports were sought to be increased with the enactment of the Economic Expansion Promotion Act. Labor and employer relations were regulated with the establishment of the National Wages Council (NWC) and wage policies were aligned with international competitiveness (Yülek, 1998). These policies made Singapore an attractive center for foreign direct investment (FDI) and attracted significant investments in key sectors such as electronics and petrochemicals. Foreign Direct Investment (FDI) refers to an investment by a company or individual from one country into a business located in another country, often involving ownership control. FDI is significant as it supports domestic investment, boosting capital accumulation, productivity, and economic growth in the host country. It offers stable financing for current account deficits, creates jobs, and facilitates the transfer of technology and managerial skills, particularly beneficial for developing countries. However, FDI can also have drawbacks, like economic instability and profit repatriation. Therefore, strategic investment policies are necessary to ensure that FDI's yield maximum net benefits for the host country rather than simply liberalizing all inflows. Singapore exemplifies FDI driven growth, especially between the late 1950s and 1970s, where its main goal in attracting FDI was to create jobs. With limited domestic technological capabilities, Singapore focused on attracting mid-level technology transfers to support its economic development (Yülek and Gür, 2017). The 1973 oil crisis notwithstanding, the economy continued to grow and the investments made during this period supported economic diversification (Mun Heng, 2015).

From 1979-1985, Singapore aimed to shift from low value added and labor intensive industries to capital and technology intensive sectors (Phase 3: 1979-1985). Labor qualifications were improved through measures such as wage increases and the Skills Development Fund (SDF), while the Economic Development Board (EDB) coordinated investment in specific

sectors. This policy helped Singapore maintain its competitive advantage and transition to higher value added production (Yülek, 1998; Mun Heng, 2015). Following the economic recession of 1985, the "Singapore Economy: New Directions" report, prepared to overcome the 1985 economic stagnation, recommended lowering taxes and labor costs, which accelerated economic growth (Phase 4: 1986-1997). The Strategic Economic Plan (SEP) focused on human resource development, innovation and increasing competitiveness. During this period, the manufacturing sector was directed towards sub sectors such as electronics, telecommunications and aerospace, and industrial clusters were developed (Mun Heng, 2015; SEP MTI, 1991). Between 1998 and 2008, following the Asian Financial Crisis, Singapore took fiscal measures and started the process of transformation to a knowledge based economy through initiatives such as Industry 21 and Manpower 21 (Phase 5: 1998-2008). The Biomedical Sciences (BMS) sector and NEWater projects to manage water resources contributed to the country's sustainability goals. In this period, free trade agreements were signed to increase international trade advantages and Integrated Resort (IR) projects were implemented to revitalize tourism (Mun Heng, 2015; Yülek, 1998).

Phase 6: 2009 and beyond (Phase 6: 2009 and beyond) marked a period of slow economic recovery as Singapore struggled to recover from the effects of the 2008 Global Financial Crisis (GFC). During this period, demographic aging and productivity issues came to the fore, and the Economic Strategies Committee (ESC) developed seven strategies to boost productivity and revitalize the economy. Policies focused on R&D and innovation supported the transition of the economy to higher value added areas. Moreover, environmental sustainability goals such as the Green Plan 2030 allowed Singapore to integrate its economic development with a sustainability perspective. During this period, Singapore consolidated its position as a global economic player (Loong, 2011; Mun Heng, 2015).

5.1. *The Structure of Singapore's Economy*

Noted for its high income level, advanced market economy and its position as a global financial and trade center, Singapore is recognized as one of the most open and competitive economies. Its economic structure is supported by high tech manufacturing, strong international trade networks and an efficient service sector. Singapore's economic rise has been built on private sector growth, export led strategies and attracting foreign investment. Despite limited natural resources, the country has adopted a development approach based on efficiency, thus consolidating its place in the global economy. A review of economic indicators shows that Singapore ranks 34th in the global economy and second globally in per capita income (World Bank data). In 2022, the economy grew by 3.6%, with growth of 2.5% in manufacturing, 6.7% in construction and 4.8% in services. Inflation rose to 6.1%, while unemployment fell to 2.1% (MTI, 2022; Singapore Department of Statistics, 2023).

ASEAN is expected to become Asia's third largest economy with a GDP of USD 3.6 trillion in 2022, and Singapore's contribution to this union is of great importance. Singapore stands out as a major producer of electronic and chemical products and has harmonized with international tax standards and raised its goods and services tax (GST) rate to 9% (Deloitte, 2023). Singapore ranked fifth in the Global Innovation Index in 2023, ranking high in government effectiveness and access to venture capital. In line with the Paris Agreement, the country increased its carbon tax and took important steps to combat climate change (Dutta et al., 2023).

5.2. Manufacturing Value Added and Its Per Capita Impact in Singapore's Economy

Moving from a low cost labor intensive production model to high value and technology intensive production, Singapore's manufacturing sector contributed 20.5% to GDP in 2022. The "Manufacturing 2030" plan aims to boost manufacturing's share of GDP by 50%, focusing on digitalization, advanced technologies, and workforce skill development. In response to the pandemic and geopolitical challenges, Singapore has emphasized strengthening its domestic manufacturing base by encouraging smart manufacturing solutions through initiatives like Industry 4.0 and NAMIC. Industry Transformation Maps (ITMs) target creating 13,400 new jobs and contributing 80% of annual manufacturing output by 2025. Technologies like AI, data analytics, and IoT are crucial in accelerating industry digital transformation and supply chain management. In 2022, Singapore ranked 26th globally in manufacturing, with a per capita value added of USD 14,112, highlighting its sector's efficiency and productivity. Over the period 2000-2022, there has been an overall increase in manufacturing value added per capita despite periods of crisis, demonstrating Singapore's resilience and capacity for strategic transformation in the manufacturing sector. Singapore ranks 9th in the United Nations Industrial Development Organization's (UNIDO) Competitive Industrial Performance (CIP) Index and third in terms of manufacturing value added per capita (UNIDO, 2023).

5.3. Science and Technology Development in Singapore

Starting with digitization in the public sector, Singapore's science and technology policy has evolved into IT mainstreaming in the private sector and the integration of technology into urban planning. Government's adaptability, interagency collaboration and partnerships with multinational companies have played an important role in this transformation (Erh, 2023). In the 1960s, the foundations of science and technology were laid with institutions such as the Ministry of Science and Industry and the Singapore Institute of Standards and Industrial Research. An R&D culture was developed with the National Science and Technology Council (1991) and the National Technology Plan (1995), and institutions such as A*STAR and SPRING were established.

Thus, Singapore has created a favorable R&D environment for the transition to a knowledge based economy.

5.4. Science and Technology Plans

Launched in 1995, the National Technology Plan encouraged R&D activities in nine key sectors with an investment of SGD 2 billion. In 2000, the National Science and Technology Plan expanded the science and technology infrastructure with a budget of SGD 4 billion and made significant progress, particularly in the biomedical sector. Subsequently, the Science and Technology Plan in 2005 supported the biomedical sciences (BMS) sector and increased R&D spending to 2.25% of GDP. This was followed by the Science and Technology Plan in 2010, which increased R&D spending to 3% of GDP with SGD 13.55 billion invested in growth sectors such as environmental technologies and digital media. By 2015, the RIE2015 Plan had developed six strategies aimed at accelerating the commercialization of R&D and supporting public and private partnerships in basic science. Finally, the RIE2020 Plan, launched in 2020, aimed to strengthen Singapore's status as an innovation driven economy, adapt R&D to industry needs, and support the startup ecosystem with a budget of SGD 19 billion (Ministry of Trade and Industry, 2024; Economic Development Board, 2024).

5.5. Education in Singapore

Due to its limited natural resources, Singapore has invested in human resources to compete globally. Its education system has consistently ranked highly in the OECD's PISA assessments. Even though education spending will reach 2.8% of GDP in 2021, success has been achieved through high efficiency and quality (Ministry of Education Singapore, 2019; World Economic Forum, 2015). The National University of Singapore and Nanyang Technological University rank highly in world rankings and Singapore ranks second in PISA. The education model has undergone three stages of development, focusing on survival, efficiency, and ability, enabling students to excel in science and mathematics, and offering an individualized, interdisciplinary curriculum (Kozma, 2011). The education system is regulated by the 1957 Education Act and administered by the Ministry of Education. Primary education consists of four years of basic education and two years of orientation; national exams determine students' future educational paths. Education aims to provide cultural and linguistic competence while maintaining multilingualism and allowing students to develop their interests and talents (Ferris and Waldron, 2023). Singapore has 45 higher education institutions and six autonomous universities. Lifelong learning and training programs for graduates are also available. NUS's "Lifelong Learners" (L3) program aims to support its graduates for 20 years, while the SkillsFuture national movement provides lifelong learning opportunities for all Singaporeans (Ministry of Education, Singapore, 2024).

5.6. *Research and Development (R&D) Expenditures and Patent Applications in Singapore*

Research and development expenditures and patent applications in Singapore are among the important indicators of economic growth and innovation in the process of realizing the country's innovation oriented economy vision. Maradana et al. (2017) reported that R&D expenditures are positively correlated with the number of publications, citation rate and H-index, which supports scientific and technological progress. In this respect, Singapore has made a significant investment in this area by allocating 1.92% of its GDP to R&D expenditures in 2022 (Ministry of Trade and Industry Singapore, 2024) found that there is a long run relationship between R&D investments and total factor productivity over the period 1978-2019. Despite the fact that Singapore lags behind OECD countries in the short run, the economic impact of R&D investments has been stronger in the long run (elasticity ≈ 0.083). Public R&D expenditures stimulate private sector R&D activities and create significant externalities. As of 2020, the majority of patent applications in Singapore were filed by foreign multinationals and public research institutes. New patent laws introduced since 1995 and the “positive approval” system introduced in 2013 aim to improve patent quality and ensure compliance with international standards. In this regard, Singapore has adopted the goal of becoming a global center for intellectual property rights and has developed the Singapore Intellectual Property Strategy (SIPS) 2030. SIPS 2030 focuses on three main areas. First, it aims to enhance regional IP enforcement through initiatives such as the Patent Prosecution Highway (PPH) and the ASEAN Patent Examination Cooperation (ASPEC) to strengthen as a Global IP Hub. Secondly, to Attract and Grow Innovative Companies, it promotes the innovation ecosystem by introducing accelerated patent processes for AI and big data innovations. Finally, under Skilled Business and Skills Development, it aims to make Singapore an international IP dispute resolution center and increase training capacity in this field (Intellectual Property Office of Singapore, 2021). Programs such as RIE2020 and RIE2025, launched to boost R&D and patenting activities, support Singapore's innovation and technological development by offering comprehensive investments in this field. These programs and adjustments in intellectual property laws have contributed to the country's vision of transformation to a knowledge based economy by supporting the increase in patent applications (Chen and Puttitanun, 2019). As a reflection of this vision, the number of domestic patent applications per million people in Singapore in 2022 is recorded at 303, reinforcing the country's status as an innovation hub (WIPO, 2024).

5.7. *Macroeconomic Indicators*

Singapore's macroeconomic indicators have fluctuated significantly since the 1960s and the country's economic policies have evolved in line with global developments. Industrialization policies implemented in the 1960s

accelerated economic growth, while value added production and technology investments contributed to growth rates in the 1970s and 1980s. However, events such as the financial crises in 1997 and 2008 and the COVID-19 pandemic in 2020 led to sharp declines in the economy. In 2021, Singapore achieved a growth rate of 8.88%, increasing its GDP to USD 466.79 billion in 2022. However, growth slowed to 1.2% in 2023 due to the global economic slowdown and anti-inflation policies (IMF estimates). In 2022 and 2023, the manufacturing sector remained under pressure due to the global demand contraction and shortages in the semiconductor industry, while geopolitical uncertainties such as the US-China chip war also had a negative impact. However, rising demand for artificial intelligence and the expansion of chipmakers provide a positive outlook for 2024. In 2022, Singapore's GDP per capita ranked 10th globally at USD 82,807.6 (World Bank Doing Business, 2020). In the third quarter of 2023, the unemployment rate remained stable at 1.9% overall and 2.9% for citizens. Employment rates increased, especially for older workers and returning women, indicating the development of an inclusive labor market. Despite the increase in incomes, real incomes have come under pressure due to inflation and government transfers have played a role in mitigating this effect (Ministry of Manpower Singapore, 2023). In terms of foreign trade, Singapore's largest export item in 2022 was “Machinery and Transportation Equipment”, accounting for 63.1% of total exports. In addition, “Chemicals and Chemical Products” and “Other Manufacturing Products” are also among the important export items (Ministry of Trade and Industry, 2024). In monetary policy, the Monetary Authority of Singapore (MAS) has adopted an exchange rate oriented policy to control the value of the Singapore dollar and inflation. In 2022, inflation rose to 6.1% and cost increases were observed, especially in items such as transportation, food, housing and utilities. MAS continues to adjust monetary policy to mitigate these pressures (SingStat, 2023; MAS, 2022).

5.8. *Singapore in Selected Reports*

At present, Singapore is recognized as one of the world's most competitive economies, home to global businesses and a leader in various sectors. According to the World Bank's “Doing Business 2020” report, Singapore ranks 2nd among 190 economies in terms of ease of doing business and encourages multinational companies to invest with its strong regulatory environment (World Bank Doing Business, 2020; Singapore Economic Development Board, 2023). Singapore's housing policies have made significant contributions to social structure. While only 20% of the population lived in public housing in the 1960s, today this rate is over 80%. In 2022, 23,800 new apartments were completed and more than 21,200 homes were delivered. This program has successfully met the housing needs of low and middle income citizens (Hirschl, 2020; Housing and Development Board, 2022/2023). Singapore has also made significant achievements in globalization and economic integration, ranking first in

economic integration and seventh in social globalization according to the KOF Globalization Index (KOF Globalization Index, 2023). Concerning income inequality, the Gini coefficient decreased from 0.437 before the government intervention to 0.378 after the intervention, which shows the effectiveness of government policies in reducing income inequality (Key Household Income Trends Report, 2022). Singapore ranked first as the world's freest economy in the 2023 Index of Economic Freedom, notable for its competitive tax rates and transparent regulatory environment (The Heritage Foundation, 2023). In addition, it stands out as the fourth most competitive economy in the world as of 2023 in the IMD World Competitiveness Ranking (IMD World Competitiveness Ranking, 2023).

6. Green Growth in Singapore

Singapore pursues a green growth strategy that balances economic development with environmental sustainability. As described in detail in the previous sections, Green growth aims to minimize the environmental impact of economic activities and use natural resources sustainably (Bowen, 2012; Yalçın, 2016). Initiatives such as the “Green Plan 2030”, Singapore promotes sustainable urbanism and energy policies and aims to integrate environmental sustainability and economic growth. These plans aim to realize the country's goal of creating a liveable environment for future generations while maintaining its competitiveness in the global economy. Singapore's green growth strategies are guided by the “Singapore Green Plan 2030” and the “Long Term Low Emission Development Strategy” (LEDS), with the goal of achieving net zero emissions by 2050. These initiatives align with the UN's 2030 Agenda for Sustainable Development and the Paris Agreement. Although Singapore contributes only 0.1% to global emissions, it has committed to reducing emissions to 60 MtCO_{2e} by 2030 and achieving net zero by 2050, consistent with the Glasgow Climate Pact signed at COP-26 in 2021 (Singapore National Climate Change Secretariat, 2024).

6.1. Singapore Green Plan 2030

Singapore's vision of a “Garden City” began in 1967, emphasizing a clean and green environment, followed by initiatives like the Singapore Green Plan in the late 1980s and the “Blue Plan for a Sustainable Singapore” in 2009. The “Green Plan 2030,” announced in 2021, aims to advance Singapore's sustainability goals (National Library Board Singapore, 2024). This comprehensive strategy targets net zero emissions by 2050, aligning with the Paris Agreement and the 2030 Agenda for Sustainable Development. Despite contributing only 0.1% to global emissions, Singapore is committed to sustainability leadership. The Green Plan 2030 is based on five key pillars: City in Nature, Energy Reset, Green Economy, Resilient Future, and Sustainable Living. The “City in Nature” initiative focuses on expanding nature parks and green infrastructure to bolster urban sustainability amid climate change. “Energy Reset” aims to boost solar

energy capacity, expand energy storage systems, and integrate with regional grids, targeting 2 GW of peak power by 2030 to meet the needs of 350,000 households. The “Green Economy” strategy includes decarbonizing industries, developing new green industries and preparing the workforce for this new economy. Incentives such as the Energy Efficiency Grant support the sustainability of industries, and initiatives such as the RIE2025 program invest in low carbon technologies. In addition, Singapore has taken the lead in Southeast Asia by introducing a carbon tax in 2019 and aims to raise it to S\$25/tCO_{2e} in 2024-2025 and to a range of S\$50-80/tCO_{2e} by 2030. The “Resilient Future” pillar includes measures against sea level rise and targets to meet 30% of food needs through local production by 2030. “Sustainable Living” aims to reduce carbon emissions, adopt circular economy principles and increase environmental sustainability in transportation by expanding the rail network.

6.2. Singapore's Green Transition Financing Efforts

As part of its green transformation goals, Singapore aims to become a major hub for carbon trading and decarbonisation finance. In 2022, the global carbon credit market was worth \$978.56 billion and is expected to reach \$2.68 trillion by 2028 (Daedal Research, 2023). Singapore is home to the regional headquarters of more than 70 international companies in this field, and this sector is expected to contribute USD 1.8 to 5.6 billion to the economy by 2050. Singapore also supports carbon market development by establishing the International Advisory Panel for Carbon Credits (IAPCC) (National Environment Agency, 2023). Singapore aims to be a leader in the carbon market and trading with its “Emerging Stronger Together” initiative, and aims to provide high quality carbon credits through its new carbon exchange, Climate Impact X (CIX) (Economic Development Board, 2023). In addition, Singapore has signed several Memorandums of Understanding (MoUs) for carbon tax credits, making it easier to realize national contribution declarations (National Climate Change Secretariat, 2024). Singapore is investing \$220 million in resource circularity and water technologies under the RIE2025 program. This effort promotes environmental research and focuses on issues such as waste management and pollution control (Research, Innovation and Enterprise 2025 Handbook, 2020).

The Enterprise Sustainability Program (ESP) specifically supports SMEs to integrate into the green economy, while the Enterprise Financing Scheme - Green provides financing to support growth in areas such as green energy and circular economy (Enterprise Singapore, 2024). The EDGE Program is a \$20 million research program to develop Singapore's energy engineering capabilities and aims to develop innovations in energy technologies (Energy Market Authority, 2023). The Monetary Authority of Singapore (MAS) aims to provide financing to support the transition to carbon neutrality through the NetZero Financing Action Plan (Monetary Authority of Singapore, 2023). The Singapore Green Finance Center (SGFC) and the Sustainable and Green Finance

Institute (SGFIN) are working to promote sustainable investment in Asia and position Singapore as a hub for green finance. These initiatives aim to provide Asia focused thought leadership in tackling climate change (Singapore Green Finance Centre, 2024). Singapore is developing strategies to counter sea level rise, improve food security and mitigate the urban heat island effect. The "30 by 30" target aims to meet 30% of its food needs with local production by 2030. Singapore supports environmental sustainability with the principle of "Reduce, Reuse, Recycle" and aims to reduce carbon emissions by expanding rail and bicycle lanes.

6.3. National Contribution Declaration (NDC) and Long-term Low Emission Development Strategy (LEDS)

Singapore commits to achieve a net zero emissions target by 2050 through its updated 2030 Nationally Determined Contribution (NDC) and Long Term Low Emission Development Strategy (LEDS) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) (Singapore National Climate Change Secretariat, 2024). The NDCs are a continuation of the National Appropriate Mitigation Action (NAMA) process, which started in 2009 and aims for GHG emission intensity 16% below 2020 levels. In 2015, this target was made clearer and 65 MtCO_{2e} emissions were targeted by 2030 with a 36% reduction in emission intensity compared to 2005. Under the Long Term Low Emission Development Strategy (LEDS), Singapore has adopted climate strategies like sustainable transportation, green buildings, waste and water management, and urban greening. Specific measures include capping private car growth and phasing out internal combustion engine vehicles by 2040. Key components of the low carbon strategy include energy efficiency, carbon capture, low carbon hydrogen, and international carbon markets. Singapore aims to increase international cooperation and position itself as a carbon trading hub, contributing through the International Advisory Panel on Carbon Credits (IAPCC) and implementing policies like carbon tax and energy conservation (Geels et al., 2017). Community engagement and education are also crucial, with initiatives like "Youth for Environment Day" promoting environmental awareness. Singapore also supports international collaboration, particularly through South-South and Trilateral Cooperation, to assist developing countries in achieving common sustainability solutions.

6.4. Singapore's Approach to Achieving Sustainable Development Goals

Singapore has adopted a comprehensive approach to achieving the Sustainable Development Goals (SDGs), focusing on inclusivity and eradicating poverty (Goal 1: End Poverty) through support programs for low-income and vulnerable groups and workforce skill enhancement (Ministry of Foreign Affairs Singapore, 2023; UNSDG, 2023). Despite limited agricultural land, the country aims to meet 30% of its nutritional needs locally by 2030 to enhance food security

(Goal 2: Zero Hunger). To promote health (Goal 3: Health and Quality of Life), Singapore has implemented high living standards, universal health insurance, and digitalized healthcare, also addressing the needs of an aging population and managing infectious diseases. For education (Goal 4: Quality Education), Singapore has established an inclusive and equitable system, ensuring flexible structures to accommodate diverse student needs. Providing lifelong learning opportunities and improving teacher quality are also important elements of this goal. In order to achieve gender equality (Goal 5: Gender Equality), legal reforms and social initiatives that strengthen women's rights are carried out to increase women's leadership and economic empowerment (Ministry of Foreign Affairs Singapore, 2023). On clean water and sanitation, Singapore has adopted an innovative water management strategy and developed the Four National Taps strategy to diversify water sources, including local water, imported water, NEWater and desalination (Goal 6: Clean Water and Sanitation).

In energy, the country is increasing the use of natural gas instead of oil and investing in the use of solar energy to support the transition to clean energy (Goal 7: Affordable and Clean Energy). There are also plans to develop regional electricity networks, with the goal of importing low carbon electricity by 2035. In line with the goal of achieving economic growth and quality employment (Goal 8: Decent Work and Economic Growth), Singapore has adopted green economy strategies for sustainable growth and developed support policies to enhance the resilience of the economy during the COVID-19 period. By promoting sustainable industrial practices and innovation (Goal 9: Industry, Innovation and Infrastructure), it contributes to economic growth and supports industrial transformation through investments in green technology and infrastructure. To reduce inequalities (Goal 10: Reducing Inequalities), policies such as the Wage Model for low income workers were developed, and the social security system and access to early childhood education were improved. To create sustainable and livable cities (Goal 11: Sustainable Cities and Communities), Singapore strives to make society more resilient through improved urban planning and green infrastructure. Transportation, housing and landscaping are important components of these efforts. At the same time, to achieve responsible consumption and production goals (Goal 12: Responsible Consumption and Production), it promotes recycling and efficient use of resources through the Zero Waste Master Plan and Resource Sustainability Act, which aim to increase waste management and recycling rates (Ministry of Foreign Affairs Singapore, 2023; UNSDG, 2023).

In the fight against climate change (Goal 13: Climate Action), Singapore has developed carbon tax, transition to renewable energy and sustainable transportation strategies, and has implemented the Singapore Green Plan 2030 in this context. Adopting the principles of Integrated Urban Coastal Management for the protection of marine and terrestrial ecosystems (Goal 14: Life in Water, Goal 15: Life on Land),

the country pursues the “City in a Garden” vision to increase biodiversity and expand urban green spaces. Initiatives such as the One Million Trees Campaign encourage public participation in protecting green spaces. Building a strong framework for peace and justice with a zero tolerance policy on corruption and transparent, accountable public institutions, Singapore places great importance on international cooperation to achieve the global sustainable development goals (Goal 16: Peace, Justice and Strong Institutions). Through the Singapore Cooperation Program (SCP), it contributes to global cooperation by sharing development experiences with more than 180 countries (Goal 17: Partnerships for Goals).

6.5. Singapore's Developmental State and Developmental Leader Policies

Lastly, the developmental leader, which is an important factor for Singapore's success in its developmental journey, is worth a mention. Together with the developmental leader, the developmental state will also be mentioned. Development economics literature has emphasized the role of the state and leaders in Singapore's development process. Behind Singapore's success lies the state's ability to develop and implement strategic industrialization policies. While industrialization often fails in countries where the developmental state structure is lacking, Singapore has built this structure and succeeded in joining the global competition. The concept of the developmental state was first defined by Johnson (1982) and defined as the state allocating resources to specific sectors by taking strategic measures for industrialization. The economic success of Asian countries has formed the basis of this concept. Krugman (1994) saw Asia's economic growth not as a “miracle” but as a growth based on an increase in resources and characterized these achievements as “paper tigers”. In contrast, mainstream approaches such as the World Bank attributed this growth to the efficient functioning of free market mechanisms. The developmental state approach, however, argued that Asia's success was based on strategic state intervention. Underlying the success of developmental states is “embedded autonomy”, which refers to the capacity to establish an effective relationship with the private sector while at the same time keeping it free from negative influences such as corruption. Meritocratic bureaucracy plays a crucial role in developing long-term, research-based policies, while developmental leaders are vital for driving transformation under complex socioeconomic conditions (Yülek and Akkemik, 2022).

Lee Kuan Yew, Singapore's founding leader, exemplified this leadership style, transforming the nation from a low-income economy to a high-income global trade hub. Lee emphasized foreign investment, long-term planning, education, and infrastructure, supported by a strong, autonomous state structure. His approach, often characterized as authoritarian, underscores the importance of state intervention and strategic industrialization in achieving development goals. The developmental state and leadership

frameworks are key to understanding Singapore's transformation and Asia's broader economic successes, showing how effective strategic state intervention can drive economic growth (Yülek and Akkemik, 2022; Yusof et al., 2023; Mechitov et al., 2021).

Conclusion

In summary, Singapore's transformation from a small island economy to a leader in green growth and sustainable development presents an essential paradigm. This study demonstrates that integrating economic growth with environmental sustainability is both feasible and beneficial. It provides a valuable contribution to academic and policy discourse by detailing Singapore's industrial and green policies for fostering a sustainable economy. The experience underscores the critical role of government and visionary leadership in navigating the challenges of sustainable development. The case study illustrates that targeted government policies promoting green growth and industrial innovation can yield substantial environmental and economic gains. By combining development leadership with a clear strategic vision, Singapore has set a benchmark for other economies seeking to follow a similar sustainable growth path. Recognized as one of the successful Asian Tigers of the 1980s, Singapore is well known for its successful development journey. Today, green transformation is a hot topic and offers significant opportunities, and Singapore, as an example of this successful development journey, is taking very important steps towards green transformation. Analysis of Singapore's green growth strategies, particularly the Green Plan and its participation in the carbon credit market, provides compelling evidence of the effectiveness of integrated policy approaches. These strategies contribute to global environmental goals while enhancing national competitiveness and social welfare. This multi pronged approach to development, balancing economic, environmental and social objectives, is a testament to the foresight and adaptability of Singapore's policy framework.

The paper highlights the crucial role of industrial policies that foster sustainable and green growth, contributing meaningfully to the global dialogue on sustainable development strategies. Singapore's policy innovations offer valuable insights into the feasibility and benefits of a green growth agenda, particularly for developing nations. As the world confronts the challenges of climate change and sustainable development, the Singapore model serves as an example of how strategic policy formulation can achieve positive environmental and economic results. Singapore's experience provides a roadmap for embedding sustainability in economic policy, emphasizing the importance of a coherent strategy that addresses modern development complexities in an interconnected world. However, while green policies present significant opportunities for developing countries, they also pose risks. For example, the rising market value of carbon credits may contribute to new income inequalities, creating a potential risk for equitable sustainable

development. Future research must focus on designing green growth strategies that yield fair economic outcomes, ensuring that the benefits are widely shared and that inequalities are not exacerbated. This requires exploring innovative financing models and integrating social equity into green policy design, making it essential for achieving truly sustainable development.

References

- Aghion, P., and Howitt, P. (1992). A model of growth through creative destruction. *Econometrica*, 60(2), 323–351. <https://doi.org/10.2307/2951599>
- Aiginger, K., and Rodrik, D. (2020). Rebirth of industrial policy and an agenda for the twenty-first century. *Journal of Industry, Competition and Trade*. <https://tinyurl.com/y82ujas5>
- Aksu, L. (2018). İktisadi büyüme, iktisat okullarının bakış açısı ve Türkiye. IKSAD Publications.
- Alacevich, M., and Boianovsky, M. (Eds.). (2018). The political economy of development economics: A historical perspective (Supplement). *History of Political Economy*.
- Allan, B., Lewis, J. I., and Oatley, T. (2021). Green industrial policy and the global transformation of climate politics. *Global Environmental Politics*, 21(4), 1-19.
- Ambroziak, A. A. (2017). Review of the literature on the theory of industrial policy. In *The new industrial policy of the European Union* (pp. 3-38). Springer.
- Arlı Yılmaz, S. (2014). Yeşil işler ve Türkiye'de yenilenebilir enerji alanındaki potansiyeli: Uzmanlık tezi (Seri No. 2887). T.C. Kalkınma Bakanlığı.
- Lütkenhorst, W., Vidican, G., Altenburg, T., and Pegels, A. (2014). Green industrial policy. Managing transformation under uncertainty. *Discussion Paper, No. 28/2014*. <https://www.econstor.eu/bitstream/10419/199441/1/die-dp-2014-28.pdf>
- WWF. (2022). *Living planet report 2022. Building a nature positive society* (R. E. A. Almond, M. Grooten, D. Juffe Bignoli, and T. Petersen, Eds.). WWF.
- Hansen, J., Ruedy, R., Sato, M., and Lo, K. (2010). Global surface temperature change.
- Hák, T., Janoušková, S., and Moldan, B. (2016). Sustainable development goals: A need for relevant indicators. *Ecological Indicators*, 60, 565-573. <https://doi.org/10.1016/j.ecolind.2015.08.003>
- United Nations. (2023). *The sustainable development goals report 2023: Special edition - Towards a rescue plan for people and planet*. United Nations.
- Claeys, G., Demertzis, M., and Papadia, F. (2019). Challenges ahead for the European Central Bank: Navigating in the dark? *Monetary Dialogue, September 2019*. Bruegel.
- Taxation and Customs Union. (2023). Carbon border adjustment mechanism. *European Commission*. https://taxation-customs.ec.europa.eu/carbon-border-adjustmentmechanism_en
- Borel Saladin, J. M., and Turok, I. N. (2013). The green economy: Incremental change or transformation? *Environmental Policy and Governance*, 23, 209-220. <https://doi.org/10.1002/eet.1614>
- Bowen, A. (2012). Green growth: What does it mean? The Grantham Research Institute on Climate Change and the Environment, the London School of Economics and Political Science. <https://www.lse.ac.uk/GranthamInstitute/wpcontent/uploads/2014/02/green-growth-environmental-scientist-dec12.pdf>
- Daedal Research. (2023). Global carbon credit market: Analysis by traded value, traded volume, segment, project category, region, size and trends with impact of COVID-19 and forecast up to 2028. <https://www.researchandmarkets.com/reports/5774731/global-carbon-credit-market-analysis-traded>
- Denison, E. F. (1962). The sources of economic growth in the United States and the alternatives before us. Committee for Economic Development.
- Dutta, S., Leon, L., and Wunsch-Vincen, S. (Eds.). (2023). Global innovation index 2023. www.wipo.int. <https://doi.org/10.34667/tind.46596>
- Energy Market Authority. (2023). Collaborations: Singapore Institute of Technology. <https://www.ema.gov.sg/partnerships/research-and-developmentengagements/collaborations/singapore-institute-of-technology>
- Feldman, M., Hadjimichael, T., Lanahan, L., and Kemeny, T. (2016). The logic of economic development: A definition and model for investment. *Environment and Planning C: Government and Policy*, 34(1), 5-21. <https://doi.org/10.1177/0263774X15614653>
- Fetting, C. (2020). The European green deal. ESDN Report, December 2020. ESDN Office.
- Frenken, K., and Boschma, R. A. (2007). A theoretical framework for evolutionary economic geography: Industrial dynamics and urban growth as a branching process. *Journal of Economic Geography*, 7(5), 635–649. <http://www.jstor.org/stable/26161121>
- Geels, F. W., Sovacool, B. K., Schwanen, T., and Sorrell, S. (2017). The socio-technical dynamics of low-carbon transitions. *Joule*, 1(3), 463-479. <https://doi.org/10.1016/j.joule.2017.09.018>
- Greenlaw, S. A., and Shapiro, D. (2017). Principles of microeconomics 2e. OpenStax. <https://openstax.org/books/principles-microeconomics-2e/pages/1-introduction>
- Greenwald, B., and Stiglitz, J. E. (1987). Keynesian, New Keynesian, and New Classical economics. *Oxford Economic Papers*, 39(1), 119-133. <https://www.jstor.org/stable/2663132>
- Hartwell, R. M. (1990). Was there an industrial revolution? *Social Science History*, 14(4), 567–576. <https://doi.org/10.2307/1171333>
- Johnson, C. (1982). MITI and the Japanese miracle: The growth of industrial policy, 1925-1975 (1st ed.). Stanford University Press.
- Kose, M. A., Prasad, E., Rogoff, K., and Wei, S.-J. (2010). Financial globalization and economic policies. In D. Rodrik and M. Rosenzweig (Eds.), *Handbook of development economics* (Vol. 5, pp. 4283-4359). Elsevier. <https://doi.org/10.1016/B978-0-444-52944-2.00003-3>
- Krugman, P. (1994). The myth of Asia's miracle. *Foreign Affairs*, 73(6), 62-78.
- Kuşat, N. (2013). Yeşil sürdürülebilirlik için yeşil ekonomi: Avantaj ve dezavantajları – Türkiye incelemesi. *Yaşar Üniversitesi E-Dergisi*, 8(29), 4896-4916. <https://doi.org/10.19168/jyu.81368>
- Kuznets, S. (1955). Economic growth and income inequality. *American Economic Review*, 45(1), 1-28.
- Lee Hsien Loong. (2011, October 24). Transcript of PM's speech for debate on the president's address (Document Number: 20111031008). Singapore. Ministry of Information, Communications and the Arts.
- Loiseau, E., Saikku, L., Antikainen, R., Droste, N., Hansjürgens, B., Pitkänen, K., Thomsen, M., et al. (2016). Green economy and related concepts: An overview. *Journal of Cleaner Production*, 139, 361-371.
- Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(3), 36-42.

- MAS. (2023). Monetary Authority of Singapore. <https://www.mas.gov.sg/>
- Mechitov, A. I., Moshkovich, H. M., and Grainger, M. (2021). Lee Kuan Yew's leadership lessons from developing Singapore. *International Journal of Business Strategy*, 21(1), 42-51.
- Ministry of Foreign Affairs and Trade and the New Zealand Government. (2023, August). ASEAN: Regional economic outlook market intelligence report. <https://www.mfat.govt.nz/market-reports>
- Ministry of Foreign Affairs Singapore. (2023). Voluntary national reviews 2023. www.mfa.gov.sg. <https://www.mfa.gov.sg/SINGAPORES-FOREIGN-POLICY/International-Issues/Singapore-Voluntary-National-Review>
- Ministry of Foreign Affairs. (n.d.). Singapur siyasi görünümü. <https://www.mfa.gov.tr/sub.tr.mfa?4fa9f9c9-e9e5-49b5-8592-8b869762ccb8>
- Ministry of Trade and Industry. (2024, January 2). Singapore Gross Domestic Product (GDP) fourth quarter 2023. <https://www.singstat.gov.sg/-/media/files/news/advvgdp4q2023.ashx>
- Singapore Economic Development Board. (n.d.). Singapore's economic development. <https://www.edb.gov.sg/en/our-industries/economic-overview/singaporeseconomic-development.html>
- Ministry of Education Singapore. (2019, December 3). Singapore students show well-developed thinking and reasoning skills: OECD PISA 2018 study. <https://www.moe.gov.sg/news/press-releases/20191203-singapore-students-showwell-developed-thinking-and-reasoning-skills-oecd-pisa-2018-study>
- World Economic Forum. (2015, April 22). Is education the secret to Singapore's success? <https://www.weforum.org/agenda/2015/04/is-education-the-secret-to-singaporessuccess/>
- Kozma, R. (2011). Transforming education: The power of ICT policies. UNESCO Institute for Information Technologies in Education. <https://unesdoc.unesco.org/ark:/48223/pf0000211842>
- Ferris, S. P., and Waldron, K. (2023). The educational system in Singapore. In S. P. Ferris and K. Waldron (Eds.), *Thriving in academic leadership (Surviving and thriving in academia)* (pp. 125-127). Emerald Publishing Limited. <https://doi.org/10.1108/978-1-83753-300-820231014>
- Ministry of Education, Singapore. (2024). *Overview of Singapore education system*. Ministry of Education, Singapore. https://www.moe.gov.sg/-/media/files/aboutus/overview_of_singapore_education_system.pdf
- Maradana, R. P., Pradhan, R. P., Dash, S., et al. (2017). Does innovation promote economic growth? Evidence from European countries. *Journal of Innovation and Entrepreneurship*, 6(1). <https://doi.org/10.1186/s13731-016-0061-9>
- Intellectual Property Office of Singapore. (2021). *Singapore IP strategy report 2030*. <https://www.ipos.gov.sg/docs/default-source/default-document-library/singaporeip-strategy-report-2030-18May2021.pdf>
- World Intellectual Property Organization. (2024). Innovation and intellectual property. https://www.wipo.int/ip-outreach/en/ipday/2017/innovation_and_intellectual_property.html
- Ministry of Manpower Singapore. (2023). *Labour market report third quarter 2023*. <https://www.mom.gov.sg/newsroom/press-releases/2023/1214-labour-marketreport-third-quarter-2023#:~:text=The%20labour%20market%20expanded%20in,increase%20was%20in%20growth%20sectors>
- Singstat. (2023). Economy. <https://www.singstat.gov.sg/find-data/searchby-theme?theme=economy&type=data>
- MAS. (2022). Monetary Authority of Singapore. <https://www.mas.gov.sg/>
- Doing Business 2020. (2020). World Bank. <https://documents1.worldbank.org/curated/en/688761571934946384/pdf/Doing-Business-2020-Comparing-BusinessRegulation-in-190-Economies.pdf>
- Hirschl, R. (2020). *City, state: Constitutionalism and the megacity*. Oxford University Press.
- Housing and Development Board. (2022/2023). About HDB. <https://www.hdb.gov.sg/cs/infoweb/homepage>
- KOF Globalisation Index. (2023, June 12). *KOF globalisation index – KOF Swiss Economic Institute | ETH Zurich*. <https://kof.ethz.ch/en/forecasts-and-indicators/indicators/kofglobalisation-index.html>
- Singapore Department of Statistics. (2022, January 14). Advance estimate of gross domestic product for 4th quarter 2022. <https://www.singstat.gov.sg/-/media/files/news/gdp4q2022.ashx>
- International Institute for Management Development (IMD). (2023). *World competitiveness ranking*. IMD World Competitiveness Center. <https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/>
- Singapore National Climate Change Secretariat. (2024). www.nccs.gov.sg. <https://www.nccs.gov.sg/singapores-climate-action/singapore-and-internationalefforts/>
- National Library Board Singapore. (2023). www.nlb.gov.sg. <https://www.nlb.gov.sg/main/article-detail?cmsuuiid=f4e013e3-bdf0-4590-a80b-7533a4c7ffc0>
- National Environment Agency. (2023, October 4). Singapore sets out eligibility criteria for international carbon credits under the carbon tax regime. <https://www.nea.gov.sg/media/news/news/index/singapore-sets-out-eligibilitycriteria-for-international-carbon-credits-under-the-carbon-tax-regime>
- Mun Heng, T. (2015). Singapore's economic development in the light of modern development concepts. In *Economic planning and industrial policy in the globalizing economy: Concepts, experience and prospects* (pp. 125-147).
- Petrashko, L. (2017). Industrial policy for a sustainable growth path in Ukraine. In M. Yülek (Ed.), *Industrial policy and sustainable growth* (pp. 11-1). Springer. https://doi.org/10.1007/978-981-10-3964-5_11-1
- Rebelo, S. (1991). Long-run policy analysis and long-run growth. *Journal of Political Economy*, 99(3), 500-521. <http://www.jstor.org/stable/2937740>
- Research, Innovation and Enterprise (RIE). (2020). *2025 handbook*. <https://www.nrf.gov.sg/rie-ecosystem/rie2025handbook/>
- Rodrik, D. (2014). Green industrial policy. *Oxford Review of Economic Policy*, 30(3), 469-491. https://drodrik.scholar.harvard.edu/files/dani-rodrik/files/green_industrial_policy.pdf
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5), 1002-1037. University of Chicago Press.
- Rostow, W. W. (1960). *The stages of economic growth: A non-communist manifesto*. Cambridge University Press.
- Rowthorn, R., and Wells, J. (1987). *Deindustrialization and foreign trade*. Cambridge University Press.
- Shackleton, J. R. (2013). Introduction. *Economic Affairs*, 33(2), 155-155. Wiley Blackwell.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65-94. <http://www.jstor.org/stable/1884513>
- Spencer, D. (2009). *The political economy of work* (1st ed.).

Tagliapietra, S., and Veugelers, R. (2020). A green industrial policy for Europe (Blueprint Series 31). In S. Gardner (Ed.), *Bruegel Blueprint Series*. Bruegel.

Taylor, J. E., and Lybbert, T. J. (2020). *Essentials of development economics*, third edition (3rd ed.). University of California Press. <https://doi.org/10.2307/j.ctv1503ghb>

UNEP. (2011). *Towards a green economy: Pathways to sustainable development and poverty eradication*. http://web.unep.org/greeneconomy/sites/unep.org/greeneconomy/files/field/image/green_economyreport_final_dec2011.pdf

United Nations Development Programme. (2018). *Human development reports*. <http://hdr.undp.org/en/countries/profiles/ZMB>

United Nations Development Programme. (2023). *Global Knowledge Index 2023*. https://knowledge4all.com/admin/2023/Methodology/GKI2023_Report_EN.pdf

United Nations Environment Programme. (2014). *UNEP year book: Emerging issues in our global environment*.

United Nations Industrial Development Organization. (2023). *UNIDO industrial statistics yearbook 2023*. https://www.unido.org/sites/default/files/unido-publications/2023-12/UNIDO_IndustrialStatistics_Yearbook_2023.pdf

UNSDG. (2023). <https://unstats.un.org/sdgs/dataportal/countryprofiles/SGP>

Yusof, A. M. M., Jaes, L., and Razali, N. A. (2023). Paternalistic leadership Lee Kuan Yew on Singapore developmental state. *AIP Conference Proceedings*, 2827(1), 030022.

Yülek, M. (1991). *Singapur. Devlet Planlama Teşkilat Yayını*.

Yülek, M. (1998). *Asya kaplanları: Sanayi politikaları ve kalkınma*. Alfa Yayınları.

Yülek, M. (2018). *How nations succeed: Manufacturing, trade, industrial policy, and economic development*. Palgrave MacMillan.

Yülek, M. A. (2017). On the middle income trap, the industrialization process and appropriate industrial policy. *Journal of Industry, Competition and Trade*, 17, 325-348.

Yülek, M. A., and Akkemik, K. A. (2022). The developmental leader. *Asia Pacific Economic Literature*, 36, 3-16. <https://doi.org/10.1111/apel.12364>

Yülek, M., and Gür, N. (2017). Foreign direct investment, smart policies, and economic growth. *Progress in Development Studies*, 17(3), 1-12.

<https://doi.org/10.1177/1464993417713272>