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Industrial Policy in Indonesia: A quantitative analysis of Indonesia's nickel export ban

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Master in Economics

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Resumo

Nos últimos anos, a transição energética global desencadeou debates intensos nos países em desenvolvimento. Neste contexto, a Indonésia, o quarto país mais populoso do mundo e membro do G20, implementou uma série de políticas industriais. Embora a política industrial não seja uma novidade na Indonésia, desde a última década que a intervenção do Estado se tem centrado nos recursos naturais e no seu papel no mercado global, bem como na sua importância para a transição energética.

Esta tese analisa as consequências da proibição da exportação de níquel pela Indonésia, um metal crucial para as baterias dos veículos elétricos e parte integrante da transição energética. Analisando um conjunto de dados de séries temporais compreendidas entre 1989 e 2021, recolhidos do World Bank e da FRED, os resultados da regressão linear múltipla mostram que a exportação de níquel tem uma correlação ligeiramente positiva com a taxa de crescimento do PIB e que os anos da proibição de exportação ainda não apresentam qualquer significado estatístico. Dado que este comportamento de "nacionalismo de recursos" é relativamente recente, irá oferecer oportunidades de investigação para os próximos anos.

Classificação JEL:

O25 - Política industrial

O53 - Economia da Ásia e Médio Oriente

Palavras-Chave:

Indonésia, Política industrial, Proibição de exportação, Níquel, Economias em desenvolvimento

Abstract

In recent years, the global energy transition has triggered intense debates in developing countries. In this context, Indonesia, the world's fourth most populous country and member of the G20, has implemented a series of industrial policies. Although industrial policy is not new to Indonesia, since the past decade, state intervention has focussed on the natural resources and their role in the global market as well as their importance for energy transition.

This thesis delves into the consequences of Indonesia's export ban on nickel, a metal crucial for electric vehicle batteries and integral to the green transition. Analysing a time series dataset comprised between 1989 and 2021 gathered from the World Bank and FRED, the results of the multiple linear regression show, that nickel export has a slightly positive correlation with the GDP growth rate and the years of the export ban do not show any statistical significance yet. Given that this behaviour of “resource nationalism” is relatively recent, it gives opportunities for research in the upcoming years.

JEL Classification:

O25 - Industrial Policy

O53 - Economy of Asia and the Middle East

Keywords:

Indonesia, Industrial Policy, Export Ban, Nickel, Developing Economies

Acronyms

BGS - British Geological Survey

BLUE - Best Linear Unbiased Estimator

BRICS - Brazil, Russia, India, China, South Africa

EV - electric vehicle

FRED - Federal Reserve Economic Data

GATT - General Agreement on Tariffs and Trade

GDP - Gross Domestic Product

IMF - International Monetary Fund

OECD - Organisation for Economic Co-operation and Development

OLS - Ordinary Least Squares

OPEC - Organization of the Petroleum Exporting Countries

R&D - Research and Development

RIPIN - National Industry Development Master Plan

RPJMN - National Medium-Term Plan

UGS - U.S. Geological Survey

USD - United States Dollar

VIF - Variance Inflation Factor

VOC - Dutch East India Company (Dutch: Verenigde Oostindische Compagnie)

WITS - World Integrated Trade Solution

WTO - World Trade Organization

Index

Index of Tables

Index of Figures

Index of Equations

1. Introduction

In recent years, the global importance of energy transition has sparked intense debates, with developing countries at its core. Among these countries, Indonesia, the fourth most populous country in the world, has become crucial in these discussions. Thanks to its abundant natural resources, Indonesia plays a significant role on the international stage.

This Southeast Asian archipelago, a member of the G20 and currently the 16th largest global economy, has a complex historical background. From its colonial past to its participation in the East Asian miracle and subsequent shifts toward more liberal economic policies, Indonesia has undergone transformative changes over the years.

Recently, industrial policy has gained importance once again in Indonesia's development strategy. The government has implemented policies aimed at stimulating economic growth, with a particular focus on the downstream industry, meaning transforming the raw material into a value-added end product. One notable policy revolves around nickel; a metal which has gained immense importance due to its role in the energy transition. Nickel is a vital component in electric vehicle (EV) batteries, and therefore in high demand in the global market.

Indonesia has also taken a bold step by imposing an export ban on nickel. This decision, while rooted in the country's industrial policy, has had significant consequences for the global nickel market. The export ban was issued with the intention of encouraging economic growth through the development of downstream industries.

As the demand for nickel continues to rise, together with the need for EV batteries in the global shift towards sustainable energy, Indonesia's policy decisions on this matter are being closely watched. The country's stance on nickel exports not only reflects its commitment to industrial development but also underscores its role as a key player in the global energy transition. Hence, Indonesia's strategic position and policy choices will shape the future landscape of the international nickel market and the broader discussions surrounding the energy transition.

This thesis is an attempt to dive into possible consequences of the export ban on the economic growth of Indonesia. To do so, various factors explored in economic growth studies were selected, with a specific emphasis on nickel exports, to explain the Gross Domestic Product (GDP) growth rate. Data spanning from 1989 until 2021 will be analysed employing econometric methods to evaluate the effects of recent export prohibitions and their connections

with GDP growth. Its purpose is to determine the influence of this extreme form of state intervention, together with other macroeconomic variables such as inflation and interest rate on Indonesia's economic development.

The literature review covers topics related to the green transition, industrial policy, and investigates the opportunities that arise for developing countries within the framework of these policies. The historical context starts with the pre-independence era under Dutch colonial rule, then delving into Sukarno's "Old Order" and Suharto's "New Order," highlighting some policies which have influenced Indonesia's industrial trajectory. The chapter further explores the challenges posed by events like the Asian Financial Crisis and the Global Financial Crisis.

Additionally, the literature review examines the recent renaissance of industrial policies in Indonesia, reflecting Indonesia's response to current economic demands and its positioning in the global industrial landscape. A specific focus is given to Indonesia's nickel industry and the consequential export bans, offering insights into the nation's role in the emerging global electric vehicle market.

The proposed method is a quantitative study, which aims to evaluate the impact on economic growth, as presented in Chapter 3. This chapter describes the foundations, limitations, and estimation of the model - facilitating hypothesis testing regarding the effects of nickel export, its subsequent ban, and other macroeconomic variables on Indonesia's GDP growth rate. This is done so through a multiple linear regression with GDP growth rate as the dependent variable and nickel export, foreign direct investment, inflation, real effective exchange rate, real interest rate, and trade to GDP, as the explanatory factors. The data is arranged in a time series setting for the period from 1989 until 2021. The model is estimated through the Ordinary Least Squares (OLS) technique with robust estimators to account for some identified autocorrelation.

Chapter 4 presents the research findings and summarizes the main conclusions from the model estimations conducted in Chapter 3. Furthermore, it lays the groundwork for future research opportunities.

2. Literature review

2.1 Topic on green transition, industrial policies, and opportunities for developing countries

2.1.1 Energy transition and renewable energy development

The term “Energy transition” describes the switch from traditional fossil fuel energy towards renewable energy sources such as wind, solar, and hydroelectric power. According to La Camera, et al. (2021), it is a crucial enabler of sustainable development and climate resilience. Forward-looking actions will create jobs, push for growth, and gain social and health benefits.

As the energy system is the largest contributor to the world's greenhouse gas emissions, decarbonization is key to limiting global warming to 2°C (Kraan et al., 2019). Therefore, transition is driven by the desire to cut these emissions and, simultaneously, decrease the dependence on non-renewable and exhaustible fossil fuels.

The initial stages of renewable energy development can be traced back to various events. The late 19th and early 20th centuries saw the emergence of hydropower, which facilitated the supply of electricity to local communities (Fasol, 2002). Wind turbines were first introduced in 1977 in the USA and in 1978 in Denmark (Gipe & Möllerström, 2022), and a significant breakthrough came in 1982 with the construction of the first solar energy plant in California, which could generate heat and electricity (Friefeld, et al, 1982). Finally, in the 1980s and 1990s, countries like Germany, Sweden, the Netherlands, and the United States began implementing government policies to support the use of renewable energy, with early policies including feed-in tariffs, tax incentives, and renewable energy targets (Gan, et al., 2007). Figure 1 describes the most important milestones in green electricity policy in Germany, The Netherlands, Sweden, and the USA.

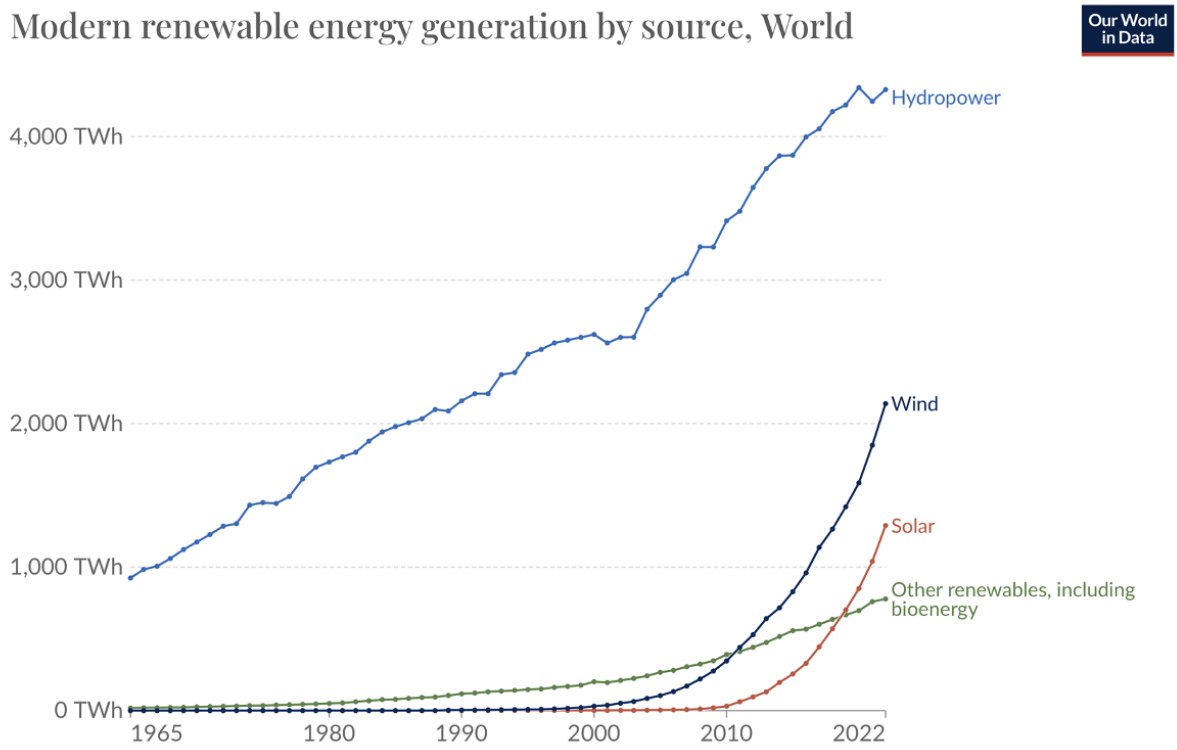
Germany	
1974	Start of R&D programs
70s and 80s	Technological support (esp. wind technology)
	Industrial development (esp. wind sector)
80s and 90s	Changing public opinion in favour of renewables and against nuclear
1991	Feed-in-Law (StrEG)
2000	Renewable Energy Act (EEG) (update of StrEG)
2001	Biomass Law (closely linked to EEG)
2004	EEG mandate
The Netherlands	
70s	RD&D policies, industrial development, especially wind and solar
80s	Investor subsidies and demonstration projects
Early 90s	New momentum: CO_2 targets
Early 90s	Voluntary agreements between the government and energy distribution sector
1996	Regulatory energy tax (consumption stimulation)
1998	Introduction of voluntary green label system
2001	Liberalization of the energy market and introduction of green certificate system
2003	Introduction of environmental quality of electricity production (MEP), focusing on production stimulation
Sweden	
1975	First energy research program (including renewables)
1991	Energy policy guidelines adopted by the parliament (a.o. introduction of direct investment subsidies for wind and biofuels and of environmental taxation)
1996	Liberalization of the energy market
1997	Energy act (extension of research program and subsidy measures)
2002	Approval of the green certificate scheme by parliament
	Elimination of investment subsidies
2003	Introduction of the green certificate system (based on obligated quotas)
USA	
1978	Start with restructuring of the electricity market (PURPA)
1992	Federal renewable energy production incentive (production tax credit) as part of the Energy Policy Act
90s-ongoing	Wide range of financial incentives, rules and regulation and voluntary measures applied by state or local governments
2003-ongoing	Adoption of RPS (state level)

Table 1: Milestones in green electricity policy and market in Germany, The Netherlands, Sweden, and the USA (Source: Gan, et al., 2007)

Today, renewable energy technologies continue having a significant influence on the global energy paradigm as they generate innovative strategies for environmental sustainability. Currently, solar energy has been put into practice by the remarkable efforts of some countries, where significant investment has gone into the production and deployment of solar panels - resulting in a substantial increase in global solar capacity (de Castro & Capellán-Pérez, 2018).

At the same time, wind energy is produced through offshore wind farms, such as the Hornsea Wind Farm in the United Kingdom (Dawid, 2019). Promising sites for large-scale offshore wind farms have also been identified in the United States (Beiter et al., 2017) and China (Yang, et al., 2017). These regions feature extensive marine areas which offer optimal wind conditions for the use of wind energy.

Graph 1 represents the breakdown of global energy production by renewable source - hydropower, solar, wind, and other renewables, including bioenergy. Hydropower is by far the largest modern renewable source. Also, wind and solar power are growing rapidly (Ritchie, et al., 2020).



Graph 1: Modern renewable energy generation by source, World. (Data source: Ember's Yearly Electricity Data; Ember's European Electricity Review; Energy Institute Statistical Review of World Energy)

As renewable energy production increases, so does its use. In terms of energy use, EVs created a shift in transportations; countries like Norway emerged as pioneers in implementing benefits such as tax incentives, the establishment of dedicated charging infrastructures, and exemption from roadway tolls (Mersky, et al., 2016).

Finally, hydrogen serves as a zero-carbon energy carrier, balancing electricity, and can be easily stored and transported. Early-mover Japanese companies, such as Honda, Toyota and South-Korean Hyundai, have launched the first mass-produced hydrogen fuel cell vehicles and are beginning to see lucrative export opportunities (Staffell, et al., 2019).

2.1.2 Industrial policies

The concept of industrial policy comes into a set of debates and has been defined in various ways by economists and institutions. According to the World Bank (1993), industrial policy refers to "government efforts to alter the industrial structure to promote productivity-based growth," while Curzon Price (1981) defines it as "any government measure to promote or prevent structural change," including measures related to international trade. Tijaja & Faisal (2014) characterize it as a non-neutral government intervention intended to improve market signals and direct resource allocation toward specific industries which shall benefit the economy in the long run.

For Rodrik (2014), industrial policies are crucial for realizing green growth and have numerous benefits for nations, including increased competitiveness in global markets, higher wages, and enhanced prestige; the main objective of industrial policy is to promote structural change for a better societal outcome.

2.1.3 Opportunities for developing countries

One of the opportunities energy transition brings to developing countries is the generation of a “good jobs economy” (Rodrik & Sabel, 2019) as it demands highly skilled jobs in engineering, manufacturing, and tech. This encourages and attracts foreign investment into green sectors.

According to the OECD 2012b report, several emerging economies and developing countries, including China, Brazil, Ethiopia, Indonesia, Tunisia, Mexico, and Morocco, have achieved remarkable success in creating new export sectors focused on green products. These countries have effectively implemented specific industrial policies to foster the development of sectors with environmentally friendly attributes.

China, for instance, has taken significant steps in promoting green growth and environmental sustainability. The country has actively subsidized the transition from traditional internal combustion engines to EVs, positioning itself as a global leader in the EV market. Through a comprehensive support package, including subsidies and regulations, China has substantially reduced the costs of EVs and batteries, making them more accessible to the public. Moreover, China has become a dominant player in the photovoltaic solar industry, with remarkable growth in photovoltaic cell production. The country's strategic approach involves innovative policies such as pollution taxes and support for pollution control spending,

exemplified by Barde et al. (2009), demonstrating China's commitment to curbing environmental degradation and increasing its national competitiveness (Altenburg, et al., 2017).

Brazil's strategic ethanol policies, as highlighted by Da Motta Veiga and Rios (2017), have significantly reshaped the country's energy matrix, promoting sustainability. With over 15% of Brazil's energy derived from sugarcane, these initiatives have yielded a favourable balance of greenhouse gas emissions compared to traditional fuels.

In 2011, Morocco heavily relied on imported coal, gas, and electricity for 95% of its energy needs. However, significant strides have been made since then, with nearly a third of the country's energy now coming from domestic renewable sources, according to its government. Morocco's ambitious efforts included the construction of Africa's largest solar power facility, the Ouarzazate Solar Complex. Apart from advancing Morocco's renewable energy sector, this solar plant is also bolstering the local economy (Vidican Auktor, 2017).

After briefly reviewing these experiences, this exploration now turns to the case of Indonesia, a country abundant in resources, mirroring the profiles of the nations discussed earlier. This thesis delves into the prospects for Indonesia, a developing nation endowed with abundant resources, and examines the pivotal role they play in the country's economic development.

2.2 Brief history of Indonesia

2.2.1 Before independence, under Dutch colonial rule

In the late 16th century, the Dutch East India Company (VOC) began colonizing Java, which led to Dutch colonialism in Indonesia; after its bankruptcy in 1796, the Dutch government took control of the territory, known as the Netherlands East Indies (Kian, 2008). The Dutch focused on exploiting Indonesia's natural resources, such minerals, and several agricultural products, which contribute significantly to the country's GDP today.

Later, during the 19th century, the agricultural sector kept paramount, as the Dutch exported rubber, coffee, tea, and tobacco (Ziltener & Künzler, 2013) and a significant share of Indonesians households were recruited to grow cash crops under the so-called Cultivation System (Bosma & van Leeuwen, 2022). During the same time, the Outer Islands[1] constituted 30% of Indonesia's exports, with about 60% consisting of sugar and coffee, produced in Java.

In the early 20th century, smallholders in Sumatra joined the rubber boom and some Eastern regions of the archipelago participated in the copra cultivation boom (Bosma & van Leeuwen, 2022). Those were the beginnings of Indonesia becoming the world's largest copra exporter (Asba et al., 2020; WITS, 2021) and the second largest exporter of rubber - to this day (Statista, 2022). From 1800 to 1942, Indonesia's economy relied heavily on exporting these commodities, as well as coffee and sugar (Knight, 2013).

During Dutch colonization, there is limited data on Indonesia's GDP, and available figures are segmented across various regions. Table 2 gives some indications of GDP by sector, starting from 1870 until 1930. Throughout the period, the share of agriculture was consistently predominant in the economy, contributing 68.5% of the total GDP in 1870 and 61.1% in 1930. Meanwhile, the industrial sector gradually expanded its contribution from 11.5% in 1870 to 16% in 1930. The services sector grew slightly, increasing from 20% of the GDP in 1870 to 23% in 1930 (Bosma & van Leeuwen, 2022).

[1] Geographically, Indonesia spans over 17,000 islands, including Sumatra in the west, Java, Bali, Lombok, and Timor in the south, parts of Borneo and Sulawesi in the central north, and New Guinea in the east. Among others, North and Central Sulawesi, Maluku, Aceh, and East Kalimantan are forming the Outer Islands.

	GDP	Agriculture	Industry	Services
1870	2262	1549	260	453
1890	2653	1805	295	554
1905	3466	2349	403	714
1920	4980	3188	677	1115
1930	6495	3966	1040	1489

Table 2: GDP by sector in 1930 constant prices (million guilders). (Source: Bosma & van Leeuwen, 2022)

2.2.2 Sukarno's "Old Order"

In the early years after gaining independence in 1949, Indonesia's economy, under the "Old Order" of President Sukarno, relied heavily on agriculture and raw material production, with rice, rubber, coffee, tea, palm oil, timber, and coal playing a crucial role (Martin & Warr, 1993). Agriculture constituted over 50% of Indonesia's non-oil GDP and employed nearly 70% of the workforce, contributing significantly to the nation's economic stability (Puspitawati, 2021). At the same time, Indonesia faced political and economic challenges, notably due to Dutch attempts to re-occupy the country which resulted in high military expenditures (Booth, 2010).

The manufacturing sector was largely under foreign ownership. This led President Sukarno to implement policies promoting local industries (van der Kroef, 1960), as well to nationalize a set of old Dutch companies (Redfern, 2010). His aim was to reduce the influence of foreign economic power and establish a robust domestic manufacturing base (Ismanto, 2017), and adopt an infant industry protection approach (Widodo, 2008). President Sukarno played a pivotal role in shaping industrial strategies, emphasizing the significance of State-Owned Enterprises in manufacturing (Kuncoro, 2007). These enterprises received substantial government support, including bank credit, subsidies, and foreign exchange.

In the 1960s, inflation soared to unprecedented levels, reaching 306% in 1965 and 1136% in 1966 (see World Bank data[2]) due to misguided economic policies, excessive government spending, and political instability (Tomasson, 1970; Suryadinata, 1976).

This, together with decreasing exports, caused a rapid economic decline. Earnings from the country's plantation sector dropped from USD $442 million in 1958 to USD $330 million in 1966, leading to a significant decrease in per capita incomes (Hill, 2000).

Amidst this crisis, Sukarno's support, especially among the middle and upper-middle-class Indonesians, dwindled. This provided an opening for the incoming government, known as the "New Order", to take corrective measures.

2.2.3 Suharto's "New Order"

From 1966 to 1996, under the "New Order" of President Suharto, Indonesia witnessed a remarkable economic transformation, achieving sustained growth averaging around 7% annually and earning recognition as part of the 'East Asian miracle' (Jomo, et al., 1997). President Suharto's government pursued policies which modernized the economy and attracted substantial foreign investments (Haggard & Maxfield, 1996). Central to these initiatives were the promotion of exports and the liberalization of trade and investment, effectively curbing hyperinflation down to 4.2% in 1971 (Grenville, 1981; World Bank data). In the late 60s, agriculturally based development and import substitution were driving the economy (Puspitawati, 2021).

In the beginning of Suharto's term, he focused on enhancing living standards, especially in urban areas where potential political dissent emerged (Suryadinata, 1976). Simultaneously, the government implemented significant economic reforms and stabilization measures with the backing of the IMF and World Bank. These reforms involved lifting restrictions on trade and capital flows, attracting increased foreign investments and aid inflows. Consequently, the economy rapidly soared, achieving significant growth hitting 10.9% GDP growth rate in 1968 (World Bank). To keep prices stable, Suharto adopted a balanced-budget strategy (Thee, 2002; Hossain, 2005).

Partly thanks to the oil boom, the economy was flourishing in the late 1960s, reaching its peak of 10.9% GDP growth in 1968 (World Bank data). During this period, the role of the national energy company Pertamina was central to the management of the country's fossil-fuel

[2] https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=ID

resource wealth (Beaton & Lontoh, 2010). In 1973/1974, a surge in oil prices occurred due to OPEC's decision to raise oil prices four-fold by reducing their collective oil exports. Indonesia being a member of the international oil cartel was also affected by this decision and benefitted from this first oil boom. The second oil boom in 1979/1980 triggered by the temporary shutdown of Iran's oil industry - Iran being OPEC's second-largest oil producer and exporter following Saudi Arabia - had a significant impact on global oil prices due to the closure (Thee, 2012). 70% of the Indonesian total revenues in 1980 were contributed by the oil industry (Prawiro, 1998; Ismanto, 2017).

In the 1970s to early 1980s protectionist policies led to the stabilization of the country's macroeconomic situation, coinciding with the oil boom, and paving the way for economic growth (Yağci & Ardiani, 2018). During this period, state-owned enterprises played a significant role in advancing industrialization and investing in technology.

The decline in oil prices and the slowdown in economic growth between 1982 and 1986 contributed to a shift in the economic approach. It led to a higher degree of liberalization and openness of the economy. These deregulatory measures included reductions in both tariff and non-tariff barriers, liberalization of foreign investment regulations, and financial sector reforms. Consequently, the industrial sector was reoriented to become export oriented (Puspitawati, 2021). In 1985, Indonesia implemented changes in trade policies. The rapid expansion of exports played a crucial role in driving Indonesia's substantial GDP growth rate averaging 6.5% (World Bank data) during the late 1980s and 1990s (Anas, 2012).

According to Habermeier (2007), during the years preceding the Asian Financial Crisis, Indonesia had maintained a steady focus on stability in its macroeconomic policies. Inflation remained between 6% and 10% annually, and the economy consistently grew at an average rate of 7% per year. This positive trend was bolstered by a supportive fiscal policy, a steady rupiah exchange rate, and substantial capital inflows.

Table 3 summarizes the policies implemented during Sukarno’s “Old Order” and Suharto’s “New Order”.

Policies of the "Old Order"	Policies of the "New Order"
• Protectionist measures: Implemented high tariffs and import quotas to support local industries (van der Kroef, 1960). • Nationalization initiatives: Nationalized key sectors like oil, minerals, and agriculture to prevent foreign dominance (Gellert, 2010). • Export diversification: Engaged in the export of rubber, petroleum, and sugar commodities (Knutson, et al., 2006; Gellert, 2010). • Attracting foreign investment: Provided tax incentives and subsidies to lure foreign investments in specific industries (Wells, 2001). • State-Owned Enterprises focus: Emphasized State-Owned Enterprises in the manufacturing sector (Kuncoro, 2007). • Industrial strategy development: Involved in privatization and developed strategic plans for industries (Puspitawati, 2021).	• Import substitution: Prioritized domestic production to reduce reliance on imports (Puspitawati, 2021). • Shift to export-oriented policies: Encouraged foreign investment and trade liberalization (Hill, 1994; Haggard & Maxfield, 1996). • Balanced budget strategy: Implemented to stabilize prices and ensure economic stability (Hossain, 2005; Thee, 2002). • Diversified economic approach: Emphasized labor-intensive industries, technological mastery in key sectors, and liberal trade policies (Puspitawati, 2021). • Investment in technology: Focused on technological advancements, particularly in aircraft and shipping sectors (Hill & Narjoko, 2010). • Liberalized trade policy: Enacted through the 1967 Foreign Investment Law, providing incentives and easing access to raw materials and capital goods (Yağci & Ardiani, 2018).

Table 3: Policies during "Old Order" and "New Order" (Source: Own elaboration)

2.2.4 Asian Financial Crisis and its aftermath

The Asian Financial Crisis hit Indonesia hard. Economic shocks caused high inflation, which made the economic performance of various sectors shrink, causing bankruptcies and enormous unemployment. Increased food prices doubled the poverty rate (Hill, 2021), reaching 33% by the end of 1998 (Suryahadi, et al., 2003). These issues resulted in a political tumult and forced Suharto's authoritarian-centralized regime to resign. By 1998, the growth rate of Indonesia hit a record low of -13.1%, while the lending interest rate reached 32.2% - making it impossible to borrow money (Bazzi, et al., 2012).

The government asked for financial aid from the IMF and the World Bank, which granted Indonesia financial help under the condition of going through a structural adjustment program. The goal was to achieve a liberal economy with price liberalization, privatization, banking reform, and decentralization (Wei, 1997).

A series of policies was implemented that aimed at restructuring the economy and fostering sustainable growth. These policies included comprehensive reforms within the finance industry to enhance government transparency, and initiatives to support small and medium-sized enterprises[3]. By early 1999, Indonesia started to emerge from the Crisis, with gradual restoration of macroeconomic stability (Thee, 2002). These measures paved the way for economic recovery, with growth rebounding to almost 5% in 2000. Over the period from 2000 to 2005, the country achieved an average growth rate of 4.7%, reflecting the effectiveness of the implemented policies, as well the rise of commodity prices (Hill & Shiraishi, 2007).

During the Crisis, Indonesia maintained an open economy and pursued further liberalization under IMF conditions. This policy success bolstered the economy's resilience in the aftermath. Post-Crisis recovery depended on the export sector's growth, which held political influence and resisted protectionist measures. Indonesia actively engaged in trade agreements, including the WTO and the Association of South-East Asian Nations Free Trade Agreement, shaping its trade policy landscape (Hill & Shiraishi, 2007).

Following Suharto's resignation, the country faced changes in political leadership. First, Vice President Habibie took office, pushing for gradual economic recovery. Habibie was succeeded by President Wahid in October 1999, followed by President Megawati in 2001. Finally, the first democratically elected president, Susilo Bambang Yudhoyono, assumed office

[3] See letter of the government of Indonesia to IMF: https://www.imf.org/external/np/loi/1999/051499.htm

in 2004 (Ito, 2007). Yudhoyono's policy orientation turned to accelerating economic growth, poverty reduction and job creation through proactive fiscal policies, government expenditures on national welfare such as education and health, and promotion of investment through infrastructural development (Hill & Shiraishi, 2007).

2.2.5 Global Financial Crisis and beyond

The 2007/2008 Financial Crisis affected Indonesia less than its peers. However, exports to other Asian countries and advanced economies declined, triggering a dip in 2009 (World Bank data). Altogether, the economy still had a positive growth rate of 4.6% in 2009, displaying a more resilient response than some of its neighbours (Resosudarmo & Yusuf, 2009). As comparison, Thailand and Malaysia had a negative growth rate during that year (World Bank data).

In this time, industrial policies were geared towards promoting export-oriented and domestic value-added policies. The aim was to leverage natural resources, boost employment opportunities and encourage participation by small and medium-sized enterprises (Yağci & Ardiani, 2018). Reasons for Indonesia's relatively good economic performance, despite the global circumstances, were thanks to a healthier banking sector and corporates, stable consumer prices, sound public finances, cautious policies, and low debt levels, while small refinancing needs allowed them to react quickly through monetary and fiscal policies (Thee, 2012).

Today, Indonesia is not as developed as the Asian Tigers. Indonesia struggles with over-reliance on volatile income stemming from natural resources like oil and gas, mismanagement, and inefficient utilization of the resource's revenue (Brunnschweiler, 2008; Guan, et al., 2021). Insufficient investment in education and human capital development, especially in rural areas, creates a shortage of skilled workers, hindering competitiveness (Bawono, 2021). Moreover, Indonesia falls behind in technology and R&D investment, unlike its rapidly growing Asian counterparts. As a comparison, South Korea invested steadily and increasingly in the last 20 years in R&D reaching its highest point in 2020 with 4.81% of its GDP (World Bank, 2022). Little to almost no data is to be found regarding investment in R&D in Indonesia (World Bank, 2022) and only 0.28% of its GDP has been invested in 2020.

2.2.6 Revival of industrial policies

In recent years, the Indonesian government had a revival of industrial policies and has adopted an interventionist approach. From 2010 onwards, several policies were issued to address global economic downturn. To reinforce national competitiveness, the government aimed to improve the investment climate and accelerate infrastructure development. The following paragraphs of this section highlight some examples.

In 2014, Indonesia published its new Trade Law which grants more authority to limit imports and exports to safeguard the domestic industry (Tijaja & Faisal, 2014). The Deputy Trade Minister emphasized that this new trade law highlights Indonesia's position of not fully embracing an unrestricted free market. He also noted that the government has the power to intervene when necessary to safeguard its citizens and that their goal is to attain equilibrium between market efficiency and protecting the interests of local stakeholders (Tijaja & Faisal, 2014; Alford, 2014; Moestafa & Sumarwan, 2014).

In 2015, Jokowi increased subsidies to transport fuels. This resulted in USD $15.6 billion in savings, and at the same time, an increase in investment in social and welfare programs, as well as various infrastructure projects. The redistribution of fuel subsidies has been a significant advancement in enhancing the utilization of public funds (Pradiptyo, et al., 2016).

Finally, in 2018, the government introduced the Making Indonesia 4.0 Program, which foresees the adoption of advanced technologies such as artificial intelligence, the Internet of Things, and robotics to create high-skilled jobs and boost economic growth. This plan aims to increase the competitiveness of the manufacturing industry (Hidayatnoa, Destyantob & Hulu, 2019).

The resurgence of industrial policies has become a trend in developing economies and Indonesia has implemented several policies related to its natural resources. This present thesis specifically concentrates on the nickel industry and delves into the export ban associated with it, a topic that will be explored in the following section.

2.3 Nickel & the electric vehicles industry in Indonesia

The discovery of nickel ore dates to 1901 and was first found in the Verbeek Mountains of Sulawesi, then known as the Dutch East Indies. Additional deposits were found in the Kolaka Regency in 1909. Nowadays, Indonesia is the top producer of nickel worldwide, with an estimated production of 1.6 million metric tons, representing up to a 37% share of global nickel mine production in 2021, and owning the world's largest nickel reserves amounting to 21 million metric tons (Statista, 2022).

Nickel is a versatile metal with a wide range of applications, including its use in stainless steel production, batteries, and various other industrial processes. Stainless steel is essential in construction, automotive manufacturing, and the aerospace industry due to its corrosion resistance and strength; hence nickel is a significant product in infrastructure and technology (Zhu, et al., 2021). Indonesia's rich nickel deposits have positioned it as a crucial player in the global energy transition. Nickel is essential for next-gen batteries, serving as a cathode material in lithium-ion batteries (Yao, et al., 2021). Amid this, Indonesia has implemented specific policies regarding nickel.

The Master Plan of National Industry Development, RIPIN, for 2015-2035, has emphasized the transition to EVs as a crucial element and identified its production as the primary industrial objective. Within the RPJMN plan for 2020-2024, a roadmap is provided to foster the adoption of EVs in the country. This transition aims to develop the export and domestic market, particularly for two-wheel vehicles, which represent 70% of households who own vehicles (World Economic Forum, 2023).

Despite the natural endowment of this ore, locally the required technological expertise for battery production is still lacking and the country presents a low willingness to pay and awareness of low-carbon lifestyles (Sambodo, et al., 2022). This situation creates opportunities for collaboration with established international battery industries through investment schemes and partnerships with other countries that can overcome these limitations.

Some nickel-rich regions in Indonesia, such as North Maluku and Sulawesi have experienced economic growth. North Maluku reached a growth of 23.89% having the highest growth within the whole country (Runtunuwu & Karim, 2023), and Central Sulawesi had grown to 15.17% in 2022 (Ladjin, et al., 2023). These impressive growth rates stem mainly from nickel mining activities. President Jokowi claims that this outstanding performance, in the referred regions, goes beyond exporting the raw commodity and it can be attributed to the downstream nickel industry (Naryono, 2023). That means that raw material is processed locally and refined

into higher-value nickel products like nickel pig iron and nickel matte (Ramadhan & Muchtar, 2023).

Lately, nickel has been under the spotlight for its importance in the energy transition, which has prompted Indonesia to ban exports (Pandyaswargo, et al., 2021). The main goal is to increase the added value of the exports by transforming it into an end product. The global supply and demand for nickel exhibit significant variations, and various countries recognized it as a strategic mineral: China included it in its list of 24 strategic minerals in 2016 (Andersson, 2020), the British Geological Survey (BGS) added nickel to its list of risky minerals in 2017 (Brown, 2018) and the United States officially designated nickel as a key mineral in February 2022 (U.S. Geological Survey, 2022).

2.3.1 The export bans

Indonesia has implemented several bans on the export of nickel ore and embraced, what can be called resource nationalism (Warburton, 2017). The first ban was initiated in 2014, despite being planned in 2009 with the mining law. Mining companies were forced to process and refine ores within the country before export, aiming to increase the added value of mineral commodities (Lederer, 2016).

In 2020, another ban was issued. It aimed to promote the domestic EV industry and attract foreign investors to relocate their manufacturing operations to the country (Pandyaswargo, et al., 2021). The goal of this policy was to keep and benefit from a larger supply chain within its borders, generating employment and promoting complementary industries and services.

Under the current energy transition paradigm, the demand for nickel is expected to grow, which raises concerns about a potential shortage of nickel resources (De Koning, et al., 2018). Hence, these policies were not received without some reactions. The 2020 ban overlapped with the COVID-19 Crisis, so the Indonesian Nickel Miners Association called on the government to lift the export ban because local ore producers were experiencing reduced earnings and profitability. However, the government rejected this request (Sappor, 2020).

Another domestic reaction took the form of a violent protest by nickel smelter workers of the Chinese ferronickel manufacturer Jiangsu Delong Nickel Industry Co Ltd. based in Sulawesi (Pandyaswargo, et al., 2021).

To respond to the global shortage due to the nickel export ban, the European Union initiated legal action against it. The EU claimed that Indonesia violated Article XI of the

General Agreement on Tariffs and Trade (GATT), which pertains to restrictions on imports and exports. This ban has adversely affected the European steel industry, as it has restricted their access to essential mineral ores, including nickel, iron ore, and chromium. In this dispute over the ban, the EU was found to be in the right by the WTO (European Commission, 2022).

The earlier ban in 2014, is considered to have spurred foreign direct investment, as over 50 smelter projects were planned (Sambijantoro, 2014). Policies led by Indonesia reflect a broader trend among developing countries seeking greater control over the extraction of natural resources (Kean, 2014). The full effect of Indonesia's mineral export ban on the global economy may have been offset by alternative sources of raw materials supplied by other countries. Following the ban in Indonesia, bauxite production in Malaysia and nickel ore production in the Philippines increased dramatically owing to demand from China (Jensen & Burton, 2014; Rusmana, 2015).

The bans have created opportunities for domestic companies to invest in nickel processing and smelting facilities as planned by Jokowi with his downstream approach. Foreign investment was attracted since international companies such as the German BASF and the Japanese Mitsui Sumitomo established nickel processing facilities in Indonesia. Moreover, South Korean carmaker Hyundai started building electric cars on the archipelago and Jokowi is in a negotiation phase with Tesla's CEO about opening a factory[4][5].

According to Schröder & Iwasaki (2023), in the EV sector, Indonesia's attempts to foster domestic industrialization have yielded mixed results. While the country encourages smelting and downstream processing, its policies lack stringent mandates for localized EV battery production. Chinese and Korean firms have invested in smelting operations in alignment with Indonesia's policy, but integrated battery projects do not fully meet the policy's requirements. Lead companies such as CATL and Hyundai maintain control over localization decisions, suggesting that Indonesia's success in attracting investments into the EV battery sector is more influenced by these firms' strategies than the nation's resource policy (Natsuda & Thoburn, 2020).

These debates around nickel and its ban, combined with the novelty of this resource nationalism strategy of Indonesia, inspired the focus of this thesis. Therefore, the purpose of the next chapter is to analyse the impact of the nickel export and its ban on the GDP growth rate, applying a quantitative method which will be explained in the following section.

[4] https://www.reuters.com/business/autos-transportation/tesla-nears-deal-build-production-facilities-indonesia-bloomberg-news-2023-01-11/
[5] https://www.eastasiaforum.org/2023/10/10/when-will-tesla-make-a-move-in-indonesia/

3. The model

3.1 Foundations

The goal of the model is to study Indonesia's economic growth from 1989 to 2021. For this purpose, several variables are chosen which are widely found in growth literature, with a special focus on nickel exports so the impact of the recent export bans can be assessed. An econometric approach has been used to analyse the relationship between GDP growth, nickel export, and other macroeconomic variables. The aim is to understand if this industrial policy - the nickel export ban - has had an impact on the countries' economic growth.

The model quantifies the relationship between GDP growth and the independent variables, which will be explained in the following paragraphs. Using econometric techniques, it seeks to offer empirical insights into Indonesia's growth dynamics and its responsiveness to nickel export fluctuations.

The equation selected for this model is a linear regression function:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \cdots + \beta_p X_{pt} + \varepsilon_t \qquad (1)$$

Where:

Y_t: Represents GDP growth in Indonesia as the dependent variable at time t

β: denotes the regression coefficient.

$X_{1t}, X_{2t}, \cdots, X_{pt}$: identify a set of independent variables, including macroeconomic factors and export-related indicators.

ε_t: Stands for the error term that captures unexplained variation in GDP growth.

3.2 Data

The chosen length of annual observations is 33, starting from 1989 and ending in 2021. Indonesia as the country in scope played a factor in the limited data available, since for some explanatory variables data before 1989 was not available.

The data for this model stems from the World Bank's database (Website: https://databank.worldbank.org/) and FRED (Website: https://fred.stlouisfed.org/). Searching for data for the total exports of nickel posed an initial challenge, however, the most trustworthy source identified was the WITS (Website: https://wits.worldbank.org/) website, provided by the World Bank, as it delivers quality and reliability to the dataset despite its relatively short time frame. The export data is measured as trade value in 1000 USD.

The reason to choose the World Bank and FRED as data sources is their extensive repository of economic data, reputation, and comprehensiveness for analysing developing countries.

Dependent variable GDPgr and independent variables FDI, INFL, REER, IR and Trade are in percentage terms and NickelExp is in absolute USD terms.

3.3 Econometric methodology

Following the usual time series configuration, the adopted regression has the linear formal form:

$$GDPgrowth_t = \beta_1 + \beta_2 NickelExp_t + \beta_3 FDI_t + \beta_4 INFL_t + \beta_5 REER_t + \beta_6 IR_t + \beta_7 Trade_t + \varepsilon_t \quad (2)$$

With t = 1989,…, 2021

Where:

GDPgrowth as the dependent variable, measured as a yearly percentage rate.
NickelExp stands for the amount of nickel exported in absolute USD values.
FDI represents foreign direct investments, measured as a yearly percentage rate.
INFL denotes inflation, measured as a yearly percentage rate.
REER means Real Effective Exchange Rates, measured as a yearly percentage rate.
IR represents the real interest rate, measured as a yearly percentage rate.
Trade is the trade-to-GDP ratio, measured as a percentage of GDP.

To estimate the model, the OLS estimator is applied. It is selected due to its capability to establish linear relationships between independent variables and the dependent variable as well as the execution of hypothesis tests for significance. The OLS is well-suited for time series analysis and given that stationarity conditions are met, it is a robust choice for the examination of regressors impacting economic growth.

Some inspiration was drawn from Turan and Karamanaj (2014) who made use of the OLS estimator to establish a relationship between foreign direct investment and trade on economic growth in Albania as well as from Habib et al. (2017) assessing whether real effective exchange rates, trade openness and inflation impact economic growth in 150 countries.

To attain the status of being the Best Linear Unbiased Estimator (BLUE), OLS must adhere to the Gauss-Markov conditions: 1. The error term in the regression model should have an expected value of zero, ensuring that OLS estimates are unbiased. 2. OLS necessitates that the error term exhibits constant variance (homoskedasticity) and lacks correlation with the

independent variables (no autocorrelation). 3. The independent variables should not be subject to perfect multicollinearity, as this renders coefficient estimates unstable. 4. OLS assumes that the error term follows a normal distribution (Larocca, 2005).

The preferred software for running the regression analysis is STATA, due to its versatile statistical capabilities, user-friendly interface, robust data management features, and extensive documentation. Its ability to produce well-structured output makes it a well-suited and reliable choice for conducting regression analyses, particularly in the context of econometrics.

Before delving into an overview of the variables and discussing the findings, it is essential to address the limitations and challenges inherent in this model, particularly regarding the estimation technique.

After conducting the Pearson Perron test and the Augmented Dickey for stationarity, it turns out, that the independent variable "trade" is non-stationarity, therefore it is mandatory to transform it into first differences before entering the model. In addition, the variable "NickelExp" demonstrates some exponential growth, it is suggested to use the logarithm to transform this skewed variable into a more normalized dataset. By log transforming a variable, the risk of heteroskedasticity is reduced as the log stabilizes the variance and leads to a stationary series, which is an important property of linear time series regression.

The variable nickel export raised another challenge for the regression, due to the values of zero in the years 2015 and 2016 which highlight the period when nickel was banned from export. To make a realistic estimation, it is suggested to create dummy variables for nickel export "nickelexpdummy" before entering the model. To have a clearer view of the years when the export ban started, the variable "dummyend" was generated to make a clear division between the years before, during, and following, the export ban. The variable "dummyendexp" was computed to analyse better the interaction between the dummys and the export.

As mentioned before, no autocorrelation is an important assumption for the OLS. Figure 1 displays the output of the Breusch-Godfrey Lagrange multipliers test for autocorrelation. Lags 1, 2, and 3, which are also the most important ones, do not demonstrate signs of serial correlation. Lag 4 shows some evidence of autocorrelation. To solve this, the Newey-West standard errors is applied, which is robust to serial correlation.

```
.
. estat bgodfrey, lags(1 2 3 4)

Breusch–Godfrey LM test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	**0.920**	**1**	**0.3374**
2	**3.253**	**2**	**0.1966**
3	**3.517**	**3**	**0.3185**
4	**11.787**	**4**	**0.0190**

H0: no serial correlation

Figure 1: Breusch-Godfrey LM test – STATA output

Another hypothetical source of problems with the model may be some evidence of multicollinearity in the variable Real Effective Exchange Rates, obtaining a value of 5.03 after conducting the variance inflation factor (VIF) test for multicollinearity (see Figure 2). A VIF less than 5 indicates a low multicollinearity of that predictor with other predictors. A value between 5 and 10 indicates a moderate collinearity. However, exceeding the significance level of 5 just by 0.03 doesn't indicate severe multicollinearity, and the decision was made to proceed with the model as it is.

```
. vif
```

Variable	VIF	1/VIF
reer	**5.03**	**0.198820**
infl	**4.39**	**0.227747**
ir	**3.72**	**0.268514**
dummyend	**3.27**	**0.305998**
fdi	**3.02**	**0.331025**
nickelexpd~y	**2.59**	**0.385699**
trade_diff	**2.45**	**0.407851**
dummyendexp	**2.12**	**0.471626**
Mean VIF	**3.32**	

Figure 2: VIF test for multicollinearity – STATA output

When computing the residuals versus fitted values plot, as displayed in Figure 3, it appears that the residuals are relatively uniformly distributed - with three outliers. To have a clearer output, save to draw a definite conclusion, it is suggested to conduct the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity. The p-value of 0.3930 (see Figure 4) lies above the significance level of 0.05 and suggests that there is no clear evidence of heteroskedasticity. This fulfils the condition of constant variance of the error terms leading to efficient and unbiased coefficient estimates.

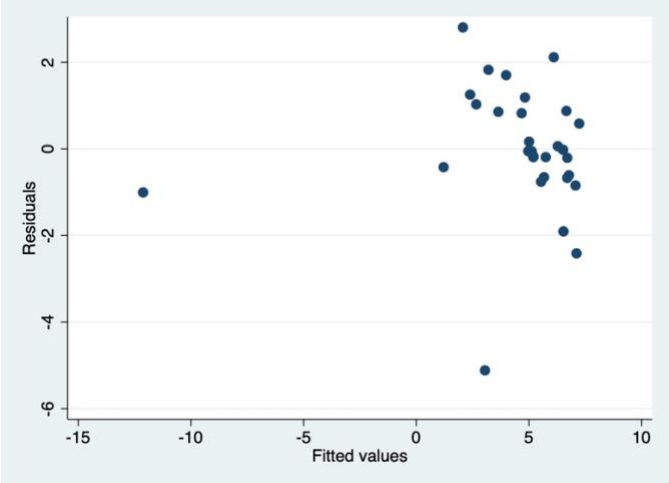


Figure 3: Residual-versus-fitted plot – STATA output

```
. estat hettest

Breusch–Pagan/Cook–Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of gdpgr

H0: Constant variance

    chi2(1) =   0.73
Prob > chi2 = 0.3930
```

Figure 4: Breusch-Pagan test for heteroskedasticity – STATA output

For a small time series sample, such as the present one, normality is an important condition. Therefore, the skewness and kurtosis tests have been applied. The outcome (in Figure 5) indicates that the residuals exhibit no significant skewness or excess kurtosis as their p-values lay above the 0.05 significance level; concluding, there is no strong evidence of deviation from a normal distribution.

```
. sktest resid

Skewness and kurtosis tests for normality
                                                    ------ Joint test ------
    Variable |        Obs    Pr(skewness)    Pr(kurtosis)   Adj chi2(2)  Prob>chi2
-------------+-------------------------------------------------------------------
       resid |         32          0.4416          0.2522          2.06      0.3577
```

Figure 5: Skewness and kurtosis tests for normality – STATA output

3.4 Variables

GDPgr – Gross Domestic Product growth (in % per year)

To analyse the potential impact of nickel export on economic growth, it is reasonable to use the yearly GDP growth rate as the dependent variable. According to the data source World Bank, the annual percentage growth rate of GDP is measured at market prices and is based on constant local currency.

As a key measure of a country's economic health and performance, the GDP growth rate captures the annual change in the total economic output of an economy. This variable serves as a critical parameter for assessing the overall well-being and economic progress of a country's population, and it reflects the effectiveness of government policies, economic stability, and competitiveness on a global scale (World Bank).

Furthermore, the GDP growth rate is recognized for its relevance in a multitude of academic and policy-oriented research areas. Its sensitivity to various economic drivers, such as foreign direct investment, inflation, exchange rates, and interest rates, makes it an ideal choice for modelling and analysing the impact of these factors on a country's economic development.

Figure 6 demonstrates the development of Indonesia's GDP growth rate from 1989 until 2021. What's evident is the sharp drop down to -13.1% in 1998 as a result of the Asian Financial Crisis. In just one year later, GDP grew again, ultimately reaching 4.9% in 2000. From then on, the growth rate was constantly fluctuating between 5% and 6%, hitting a small dip in 2009 at 4.6% during the Global Financial Crisis. In the following ten years, the rate was stable again until reaching a low of -2% in 2020.

As displayed in the graph, GDP growth has two structural breaks: one in the year of the Asian Financial Crisis, and another one in the year of Covid-19. To solve this, two dummy variables were created, namely "gdpgrAFC" referring to the year 1998, and "gdpgrCOV" reflecting the year 2020 which entered on the right side of the equation. Both dummies have passed the Augmented Dickey-Fuller test for stationarity.

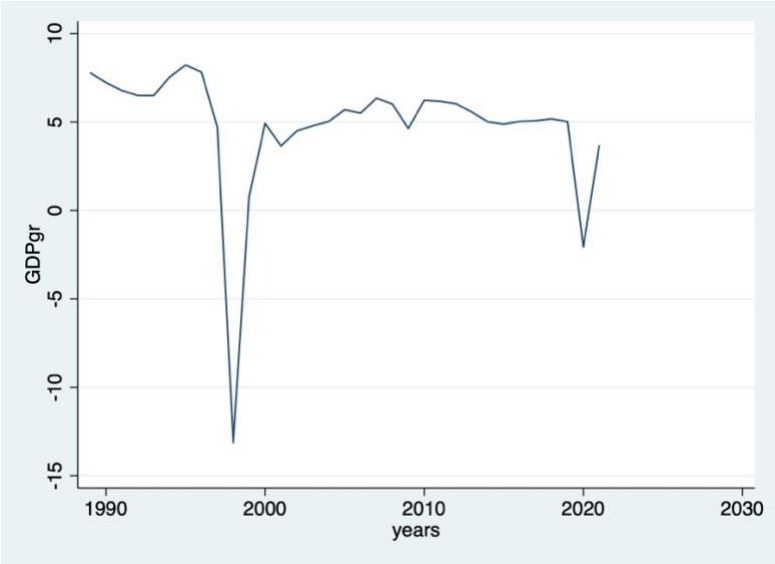


Figure 6: Annual GDP growth (in %). Data source: World Bank

NickelExp – exports of Nickel ores and concentrates (trade value in 1000 USD)

Nickel export was included as an explanatory variable in the model due to its significant relevance to the economic context under investigation. By including nickel export as an explanatory variable, the model seeks to assess the potential influence of this key economic activity on GDP growth.

Astuti (2023) completed a regression analysis of whether export, exchange rate, inflation, and tax revenue have an impact on economic growth in Indonesia, observing the period from 2012 until 2021. The findings have shown that all these variables have a significant impact on GDP growth.

Figure 7 displays the export of nickel ores and concentrates starting from 1989 until 2021. The y-axis represents the absolute value in 1000 USD. While the amount of gross export in the beginning years of observation was relatively low, it started accelerating and growing faster until 2005 and reaching a first peak in 2007 with a value of 608,403.87 (in 1000 USD). Shrinking again in 2009 to almost one-third of the amount exported in 2007, which is the year when the government issued law Number 4/2009 on Coal and Mining (International Energy Agency, 2022) with to control the mining of minerals and coal.

From 2010 until 2013 exports sharply increased, reaching an all-time high of 1685247.62 in 2013. From then on, exports drastically decreased to 85913.01 in 2014 and

dropped down to zero in 2015 and 2016 due to the imposed nickel ore export ban issued by the government. Only in 2017, the export started to pick up again reaching a peak in 2019 with a total value of 1097012.52 before finally plunging to a humble 0.12 and 0.04 in 2020 and 2021 respectively. This final drop is the result of yet another nickel export ban and the Covid-19 pandemic (Sappor, 2020).

In the model, the data for nickel export has been converted from USD into log form to overcome the nonlinearity problem and standardize the data uniformly. A study by Feng et al. (2014) claim that "The log transformation is, arguably, the most popular among the different types of transformations used to transform skewed data to approximately conform to normality." When analysing the data, the years 2015 and 2016 both have zero as a value. This is because during those years an export ban of nickel ore was implemented. To estimate the model correctly, dummy variables for NickelExp have been created to see how this regime impacts GDP growth.

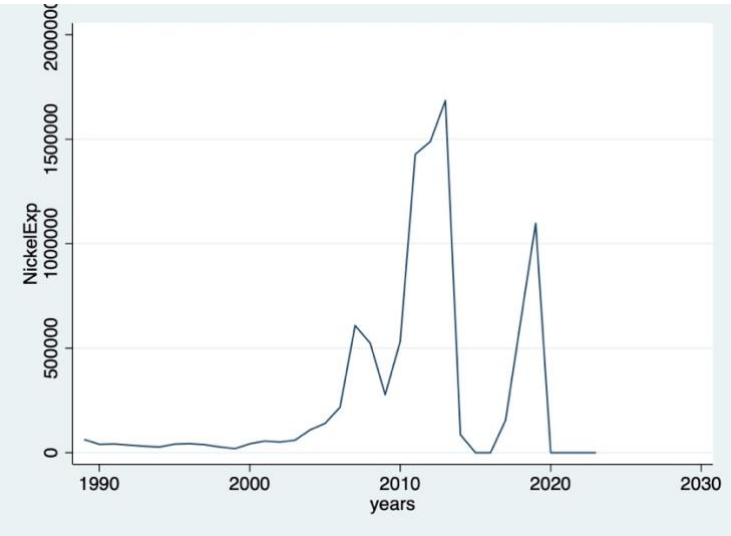


Figure 7: Nickel export in USD. Data source: WITS

FDI – Foreign direct investment (net inflows % of GDP)

According to the World Bank, FDI represents the net financial injections made to obtain a substantial managerial stake, typically exceeding 10% of voting stock, in a business entity operating within an economy distinct from that of the investor. FDI encompasses several components, including equity capital, the reinvestment of earnings, additional long-term

capital, and short-term capital, as detailed in the balance of payments. This data series illustrates the net inflow of investments into the host economy by foreign investors, taking into account new investment inflows and disinvestment, and it is presented as a ratio relative to the GDP.

Nawaz et al. (2014) conducted a study on which factors influence economic growth in Pakistan and found that FDI, inflation rate, and interest rate demonstrate a significant positive relationship with GDP growth. According to Riedel (1975), when foreign investment enters a developing nation, it primarily leads to a rise in the employment rate. This results in impoverished individuals securing jobs, experiencing an improvement in their living standards, and exerting greater effort in their work, ultimately contributing to an increase in the country's economic growth.

Figure 8 represents the development of FDI in Indonesia showing a sharp drop down to -2.8% in 2000 as a response to the Asian Financial Crisis, as it started decreasing since 1998. Afterward, FDI picked up again, reaching 2.9% in 2005, and hardly moved below 1%.

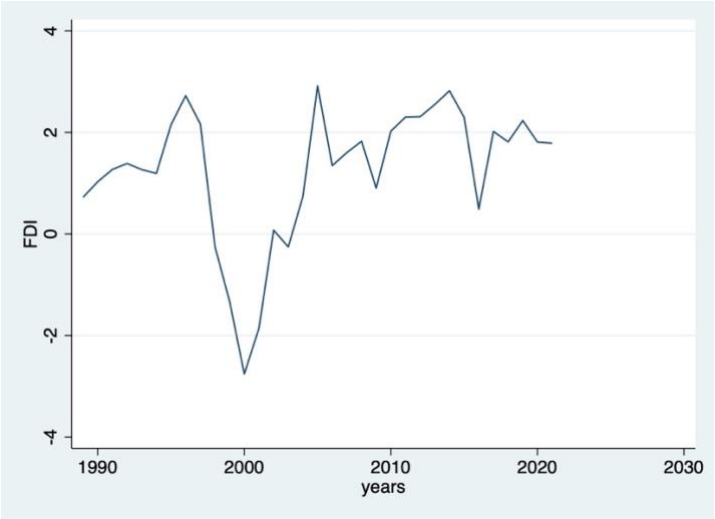


Figure 8: Foreign direct investment, net inflows (% of GDP) - Indonesia. Data source: World Bank

INFL – Inflation (consumer prices, annual %)

The measurement of inflation relies on the consumer price index. This index gauges alterations in the average pricing of goods and services across various categories, each classified based on their intended purpose in consumption (World Bank).

A research project took place in South Africa, where investigators determined that when inflation remains in single digits, it can positively impact the country's economic growth. However, if inflation reaches double digits, it might have detrimental effects on the country's economic development (Nell, 2000). Additionally, a separate study was undertaken in Brazil to examine the connection between inflation and GDP. The findings of this study indicated that inflation does not exhibit any influence on the country's output or economic growth (Faria & Carneiro, 2001).

Figure 9 represents the annual inflation rate of Indonesia, and it's clearly evident that it reached a record high of 58.5% during the Crisis year. This high level did not last long and reached a pre-Crisis level again from 2000 onwards. From 2013 until 2021 inflation kept slowly decreasing, until it eventually dropped to a level of 1.6% in 2021. COVID-19 has no noticeable influence on inflation.

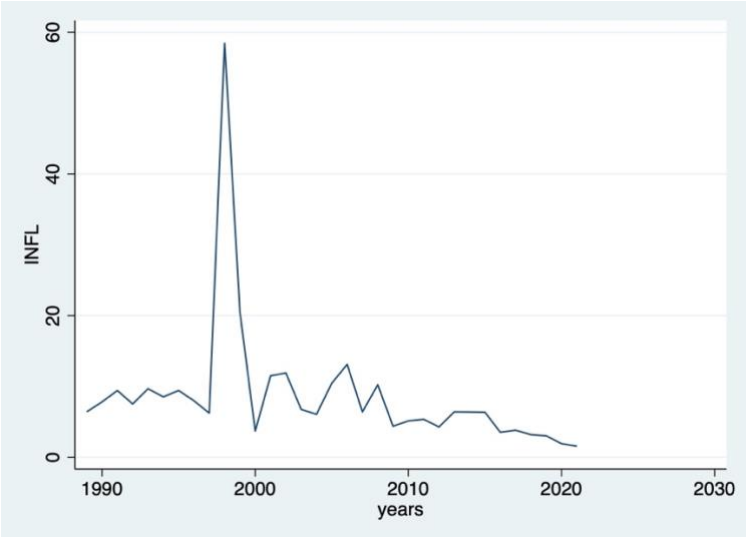


Figure 9: Inflation, consumer prices (annual %) – Indonesia. Source: World Bank

REER – Real effective exchange rates (% per year)

The real effective exchange rate is obtained by dividing the nominal effective exchange rate - which quantifies a currency's value - against a weighted average of multiple foreign currencies by a price deflator or a cost index (World Bank).

Machado et al. (2015) conducted research regarding the relationship between the economic variables and the economic growth and development of the BRICS countries. The results suggest that GDP growth is linked to lower exchange rates, larger exports, and controlled inflation. According to Rapetti et al. (2012), growth-enhancing effects of competitive exchange rates are found primarily in developing countries.

Figure 10 represents the real effective exchange rate from 1989 until 2021. During the first seven years of the observation, the rate was moving at a constant rate of around 120%, and in 1998 reaching a drop of 57% due to the drastic devaluation of the rupiah. In the years after the Asian Financial Crisis, the rate initially moved to 84% and grew steadily until reaching 116% in 2010. In the following years, the rate slightly decreased, reaching a level of 101% in 2021.

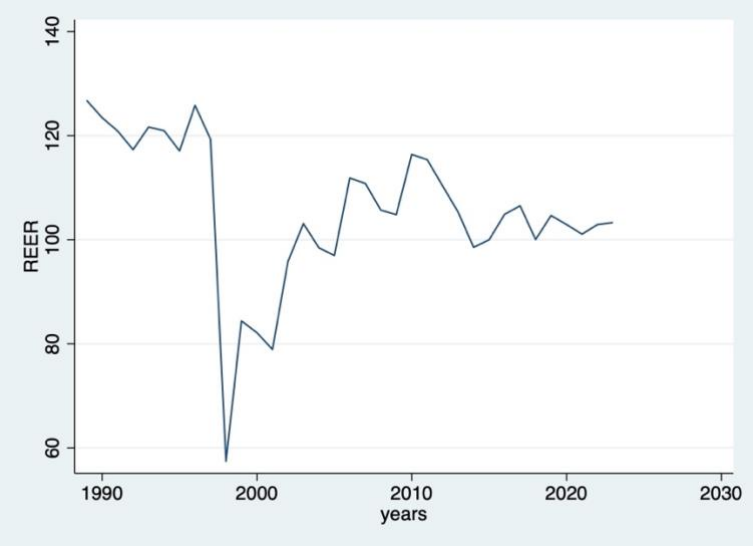


Figure 10: Real Effective Exchange Rates (annual %) – Indonesia. Source: FRED

IR – Real interest rate (% per year)

The real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator; it is a component of monetary policy and one of the measures used by central banks to control inflation. If it is positive, it means that the interest rate set by the central bank is higher than the inflation rate (World Bank).

Real interest rate is an important variable to add when assessing economic growth. Shaukat et al. (2019) found, that during the transition period of developing economies, high real interest rate restricts the economy's potential to grow.

Figure 11 illustrates that the real interest rate has remained stable despite a huge drop in 1998 - the year of the Asian Financial Crisis - which may be explained by a prudent monetary policy of the central bank. As of 2000 until 2021 the rate is moving between -3 and 10%.

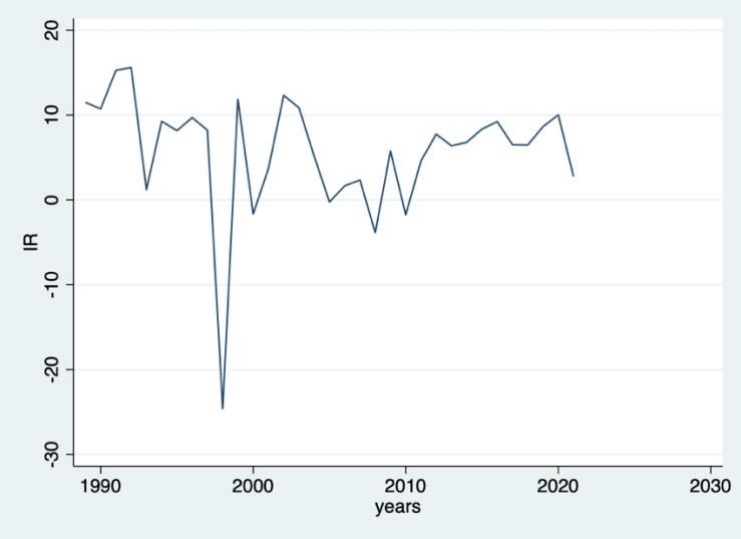


Figure 11: Real interest rate (% per year) – Indonesia. Source: World Bank

Trade – Trade to GDP (% of GDP)

Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product. In some literature, it is also called trade openness and it is one of the most common variables used in the growth literature. Many Asian nations followed an export-led strategy to spur economic growth, which contributed to an increase in their living standards.

Nursini (2017) showed evidence that trade openness contributed to economic growth in Indonesia. An opposite result was found by Abbas (2014). The author studied several developing economies and found a negative contribution from trade openness to economic growth.

Figure 12 shows that trade openness follows a negative trend in Indonesia, meaning that it occupies a smaller piece of the total GDP. It does not mean that trade in Indonesia has dwindled, but it has grown at a smaller pace than GDP.

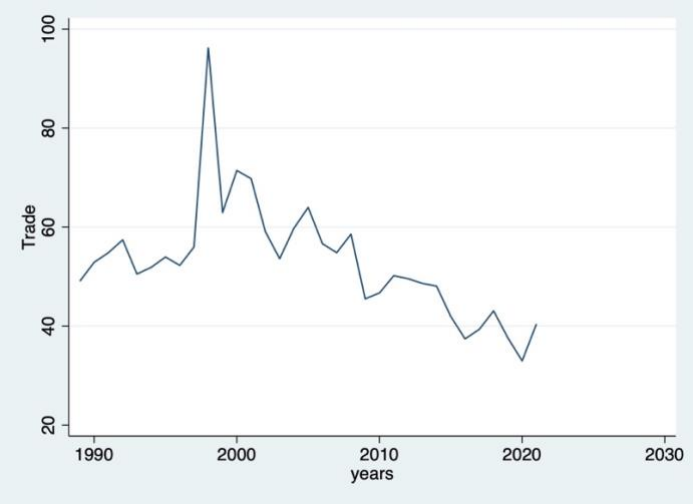


Figure 12: Trade to GDP (% of GDP) – Indonesia. Source: World Bank.

3.5 Results and discussion

Upon executing the tests for the Gauss-Markov conditions and running the regression excluding statistically non-significant variables, the final linear equation is given by:

$$GDPgrowth_t = \beta_1 + \beta_2 REER + \beta_3 l.IR + \beta_4 GDPgrAFC + \beta_5 GDPgrCOV + \beta 6 l.log\_NickelExp + \varepsilon_t \quad (3)$$

Where:

REER indicates the real effective exchange rate and remains untransformed.
l.IR is the lagged version of interest rate.
GDPgrAFC represents the dummy variable for GDP growth during the Asian Financial Crisis.
GDPgrCOV represents the dummy variable for GDP growth during COVID-19.
l.log_NickelExp denotes the lagged version of the logarithm of nickel exports.

The STATA output displayed in Figure 13 provides an overview of the definite model. The high R-squared value of 0.9618 indicates that 96.18% of the variance in GDP growth is explained by the included variables REER, gdpgrAFC, gdpgrCOV, and the lagged versions of log_nickelexp and IR. The adjusted R-squared considers the model complexity and its value 0.9544 confirms its explanatory power. The assigned coefficients explain the relationships between the explanatory variables and GDP growth.

The real effective exchange rate obtained a significant p-value and a positive coefficient, meaning that a one-unit increase in the real effective exchange rate causes a 0.0716346-unit increase in GDP growth, holding the other variables constant. This result confirms the analysis done by Machado, as discussed previously in the variables section, that real effective exchange rate has a positive correlation with GDP growth.

With a p-value obtained of 0.213, the interest rate has no significant impact on GDP growth. However, computing the regression with the lagged version of IR, the p-value equals 0.006 confirming statistical significance in explaining GDP growth. The coefficient of the interest rate at one lag has a positive value stating that an increase in interest rate generates a 0.0667899-unit increase in GDP growth with a year delay, which contradicts the research of Shaukat et al. (2019) that concluded that high interest rate has a negative impact on GDP growth of developing countries.

The dummy variables gdpgrAFC and gdpgrCOV, created to capture structural breaks in 1998 due to the Asian Financial Crisis and in 2020 due to COVID-19, exhibit negative coefficients of -15.3242 and -7.759376, respectively. As expected, when the economy gets hit by exogenous shocks such as a pandemic or a financial crisis, the GDP growth rate decreases.

Zooming into the explanatory variable of interest, namely nickel export, the output for the dummy variables, computed for the years of the ban, do not demonstrate a significant impact on the growth rate. Exceeding the p-value for significance, dummyend and dummyendexp are not statistically significant. Therefore, the regime of two years in 2015 and 2016 express no significant impact on the growth rate for the span of the years available in the sample.

Resosudarmo and Yusuf (2006) conducted a study on the Indonesian log export ban and concluded that its implementation is not beneficial for the economy in the short term, it lowers the GDP and incomes for most household groups. However, it's important to highlight that their study focused on the impacts of the ban in the 1980s, having therefore a considerable number of years of observation available after the ban. The limited amount of yearly data could be a reason, that in the present work, no direct correlation between the export ban and the GDP growth rate was found.

When analysing the log-transformed nickel export variable at lag 1, there is some evidence of statistical significance at a 10% level (p-value = 0.599), indicating its influence on GDP growth. This implies that a one-unit increase in l.log_nickelexp leads to a 0.03-unit growth in GDP, albeit with reduced statistical confidence compared to other variables. Concluding, the lagged value of the logged nickel exports has a positive but marginally significant impact on the GDP growth rate and the years of the nickel export ban don't demonstrate statistical significance, as the p-values of nickelexpdummy, dummyend and dummyendexp lay above the significance level of 0.05.

```
. regress gdpgr reer gdpgrAFC gdpgrCOV l.ir l.log_nickelexp nickelexpdummy dummyend dummyendexp
```

Source	SS	df	MS	Number of obs	=	32
				F(8, 23)	=	75.40
Model	425.98745	8	53.2484312	Prob > F	=	0.0000
Residual	16.2437414	23	.706249625	R-squared	=	0.9633
				Adj R-squared	=	0.9505
Total	442.231191	31	14.2655223	Root MSE	=	.84039

gdpgr	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
reer	.07109	.0148162	4.80	0.000	.0404404	.1017395
gdpgrAFC	-15.41171	1.165096	-13.23	0.000	-17.82189	-13.00152
gdpgrCOV	-7.029677	1.31435	-5.35	0.000	-9.748618	-4.310736
ir						
L1.	.0676392	.0236909	2.86	0.009	.0186309	.1166476
log_nickelexp						
L1.	.0300131	.0562482	0.53	0.599	-.0863452	.1463715
nickelexpdummy	-.1013396	.6525974	-0.16	0.878	-1.45134	1.248661
dummyend	-.719605	.8355187	-0.86	0.398	-2.448007	1.008797
dummyendexp	.0310235	.0687133	0.45	0.656	-.1111208	.1731678
_cons	-2.567738	1.574618	-1.63	0.117	-5.825084	.6896067

```
.
```

Figure 13: OLS regression with GDPgr as the dependent variable – STATA output

Upon completing several regressions to assess the statistical significance of the explanatory variables, FDI, INFL, and Trade rate have been dropped. Those variables resulted in a p-value higher than the significance level of 0.05. Having tested also their first, second, and third lags, they still do not show any particular significance. Therefore, the decision has been made to exclude them from the model.

As stated previously in the variable description, some scholars concluded there is no direct impact of FDI on GDP growth as it is linked to specific sectors within the economy where the FDI is directed. This could be one of the reasons why in the case of Indonesia, no significant impact of FDI on GDP growth could be established. Some further research needs to be done on this topic focusing on specific industries.

INFL has not been identified as a crucial factor in predicting GDP growth replicating the conclusion of the research of Faria and Carneiro (2001) who established that in the case of Brazil, no influence from inflation to GDP growth was found. Also, research by Chowdhury (2002) has shown, that inflation has no significant impact on GDP growth in Indonesia. This is being reflected in the present research as well. While it is important to consider that his research is based on data from two decades ago, the outcome of the present research confirmed the same hypothesis.

Analysing solely the impact of trade on GDP growth, it does have a negative impact (see Figure 14, STATA output), similar to the result established by Abbas (2014). However, variable trade in combination with l.IR, REER, log_NickelExp, GDPgrAFC, and GDPgrCOV in the model does not demonstrate any relevant significance. Consequently, trade to GDP has been excluded from the model.

```
. regress gdpgr trade
```

Source	SS	df	MS	Number of obs	=	33
				F(1, 31)	=	9.89
Model	109.22802	1	109.22802	Prob > F	=	0.0037
Residual	342.359917	31	11.0438683	R-squared	=	0.2419
				Adj R-squared	=	0.2174
Total	451.587937	32	14.112123	Root MSE	=	3.3232

gdpgr	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
trade	-.1558459	.0495552	-3.14	0.004	-.2569144	-.0547775
_cons	13.02614	2.686771	4.85	0.000	7.546433	18.50584

Figure 14: OLS regression with GDPgr and trade to GDP as explanatory variable – STATA output

Finally, a forecast for GDP growth for 2023 has been conducted with the equation given by

$$GDPgrowth_{2023} = \beta_1 + \beta_2 REER_{2023} + \beta_3 IR_{2023} + \beta_4 log\_nickelexp_{2023} + \varepsilon_{2023} \quad (4)$$

Where

REER = 103.2981 and *Log_nickelexp* = 0

Figure 15 visually displays the forecast for GDP growth in 2023. The blue line represents the growth rate as previously seen in Figure 6 and the red line represents the forecasted values for GDP growth.

The forecast has been predicted by creating a scenario for the exchange rate. The semi-annual exchange rate 103.2981 has been inserted in the graph editor (data source: FRED). The scenario for log_nickelexp is equal to zero, due to the export ban. For the interest rate, no

conjecture was required, since the value inserted in the regression model is its lagged version. Under those conditions, the GDP growth rate for 2023 has been computed. The forecasted GDP growth has a value of 4.059047%, under the assumption that log_nickelexp has a value of zero and the exchange rate equals 103.2981%.

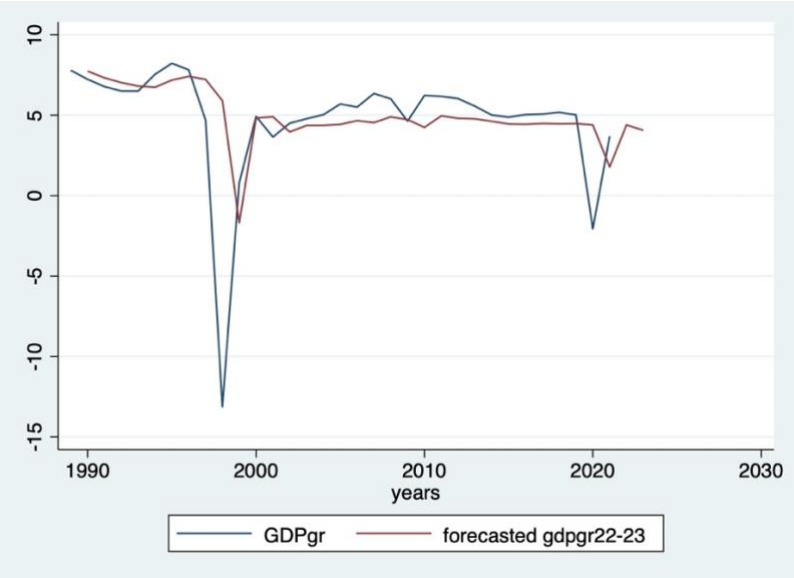


Figure 15: GDPgr and forecasted GDPgr for 2022 and 2023 – STATA output

4. Conclusions and future investigation opportunities

This study presented an overview of the currents trends in the energy transition and industrial policy, from a world level analysis, passing through developing countries, and ending in Indonesia. To contextualise it, a brief overview of Indonesia's history was drawn, examining the main policies and policy shifts over the years. At the present moment, industrial policy is back on the policy-makers agenda and newspapers' headlines, such as the two nickel export bans imposed by the Indonesian government.

Hence, this thesis is an initial attempt to analyse the effects of industrial policy implementation in a developing country, specifically focusing on the nickel export ban in Indonesia. For a quantitative understanding of the nickel industry in Indonesia, an empirical model was built. A time series OLS was employed to assess the impact of this sector on economic growth from 1989 until 2021. The regression analysis indicated a significant correlation at the 10% significance level between the nickel export and the growth rate, showcasing a positive relationship (indicating that an increase in exports results in a 0.0531358-unit growth in GDP), there was no statistical significance found for the years of the export ban on GDP growth. Also, other essential macroeconomic factors such as foreign direct investment, inflation, and trade rate did not exhibit statistical significance. Additionally, the model demonstrated that the Asian Financial Crisis and the COVID-19 pandemic led to declines in the growth rate.

Historically, industrial policies have demonstrated their pivotal role in economic development. The literature findings emphasize that nickel exports can significantly influence a country's economic performance, and the export bans result in diverse consequences. This impact resonates globally, sparking responses from entities like the WTO, while domestically, it can add value to the economy. In the aftermath of Indonesia's initial nickel export ban, tangible economic benefits were experienced. The ban stimulated investments, leading to the establishment of new smelters and refineries. This not only created job opportunities, but also elevated Indonesia's position in the global nickel market, capitalizing on the rising demand driven by the surge in electric vehicles and renewable energy sources.

However, it is important to note that the full impact of the nickel export ban on Indonesia's economic growth may take time to fully materialize. While initial signs have been promising, long-term success will depend on the country's ability to maintain a stable regulatory

environment, attract sustainable investments, and make sure to follow environmental and social responsibilities in the mining and processing of nickel. Furthermore, external factors such as fluctuations in global nickel prices, competitive products such as hydrogen cars, and market demand may also influence nickel export in the upcoming years.

The relatively short timeframe from 1989 to 2021 may be a limitation of the study as it does not fully capture the long-term trends and impact. Additionally, including factors such as employment created in the nickel processing industry, investment in nickel related research, and tax revenue from the nickel industry may represent opportunities for further research in order to provide a more nuanced understanding of the export ban's effects on the economy.

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