

The Dutch disease, natural resource booms and policy adjustments: The case of Indonesia

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Declaration of originality

This entire thesis is my own work.

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Abstract

The role of natural resources in economic development has sparked debates amongst economists for decades. While theories such as the natural resource curse thesis and the Dutch disease have been developed to explain the adverse effects of natural resources, the empirical findings are mixed. This thesis consists of one theory chapter (Chapter 2), one background chapter about Indonesia (Chapter 3) and three distinct but closely related empirical chapters (Chapters 4, 5 and 6) on natural resources and their impact on the economy. The theory and Indonesia chapters provide some background on relevant theories and on the case study of Indonesia, which will be discussed and applied throughout the thesis. The theory chapter (Chapter 2) focuses on the Dutch disease theory and natural resource curse theory, along with their development and related empirical studies. The Indonesia chapter (Chapter 3) discusses the complex relationship between natural resources and economic development in Indonesia's modern history.

The first empirical chapter (Chapter 4) explores and compares various methods to construct the real exchange rate as a tool to measure the effects of the Dutch disease in natural resource booms in Indonesia. Theoretically, a natural resource boom will lead to an appreciation of the real exchange rate, defined as the price ratio between non-tradeables and tradeables. Real effective exchange rate data (REER), as published by international organisations such as IMF and BIS, is therefore not suitable for measuring the effects of the Dutch disease because it is constructed differently from its theoretical definition. This study uses Indonesia as a case study and constructs trade-weighted REER, CPI-based, and GDP-deflator based price ratios. Indonesia is an interesting case study because, in the last fifty years, it has experienced two very different resource booms. The study finds that, while each method has its advantages and disadvantages, the GDP-deflator price ratio is the most appropriate method to measure the effects of the Dutch disease.

The second empirical chapter (Chapter 5) tests the total effect of natural resource extraction on manufacturing in a cross-country setting. The total effect of natural resource extraction can include

the Dutch disease and natural resource curse effects, both of which may have adverse effects on manufacturing. However, it can also include the effects of backward-and-forward linkages and productivity spillover, which may have positive effects. The test is done by estimating the effect of natural resource rents on manufacturing value-added. It uses an instrumental variable method that utilises fluctuations in world resource prices, weighted by each country's resource exports. Using data from 149 countries over the period 1970-2014, the study finds that natural resource rents have a mildly positive effect on manufacturing value-added. The findings are then compared to the experience of Indonesia and Australia, two relatively resource-dependent countries.

The final empirical chapter (Chapter 6) measures the welfare impacts of coal and palm oil prices in Indonesia during the 2000s commodity boom. The welfare outcomes include the poverty rate, household consumption, employment, and wages, all measured at the district level. The study exploits the within-country variation in exposure to each commodity, interacted with exogenous changes in global commodity prices. The study focuses on coal and palm oil prices because they were the main driver in Indonesia's export growth during the 2000s commodity boom. The results suggest that both coal and palm oil prices have strong poverty reduction effects. While palm oil price affects poverty mainly through employment creation effect, coal price affects poverty mainly through the wage effect.

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Chapter 1

Introduction

It is hard to overstate the importance of natural resources in the global economy. Virtually all the goods and services that we consume, from food to transportation to highly sophisticated computers, require natural resources at certain stages of their production. These are defined as materials that occur in nature that can be used in production process or consumption. Broadly defined, they include fossil fuels, minerals, forestry products, and agricultural raw materials. Like many other natural features, these resources tend to be concentrated in certain parts of the world. While some countries are endowed with large reserves of these resources, other countries barely have any.

As a consequence of their importance and concentrated nature, these resources are traded intensely in the global market; with resource-abundant countries exporting them to resource-scarce countries. This may create the impression that resource-abundant countries are at an advantage to resource-scarce countries. If that is the case, resource-abundant countries should be comparatively richer to countries that are not. The reality is more complicated. On the one hand, it is true that some resource-abundant countries are high-income countries. There are plenty of examples for this case, including the oil-rich countries in the Persian Gulf, Norway, Australia, and others. On the other hand, there are also plenty of examples of resource-abundant countries that fail to achieve high-income status. Some of them can only reach middle-income status but not higher, such as Russia, Brazil, Indonesia, or Venezuela. Others cannot even reach the middle-income status, such as Nigeria, Angola, or the Democratic Republic of the Congo. The diverse experience of these resource-abundant countries raises an important question, how do natural resources affect the economy? This question is especially important in the case of developing countries, many of which rely on natural resources as a substantial component of their economies, especially as a part their exports.

In many cases, resource-rich developing countries are riddled with problems such as poverty, inequality, conflicts, poor institutions, and a lack of capital. Exploiting and exporting available natural resources seem to offer a way to solve these problems. To some extent, this strategy works in several countries with enormous resource revenue, such as Saudi Arabia and some Persian Gulf countries. Their entire population can subsist on natural resource rents, i.e. unearned income from wealth, albeit perhaps only temporarily. Unfortunately, few countries have managed to achieve the same result. For many countries, the pattern has been one of stagnation, or rather of booms and busts around a generally flat trend (Collier, 2007). Unsurprisingly, the problems that they try to solve (poverty, inequality, etc.) persist even after decades of exploiting natural resources. Harnessing the resource wealth for growth has proved to be difficult. In contrast, rapid, sustainable economic development throughout the last century has mainly occurred in countries with barely any natural resources to speak of, or at least in those that do not develop their economy around natural resource extraction. From post-war Japan to the East-Asian tigers, and more recently China, the list of economic champions of the last century are dominated by natural-resource net importers, not exporters.

1.1. Understanding the impacts of natural resources

Economists have been attempting to understand how natural resources affect the economy for a long time. In the big-push logic, developing countries need some sort of large demand expansion, such as natural resources booms, to expand the size of their market, so that entrepreneurs will find it profitable to incur the fixed cost of industrialisation (Rosenstein-Rodan, 1943). This idea leads to the widespread employment of the Resource-Based Industrialisation (RBI) strategy, which suggests that developing countries should utilise their natural resources to achieve their industrialisation objectives. The strategy generally involves (i) more complete processing of raw materials for export (the so-called value-added argument) and (ii) utilisation of domestic resources principally for

domestic consumption. Roemer (1977) summarises and tackles the RBI arguments, and casts doubt on the notion that the strategy can actually achieve what it promises.

After the oil bonanza in the 1970s and early 1980s, more evidence about the impact of natural resource booms became available. One of the most discussed cases is the so-called “Dutch disease”, a term coined by *The Economist* (1977) magazine to describes the woes the Dutch economy faced after the discovery of a large oil reserve in 1959. Following this discovery, the Dutch economy saw a decline in its export competitiveness and a rise in its unemployment rate. The phenomenon is explained by Corden and Neary (1982) through a formalised theoretical framework for the Dutch disease. Following their publication and the scepticism towards the RBI strategy, several studies started to raise the possibility of a ‘natural resources curse’ (Auty, 1993; Gelb, 1988). The natural resource curse thesis suggests that in the long run, countries that have natural resources tend to have slower economic growth than countries that do not. However, at the time, there was not enough empirical evidence to support the thesis.

Several years later, Sachs and Warner (1995) provided the first empirical evidence for the resource curse. In their seminal paper, Sachs and Warner (1995) question the big-push logic and spark further debate on the natural resource curse, sometimes called the paradox of plenty. Following their studies, thousands of studies have been done to test the resource curse and explain the reasoning behind it. Nevertheless, more than two decades later, evidence for the resource curse is still mixed, and the thesis is still heavily debated amongst economists.

There are two major ways to explain why the natural resources curse may happen: (i) a market-based viewpoint related to macroeconomic mechanisms and (ii) a political economy approach stressing the role of institutions (Deacon, 2011). The market-based explanations covers a wide range of topics, including (among others): the Dutch disease (Corden & Neary, 1982; Sachs & Warner, 1995), over-expanding public sectors and debt overhang (Manzano & Rigobon, 2001), low savings (Atkinson & Hamilton, 2003), low investment in human capital (Gylfason, 2001), and the high

volatility of commodity prices (van der Ploeg & Poelhekke, 2008). The political economy approach, in contrast, focuses on the institutional effects of natural resources, which fosters rent-seeking behaviour (Dauvin & Guerreiro, 2017)¹.

This thesis mainly employs market-based viewpoints to analyse the impacts of natural resources, particularly the Dutch disease mechanism and its modifications. This does not mean other viewpoints are ignored or seen as less important. It merely means that the questions and explanations are framed through this point of view. According to this theory, a natural resource boom can affect the economy through the resource movement and spending effects. The resource movement effect is a consequence of the reallocation of factors of production in the economy, from the non-booming sector to the booming sector. The spending effect is a consequence of the higher income received by the population in a booming economy, and consequently, how the income is spent. Together, both effects will lead to an appreciation in the ratio between non-traded and traded prices, and in the decline of traded non-booming sectors. The theory will be discussed in greater detail in subsequent chapters.

There are several benefits of using the Dutch disease theory as a starting point. Firstly, the economic development implications of the theory are of great consequence, especially for developing countries. The development of the traded sector, specifically manufacturing, is often viewed as essential in long-term economic development. Secondly, the focus on natural resource booms (and busts) enables us to understand this recurring aspect of the global economy, which is becoming increasingly important as the world continues to globalise. Thirdly, most of the theoretical indicators of the Dutch disease are measurable, meaning that the theory can be tested using available macroeconomic and microeconomic survey data. Lastly, the theory can be modified to analyse other issues that are relevant to natural resource booms, such as its local (subnational) impacts and welfare implications.

¹ These explanations will be discussed in detail in Chapter 2.

Years of studies on this topic have brought the economics discipline to a better understanding of how natural resources can affect the economy. The importance of this topic has also increased over the years, as commodity booms are a recurring aspect of the global economy. However, this does not necessarily translate into better policies in resource-abundant countries, especially during commodity boom and bust periods. Irresponsible policies are common among these countries, such as spending resource windfalls while the boom lasts (and in some cases, also incurring large debts) and then encountering issues when the boom ends. One extreme recent example is Venezuela, an oil-rich country which sank into a humanitarian crisis after the oil price crashed in 2014 (among other factors). Whatever lessons that can be learnt from previous commodity booms seem to be either unclear or not applied in some countries. More studies, especially those which can give policy recommendations to resource abundant countries, are still needed. To this end, this thesis aims to contribute to the literature by providing comprehensive evidence from multiple perspectives on the impact of natural resources on the economy, specifically in the case of Indonesia, and the relevant policy implications.

As demonstrated by the various approaches used to explain the possible causes of the natural resources curse, there are multiple ways natural resources can affect the economy. Moreover, the mixed empirical evidence in previous studies, either for or against the resource curse thesis, shows how complicated the issue is. Reflecting this complexity, this thesis will cover a broad range of topics, including measurement issues, manufacturing sector development and welfare, at various levels of analysis from the global to the national and local level.

This thesis consists of three interrelated studies (Chapters 4, 5 and 6), each dealing with a certain aspect of how natural resources can affect the economy. The first study (Chapter 4) will discuss the real exchange rate (RER) and its measurement issues using the case of Indonesia. As mentioned, RER measurement is important because RER is a channel through which natural resource booms can lead to the Dutch disease. The second study (Chapter 5) will discuss the total impact of natural resources

rents on manufacturing sector value-added using cross-country data. This is to test the Dutch disease predictions on the manufacturing sector at the global level. Lastly, the third study (Chapter 6) will observe the impact of coal and palm oil prices on poverty, employment, wages and inflation at the subnational (district) level in Indonesia during the 2000s commodity boom. This study will use a modified version of the Dutch disease model to analyse natural resource boom effects at the subnational level. Together, they will offer a comprehensive approach to answering the question of how natural resources affect the economy. While I use the Dutch disease model as a starting point in all of them, the discussion is broadened to other possible explanations. Context is also crucial since the whole thesis is written using an economic development perspective, largely based on the case of Indonesia.

Although the discussion about the “disease” and “curse” so far may have implied that natural resources are a cause for concerns, this thesis starts with an eclectic goal of understanding the role of natural resources in economic development. The debate about the positive and negative impacts of natural resources extraction will be discussed in subsequent chapters when they are applicable. This thesis also concentrates most of the discussion on the Indonesia case, for reasons which will be discussed in the following chapter. Nevertheless, I believe that the lessons from Indonesia are highly relevant to other resource-abundant countries, especially in the developing world.

1.2. Indonesia

From an economic development perspective, Indonesia always represents an exciting case study. Currently, it is one of the biggest countries in terms of population and economic size. With a population of 265 million people in 2018, it is the 4th most populous country in the world. At the same time, the country’s GDP is the 16th largest in nominal terms and 7th largest in PPP terms. It has been through several extreme ups and downs: a “chronic dropout” in the early 1960s (Higgins, 1968), became a petroleum economy during the 1970s oil boom, then transformed into a rapidly industrialising export-oriented economy in the late 1980s and early 90s. It then fell into a deep

economic crisis in 1997-98, and suddenly transformed from a centralised authoritarian regime to a decentralised democracy, only to recover as a commodity exporter in the 2000s.

It is a country that has a long and complicated relationship with natural resources. Since before the modern Indonesian state was established, natural resources have played a central role in the region. Initially, it was spices that brought European traders and colonial powers to the region. During the Dutch colonial period, the region produced various commodities to be sold in Europe, including cloves, cocoa, coconut, tobacco, tea, coffee, rubber, sugar, tin, and other commodities. From the late nineteenth century, oil became one of Dutch East Indies' valuable exports to industrialising Europe.

Natural resources continue to play a central role throughout modern Indonesia history. Following its independence from the Dutch in 1945, Indonesia became increasingly reliant on oil exports. In 1967, 36 per cent of the country's merchandise export was oil and gas. By 1975, during the early period of the oil boom, the share had reached 75 per cent; and by 1982, at the end of the oil boom, the share had reached 82 per cent. Consequently, oil revenue also became the primary source of government revenue. It exceeded 50 per cent of total government revenue in 1975 and 70 per cent in 1982. Dependence on natural resources exports declined gradually following economic reforms after the oil boom ended in 1985, when economic growth fell into near crisis territory. Natural resource dependence returned during the 2000s commodity boom, although in a smaller scale. In this respect, the economy of modern Indonesia seems to continue the Dutch colonial tradition of thriving during commodity price booms and suffering during price busts (Booth, 1998).

Despite its long history of natural resources dependence, Indonesia is hailed as one of the few examples of countries that managed to avoid the Dutch disease, or the resource curse (Coxhead, 2007; Gelb, 1988; Hill, 2000). The Indonesian economy grew rapidly throughout the oil boom and continued to do so after the boom ended in 1985. Manufacturing grew faster than overall economic

growth. Moreover, living standards improved significantly, with the national poverty rate declining from 40 per cent in 1976 to 11 per cent just before the Asian Financial Crisis (AFC) hit in 1997-98².

The AFC hit Indonesia hardest among countries that were affected by the crisis. GDP fell by 13 per cent, and the poverty rate (based on World Bank's \$1.9 PPP/day) jumped from 47.4 per cent in 1996 to 66.7 per cent in 1998. The economy recovered quickly, but the crisis has changed the country permanently. After the crisis, average growth has been consistently below its pre-crisis level and manufacturing growth even lower. The national poverty rate has been declining since the crisis, albeit at a slower rate. It took nearly a decade to reach the pre-crisis poverty-rate.

Another natural resources boom began a few years after the country recovered from the AFC, but Indonesia has now diversified from oil to other resources, including coal and palm oil. Indonesia is no stranger to either of these commodities, both of which have been produced in the country since before Indonesia's independence. However, the scale at which they were produced during the 2000s commodity boom is unprecedented. This boom is different from the oil boom in many ways, both internally and externally. Internally, the political and economic setting in Indonesia has transformed radically, from a centralised autocratic government in the 1970s to a decentralised democratic one in the 2000s. Externally, the world has globalised to a much larger extent, and Asia now constitutes a larger share of the global economy.

Whether Indonesia has suffered from a case of the Dutch disease, or natural resources curse remains an open question. Its economic performance during the 2000s commodity boom and after, while relatively decent compared to other countries, is comparatively less remarkable than during the oil boom. The period saw slower economic growth, manufacturing growth and poverty rate reduction. Taking into account the immense and lasting effects the oil boom had on Indonesian economic development, it is important to investigate how much of the 2000s commodity boom affected the country. In this thesis, I empirically test the effect of the commodity boom on

² Based on Indonesia Statistical Agency (BPS) national poverty line

manufacturing value-added, poverty and several other outcomes. I also compare Indonesia's experience between the two commodity booms to find clues about the differences in economic performance.

1.3. Objectives of this thesis

The objective of this thesis is to find empirical evidence for the impact of natural resources on the economy. As mentioned above, this thesis consists of three studies. Each of them is a self-contained yet closely related research paper with a specific focus: the Indonesian macroeconomy, cross-country manufacturing sector, and local district welfare. This multi-level study on the impact of natural resources is important because natural resources affect the economy through specific channels at each level of analysis. Each study will complement the findings of the other two, thus providing comprehensive evidence of how natural resources, specifically their booms and busts, affect the economy.

Since the channels are different at each level, the measured outcomes and the variables of interest are also different between the three studies. At the macroeconomy level, the focus will be on the fluctuations of the real exchange rate, one of the primary indicators of the Dutch disease, during natural resources booms and busts. The cross-country level study will look at the impact of natural resource rents, a measure of a country's resource revenue less the cost of extraction, on manufacturing value-added. The local district level study will focus on the impact of international prices on poverty, household expenditure, and wages in resource-producing districts.

Given the differences in context, data, and the research questions between these studies, each will employ different research methods that are appropriate for each case. The first one will compare multiple methods to measure the real exchange rate and will use Indonesian macroeconomic data collected since 1966, therefore encompassing the last two natural resources boom. The second study will use an instrumental variable method to establish causality. It will use data from 149

countries, over the period of 1970 to 2014. The third study will use a panel fixed-effect method, using data from 450 districts, over the period of 2007 to 2013.

1.4. Key research questions and results

1.4.1. Chapter 4 - Measuring the Dutch disease in Indonesia

This study discusses the issues in measuring the Dutch disease and applies various measurement methods to the case of Indonesia. According to the Dutch disease theory, real exchange rate appreciation is one of the primary channels through which the natural resources sector can affect the other parts of the economy. Therefore, the rate at which the real exchange rate changes during a natural resources boom can indicate if a country is experiencing a Dutch disease and, to a certain degree, its severity. The Dutch disease literature defines the real exchange rate as the price ratio between non-traded and traded goods and services. While the definition is clear in theoretical terms, it is not easily defined in practical terms. Most goods and services are partly traded, and the level of tradability constantly changes, especially in the longer term.

The most widely used method to measure the real exchange rate (RER) is the trade-weighted RER. However, this is problematic for measurement of the Dutch disease as the definition of RER in this method is different from the theoretical definition. In this study, I will compare the trade-weighted RER to CPI, WPI, and GDP deflator based relative price. To address the issue of tradability, I will use a clearly defined definition of tradability so that there is a consistent classification for traded and non-traded sectors in GDP deflator, as well as for items in the CPI and WPI basket of goods and services. Indonesia is an interesting case because it has experienced two distinct natural resources booms in the past fifty years. Furthermore, the question of whether Indonesia had suffered from Dutch disease symptoms during either boom has important analytical and policy implications.

I find that while each method has its own advantages and disadvantages. The GDP deflator based relative prices is preferred to a CPI-based relative price if the objective is to measure the Dutch disease. This is because the GDP deflator based relative price can provide more detailed information about sectoral prices during natural resource booms. Moreover, the GDP deflator based relative price includes sectors that produce non-consumer goods, such as parts and components, which are not part of the consumer basket of goods, and also includes non-traded sectors, such as services, which are not included in the wholesale price index. In contrast, CPI-based relative price suffers from a more rigid classification in its basket of goods, with foodstuffs component given relatively heavy weight in the traded basket of good.

GDP deflator relative price shows a pattern predicted by the Dutch disease theory, with non-traded to traded price ratio appreciating during a natural resource boom. Due to data limitation, I cannot compare the price ratio pattern between the 1970s oil boom and 2000s commodity boom. Nevertheless, the relative price depreciation after the oil boom and the modest appreciation in the 2000s commodity boom is observable. Sensitivity testing by using combinations of specific sectors prices within the non-traded classification shows substantially differing patterns between sectors. For example, while both the construction sector and the trade, hotel and restaurant (THR) sector are both non-traded, their price changes during the boom were dramatically different, suggesting the importance of within sector dynamics.

[1.4.2. Chapter 5 – Natural resource rents and manufacturing](#)

The second empirical chapter of this thesis measures the impacts of natural resource rent on manufacturing value-added using cross-country data. This study moves the focus from Indonesia to a global scale to test if natural resources extraction has any effect on manufacturing. According to the Dutch disease theory, one of the impacts of natural resources boom is a long-term decline in traded non-resource sectors. These sectors, which typically include a broad range of activities, are often interpreted as the manufacturing sector. Several studies argue that the manufacturing sector has a

vital role in a country's long term economic development because it has "learning by doing effect" (Krugman, 1987; van Wijnbergen, 1984) and productivity spillover effects (Ellison et al., 2010; Greenstone, Hornbeck, & Moretti, 2010; Kline & Moretti, 2014).

This is important because many developing countries rely on the natural resource extraction sector while also they aspire to develop their manufacturing sector. On the one hand, if natural resource extraction does curtail manufacturing sector development, long-term economic development may suffer. On the other hand, RBI arguments suggest that industrial policies that promotes natural resource processing can encourage manufacturing development.

I use data from 149 countries over the period 1970-2014, covering the last two global resource booms (1970s oil boom and 2000s China-driven commodity boom). I estimate the model using an instrumental variable method that utilises fluctuations in world resource prices, weighted by each country's resource exports.

I do not find evidence for manufacturing contraction caused by natural resource rents. I find that an increase in natural resource rent has a mild positive impact on manufacturing value-added. However, the results vary when the data are divided into several sub-samples based on initial GDP per capita, the initial manufacturing share of GDP, boom period, and regional area. This suggests that there are other factors that can affect the relationship between natural resources extractions and manufacturing value-added, such as government policies. While my findings appear to reject the Dutch disease hypothesis, the implications of my findings are more nuanced. Factors such as timeframe, the definition of manufacturing and the measurement of natural resource rents may also affect the results.

1.4.3. Chapter 6 – Natural resource prices and welfare

The third empirical chapter measures the impacts of coal and palm oil international price on welfare indicators in Indonesia at the district level. The focus shifts back from the global scale to Indonesia at

the subnational level, specifically during the 2000s commodity boom. This study will show how the global market, through resource prices, affects people's livelihood at the localities that produce these resources. As such, while the two other studies are more focused on macroeconomic impacts, this study shifts the focus to district level indicators that can represent welfare. Furthermore, the focus on coal and palm oil will highlight that each resource has different channels to affect welfare.

The boom was driven by robust global economic growth, especially in China. Consequently, demand for various commodities, including coal and palm oil, increased rapidly throughout the period, which led to record high commodity prices. Commodity producers, including Indonesia, responded by ramping up production but the response took time.

Coal and palm oil are both crucial in Indonesian exports growth since *Reformasi*, the period after Indonesia's sudden transition to democracy in 1998. Increase in their prices can increase welfare in the districts that produce them by creating employment, increasing wages, and lowering the poverty rate. However, coal and palm oil have very different characteristics. While the location of oil palm plantations is dispersed and its production method relatively labour intensive, coalmines are concentrated in a few areas and use relatively capital-intensive production method. These differences, along with other characteristics, can lead to different impacts on welfare indicators.

I test the impact of coal and palm oil price on the poverty rate, average wages, average household expenditure, district inflation and employment using a panel fixed effects model. The data cover Indonesia's 450 districts from 2007 to 2013. The strategy is to exploit the within-country variation in exposure to each commodity, interacted with exogenous changes in global commodity prices.

I find that both commodity prices have significant poverty alleviating effects in districts that produce them relative to districts that do not. However, the mechanisms through which they affect poverty are different. While coal price has a positive impact on district average wages, palm oil prices only affect the wages of labour in the agricultural sector. In contrast, palm oil price has a positive impact

on employment, while coal price does not. I find no evidence that international prices have any effect on local inflation.

1.5. Contributions

This thesis observes the effects of natural resources booms through several different lenses. The first empirical chapter proposes a rethink of the way we measure the real exchange rate in the context of the Dutch disease and natural resources boom. Its contribution to the Dutch disease and natural resources boom literature is the new methods it introduces to measure non-traded to traded relative price. Instead of using trade-weighted real effective exchange rate, which is widely used in the literature, the paper constructs several price ratio indices using domestic price indices data. The paper also establishes a clearly defined definition of tradability that can be applied easily and updated when necessary. These indices offer an arguably more accurate and theoretically suitable measure of non-traded to traded price ratios during commodity booms and busts than the trade-weighted RER.

The second empirical chapter contributes to the natural resources impact literature in two ways. Firstly, it provides evidence on the total impacts of natural resources on the manufacturing sector. This is important because most studies on this topic measure the impacts on welfare or other social outcomes, not manufacturing. The manufacturing sector itself is important because evidence shows it is important in long-term economic development. The second contribution is the method. Previous studies on this topic may be affected by endogeneity problems (van Der Ploeg & Poelhekke, 2016). This paper addresses the possible reverse causality problem using an instrumental variable method, utilising each country's resource export prices as an instrument for natural resources rents.

The third empirical chapter has several contributions. Firstly, it looks at the impact of international commodity prices directly. International price is important because it is one of the main channels through which global commodity booms can affect welfare at the local level. Most studies on the impact of natural resources on welfare focus on the discovery of new resources or production

expansion to ensure exogeneity. This study argues that international price is exogenous to the district and exploits district-specific exposure to each commodity. The second contribution is the comparison between two commodities with distinct characteristics. Most studies either focus on one commodity or do not differentiate the measured impacts between commodities. This study shows that each commodity affects welfare through specific channels.

While each empirical chapter has distinctive contributions, together they provide a comprehensive view of how a natural resource boom can affect the economy through various channels, at different levels of analysis (cross-country, national and subnational). Outcomes are measured in various ways, including price level and inflation, real exchange rate, manufacturing value-added, poverty rate, average household expenditure, average wages, and employment.

1.6. Organisation

This thesis consists of seven chapters. Chapter 2 discusses the Dutch disease theory, natural resources curse thesis and related studies. Chapter 3 explains Indonesia's experience during the last two natural resources booms. Chapter 4 to 6 are empirical chapters. Chapter 4 presents a comparison between various methods used to calculate the real exchange rate and their application in the measurement of the Dutch disease. Chapter 5 attempts to find evidence for the impact of natural resources on manufacturing value added at a cross-country level. Chapter 6 analyses the impact of natural resource prices on welfare measurement on the district level. Chapter 7 summarises the key findings of my research and briefly discusses their implications.

Chapter 2

Theory and background: the Dutch disease and resource curse hypothesis

The idea that natural resource wealth can be bad for a country may seem paradoxical at first. After all, natural resources are important for a wide range of economic activities and have brought riches to people in many countries. To some, the phrase “natural resource rich countries” may generate images of oil-rich Saudi Arabia and Persian Gulf states such as Kuwait or Qatar. To others, the phrase can mean an entirely different set of countries, such as conflict-ridden Venezuela, Angola, or the Democratic Republic of the Congo.

Some of these resource-rich countries were already rich before they discover the resources, such as Norway and the Netherlands. Some others can get rich through the extraction of natural resources but lag in terms of social indicators such as inequality, institution, education, and health. For many countries, the pattern has been one of stagnation, or rather of booms and busts around a flat trend (Collier, 2007, p. 38), while also lagging in social indicators.

The fact that many countries fail to harness natural resource riches for development has puzzled economists for decades. Economists call this paradox “the resource curse” or “the paradox of plenty.” One of the earliest potential explanations for the curse is “the Dutch disease,” a phenomenon when natural resource exports make the country’s other traded sector uncompetitive, which then leads to slower technological progress and slower long-term economic growth. This chapter will summarize the theory and implications of the Dutch disease and the natural resources curse. Firstly, I will discuss the earliest papers that founded the theory. Secondly, I will discuss the modifications of the theory and attempts to uncover evidence for the Dutch disease. The chapter will then proceed to discuss the resource curse in general as well as its development in the literature.

2.1. The Dutch disease

The Dutch disease theory is developed to explain what happens to a small open economy with a booming extractive sector. The Economist coined the term to describe the woes of the Dutch economy after the discovery of large gas reserves in 1959 (The Economist, 1977). Gas exports led to an influx of foreign currency, which increased demand for the guilder and thus made it stronger. This made other parts of the economy less competitive in the international market. From 1970 to 1977, unemployment soared from 1.1% to 5.1%. The experience of the Netherlands spread fears of similar incidents to other industrialised countries with energy resources, including the United Kingdom, which saw manufacturing shrink in the late 1970s.

While the idea that the extractive sector can harm long-term economic development was not new, at the time, there was no formal theoretical explanation as to why or how it might happen. There was already scepticism towards the idea that promoting natural resources processing is the best way to develop a country's industrial base. Roemer (1978), for example, criticised Resource-Based Industrialisation (RBI) arguments and cast doubt that RBI can achieve its promises. A few years later, W. Max Corden and J. Peter Neary published a paper which provides the theoretical explanation for the Dutch disease (Corden & Neary, 1982). Theoretically, the Dutch disease is a resource reallocation process away from less profitable non-booming tradable sectors (manufacturing) to more profitable non-tradable sectors. Although it is called a "disease," the Dutch disease in itself does not have any direct welfare implications. For the Dutch disease to have negative welfare implication, it has to lower long-term growth by limiting the learning-by-doing effect and, as Krugman (1987) argues, the manufacturing sector does not recover after the resource boom ends.

Corden and Neary (1982) and Corden (1984) develop the core theoretical model of the Dutch disease phenomenon in a small open economy with a booming extractive sector. The discussion of the Dutch disease theory in this chapter largely summarises the explanations as given by Corden and Neary (1982). Their model assumes three sectors in the economy: traded extractive sector, traded

manufacturing sector, and non-traded services sector. There are two factors of production, i.e. capital and labour, but the extractive sector only shares labour with the other two sectors and has its specific kind of capital which can only be used in the extractive sector. The effects of the booms take two forms: resource movement effect and spending effect. The *resource movement effect* refers to the reallocation of factors of productions from non-booming and non-traded sector to the booming sector. *Spending effects* refer to the effect of increased income which expands domestic aggregate demand. While traded goods can be imported at the international price, non-traded goods have to be produced domestically. As a result, spending effects increase the relative price of non-traded goods to traded goods (defined as real exchange rate appreciation in this literature), further drawing resources away from the non-booming traded sector.

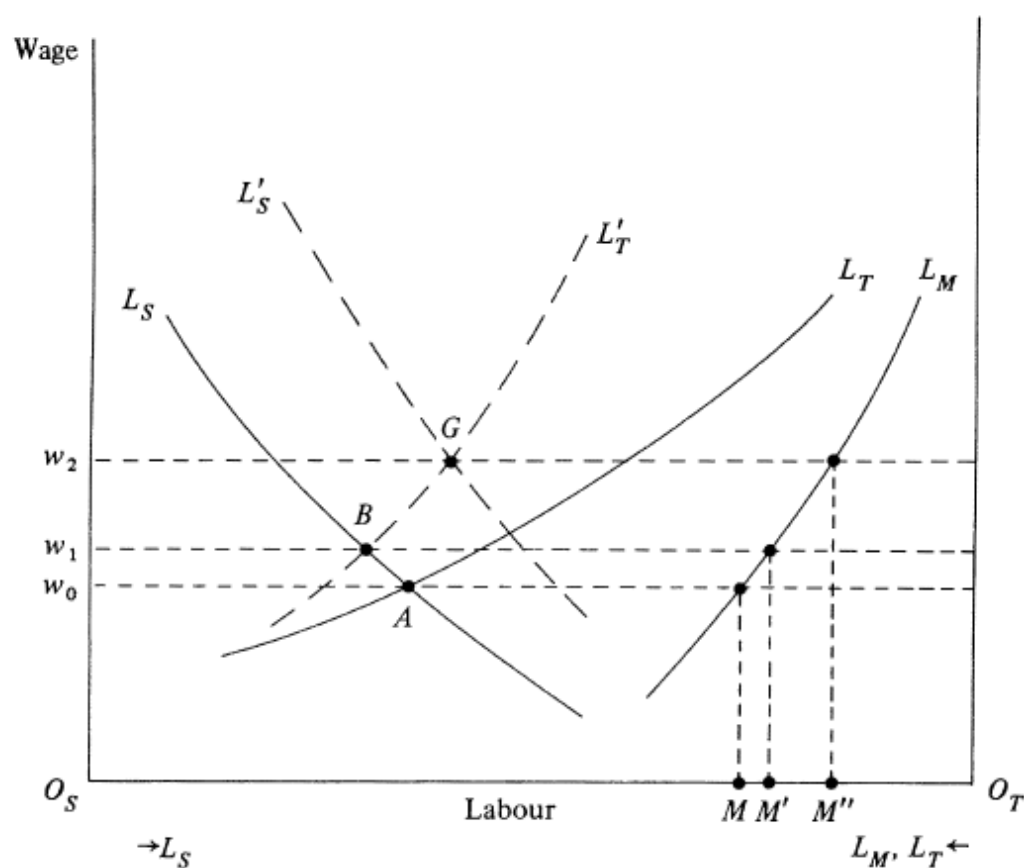


Figure 2.1. Effect of resource boom on the labour market

Source: Corden and Neary (1982)

Figure 2.1 illustrates a labour market with the traded sector (T) and non-traded services sectors (S). The wage rate (on the vertical axis) is measured in terms of manufacturing goods, and the economy's total labour supply is given by the horizontal axis $O_S O_T$. Labour input into services is measured by the distance from O_S while distances from O_T measure labour input into two traded sector goods (manufacturing and extractive goods). Demand for labour in each sector is a decreasing function of the wage rate relative to the price of the sector's output. L_M is the labour demand schedule for the manufacturing sector, and by laterally adding to this the initial labour demand schedule for the extractive sector we obtain L_T , the pre-boom labour demand schedule for the two traded goods sector combined. Likewise, L_S is the initial labour demand schedule for the services sector, drawn for the initial price of services. Point A is the initial full-employment equilibrium, where L_T intersects L_S , with initial wage rate w_0 .

When the boom starts, the extractive sector's labour demand schedule shifts upwards by an amount proportional to the technological progress: the latter acts in exactly the same way as a price increase, rising profitability and the demand for labour in the extractive sector at a given wage rate. This is the resource movement effect. This, in turn, causes the composite labour demand schedule L_T to shift upwards to L'_T , and so a new equilibrium at B is attained. Wage rate in the new equilibrium is w_1 , which is higher than the initial w_0 at a constant real exchange rate. The higher wage rate then causes labour to move out of both manufacturing and services sector. Since this causes employment in manufacturing to fall from $O_T M$ to $O_T M'$, we may say that the resource movement effect gives rise to *direct deindustrialisation*. Furthermore, because the resource movement effect moves labour out of the services sector, the effect leads to excess demand for services. To restore the equilibrium, the price of services has to increase (i.e. an appreciation of the relative price of non-traded to traded goods). The increase in the price of services will eliminate the excess demand, switching demand away from services and dampening the fall in the sector's output induced by the resource movement effect. This, however, cannot reverse the fall in the services sector output.

The next thing to consider is the spending effect. Provided the demand for goods and services rises with income, demand at the initial price level increases with the increase in the wage rate. This causes an excess demand for services, but not for traded manufactured goods, which can be imported. This, again, must be followed by an appreciation of the relative price of non-traded goods to restore equilibrium. In effect, labour demand schedule for services sector shifts upwards to L_S' , moving the final equilibrium to point G and as a result, causing wage to increase further to w_2 . The spending effect, therefore, increases the output of services compared with the initial situation.

Together, both effects contribute to an increase in the real exchange rate, i.e. the relative price of non-traded to traded goods and services.³ While the spending effect tends to increase non-traded sector output, the resource movement effect tends to lower it, and there is no presumption as to which will dominate. This ambiguity of output, however, does not apply to the non-booming traded sector. While the resource movement effect lowers non-booming traded sector output directly through the movement of factors of production, the spending effects contribute indirectly through expansion in non-traded sector demand. Thus, the boom gives rise to both direct and indirect deindustrialisation.

In this model, the declining non-booming traded sectors (i.e. manufacturing and agriculture) are regarded as the 'learning by doing sector' (Krugman, 1987; van Wijnbergen, 1984), which historically has been the vehicle for technological progress. Krugman (1987) argues that this phenomenon can only be regarded as a 'disease' if the manufacturing sector does not rebound after the resource boom. Furthermore, the idea of the Dutch disease can be applied to any sector which become the primary generator of foreign exchange in a country, such as remittances (Acosta, Lartey, & Mandelman, 2009; Amuedo-Dorantes & Pozo, 2004; Lartey, Mandelman, & Acosta, 2012) and foreign aid (Rajan & Subramanian, 2011; van Wijnbergen, 1986; Younger, 1992).

³ Although Corden and Neary (1982) use the term real exchange rate in their publication, I use the term relative price of non-traded goods for reasons discussed further in this section.

The Dutch disease impact in terms of the increase in the relative price of non-traded to traded goods can also be demonstrated using the production possibility curve analysis. To do so, this study draws on Warr's (1984) paper on exchange rate protection in Indonesia. Figure 2.2 illustrates the production possibility frontier before and after a resource boom. The production possibility curve before the boom is depicted by the schedule $N'T'$. In this diagram, tradeables include goods produced by both the manufacturing and the resource sectors. The price of tradeables will be determined by international prices, the exchange rate, and any tariffs or other taxes which may be present. On the other hand, non-tradeables prices are determined by domestic supply and demand conditions. For convenience, it is assumed that domestic demand conditions can be represented by the social indifference curves U_0 , U_1 , and U_2 . The initial equilibrium is at point A. The level of absorption, measured in terms of non-traded goods, is N_A and the price of traded goods relative to non-traded goods is given by the slope of the common tangent at this point, P_A . The expansion path OY represents the pattern of demand when relative prices are held at P_A , and aggregate expenditure is increased. The positive slope OY reflects the assumption that both traded and non-traded are normal goods.

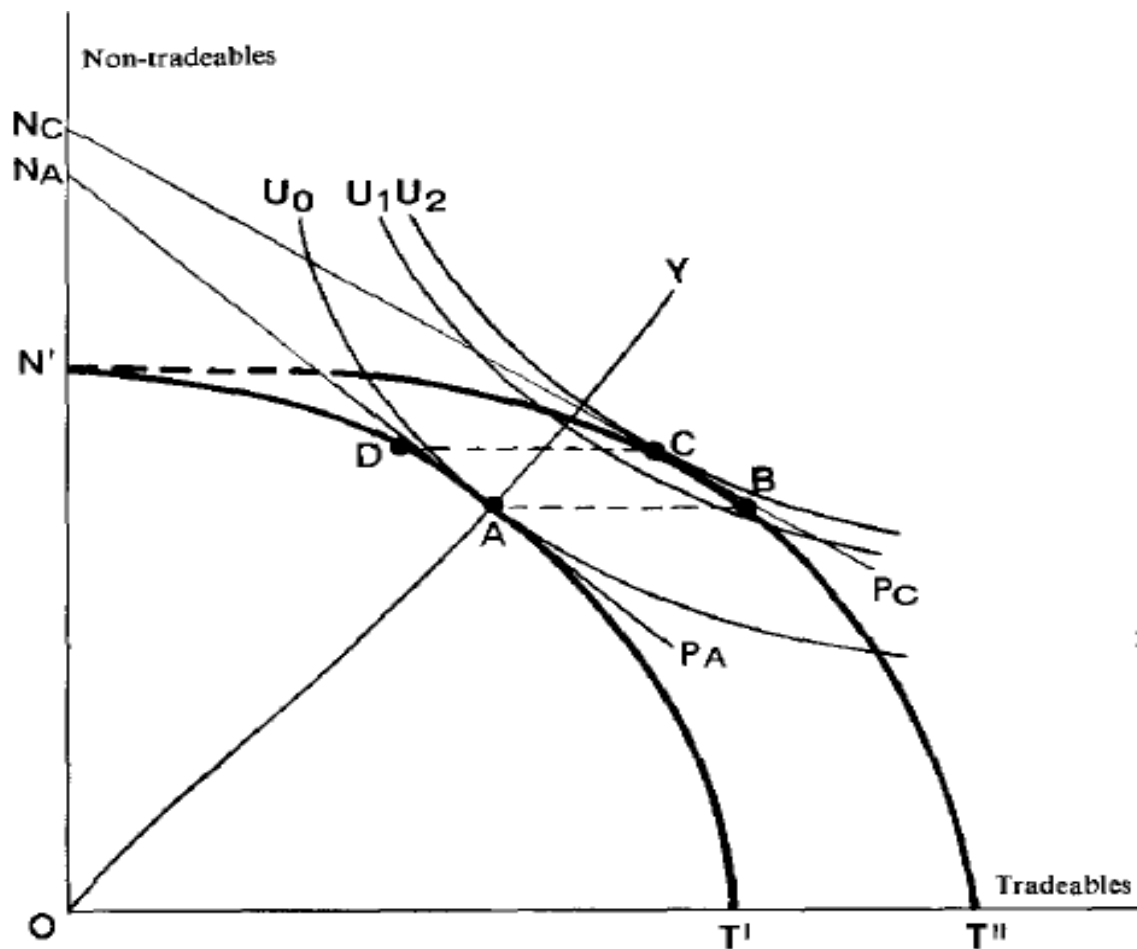


Figure 2.2. Production Possibility Curve during resource boom

Source: Warr (1984)

Before discussing the price adjustment mechanism during a resource boom, I will show how a balance of payment deficit operates in the production possibility curve. Suppose that no resource boom has occurred and therefore that $N'T'$ is the relevant production possibility frontier. Let the initial traded/non-traded goods price ratio be given by the slope of $N'T'$ at D , P_D , which is less than P_A . Production occurs at D and assuming the non-traded goods market clears, consumption will occur at point C , lying at a point where a line drawn horizontally to the right from D cuts an indifference curve having the slope P_D . Thus, $P_C = P_D$. The distance DC now represents the balance of payment deficit on the current account – the degree by which the consumption of traded goods exceeded their production. To eliminate this deficit, a rise in the traded/non-traded price ratio (from P_C to P_A) is necessary (in other words, a decline in the relative price of non-traded goods to traded goods). This permanent change in relative prices might be achieved by domestic deflation at a fixed

exchange rate or by devaluation followed by a less than commensurate rise in the domestic price level.

Now suppose the schedule $N'T''$ illustrates production possibilities after the resource boom. The old production possibility schedule, $N'T'$, now represents the non-resource sector of the economy. Since few domestic factors of production are employed in the resource-producing sector, the boom is represented as a horizontal shift in the production possibility schedule. The slope $N'T''$ at point B is the same as that at point A, but B is not an equilibrium. Producers are willing to produce at this point given the initial price, but this combination of traded and non-traded goods will not be consumed at these prices. These relative prices can be maintained if absorption is restrained. In particular, if non-traded market clears, as we expect, consumption must be at A and there will be an excess supply of traded goods (a balance of trade surplus on current account) of the amount AB. The level of absorption, exogenously given in the present discussion, must be held at N_A .

If full absorption is to occur, the traded/non-traded price ratio must fall (that is, an increase in the relative price of non-traded to traded goods). The new equilibrium will be at point C, at which absorption is N_C and traded/non-traded price ratio will have fallen to P_C . The crucial point is that in the non-resource sector of the economy, as indicated by the old production possibilities schedule, $N'T'$, production has moved from A to D. The non-traded sector has expanded, but the non-booming traded sector has contracted. This outcome is equivalent to the one explained in Figure 2.1 and occurred in spite of the fact that national income has risen. This contraction in the non-booming traded sector, the 'Dutch disease', is arrived at by reduced profitability in that sector, and this represents the heart of the adjustment problem. On the other hand, if absorption does not occur, consumption remains at A, production occurs at B, and the price ratio remains P_A . Reserve would then be accumulated indefinitely at the rate AB. The benefits of the resource boom, in terms of increased consumption, are then deferred, and no contraction of the non-booming traded sector occurs.

Some countries, including Indonesia during the 1970s oil boom, try to prevent the tradeables/non-tradeables price ratio from continuing to decline as the resource boom proceeds. The objective is to keep the price ratio as close to P_A as possible in the interval between P_A and P_C , or at least to delay transition towards P_C . To achieve this objective, the country has to (i) maintain a fixed exchange rate and (ii) restrain money growth. Maintaining a fixed exchange rate is to hold traded goods prices constant (assuming international prices are constant), and restraining money growth is to hold the non-traded goods prices constant. The main aim of such policies is to prevent inflation in non-traded goods prices, which would otherwise occur following the absorption of resource revenues, and which would decrease the traded/non-traded price ratio. If this policy fails, the country can devalue its currency and put a further restraint on monetary growth. The effect of devaluation will be more immediate, but its effect will only have a temporary effect on tradeables/non-tradeables price ratio if monetary growth cannot be restrained. Devaluation will rise traded goods prices, with some lags, but the increase in non-traded goods prices can only be prevented if domestic demand is restrained.

During the 1970s oil boom, the Indonesian government devalued its currency several times based on this idea. Warr (1984) evaluates the 1978 and 1983 devaluation using this framework. He argues that part of the motivation for these devaluations was also to protect domestic traded goods-producing sectors, which held some political power. These devaluations were not managed well in the short term, especially the 1978 devaluation and the government needed to impose price controls on imported goods. However, they managed to achieve its protectionist objectives in the long term.

Empirical evidence for the Dutch disease is mixed. In his study of oil exporters during the 1970s oil boom, Gelb (1988) finds evidence of contraction in the traded non-booming sector in Ecuador, Iran, Nigeria, and Trinidad and Tobago, but not in Indonesia, Algeria, and Venezuela. However, the contraction was only found in the agricultural sector, not in manufacturing. Several studies measure the Dutch disease effect in real exchange rate appreciation (Cashin, Céspedes, & Sahay, 2004; Y.

Chen & Rogoff, 2003; Spatafora & Warner, 1999), but these are not always accompanied by manufacturing contraction. Other studies find evidence of a manufacturing contraction effect of the Dutch disease in terms of value-added (Allcott & Keniston, 2014; Ismail, 2010) or employment (Beine, Bos, & Coulombe, 2012). Contrastingly, there is evidence for productivity spillover effects from the resource extraction sector to the rest of the economy, which do not lead to a decline in manufacturing (Bjørnland & Thorsrud, 2016).

2.2. The natural resource curse, a short review

The “natural resource curse,” a term popularised by Sachs and Warner (1995), suggests that a country with a high dependence on natural resource exports will have lower long-term economic growth than its resource-poor counterparts. Since then, the literature has grown rapidly – a Google Scholar search shows that the number of studies that explicitly referred to the term has grown from only 13 in 1995 to 543 in 2005, and 2360 in 2015 (Papyrakis, 2016). While the initial focus is on economic growth, it has since been expanded to a vastly diverse range of topics from poverty, to education, institutions, and conflict. The literature has also been evolving with the discipline as more methods, and detailed data become available.

As I mentioned, there are two major ways to explain why the natural resources curse may happen: (i) a market-based viewpoint on macroeconomic mechanisms and (ii) a political economy approach stressing on the role of institutions (Deacon, 2011). The market-based explanations are first suggested by Sachs & Warner (1995), who find that a one standard deviation increase in the primary product exports share reduced a country’s predicted growth rate by 0.6 to 1.5 percentage points. Sachs & Warner (1999, 2001) emphasise the Dutch disease as an explanation for their findings.

There are several other explanations based on a “crowding out” phenomenon, where a windfall diverts economic activity in counterproductive ways. Gylfason (2001) argues that countries with natural resources wealth tend to view natural resources as the key to their futures and to neglect educational investment as a result. Torvik (2002) argues that a resource boom diverts

entrepreneurial talent away from wealth creation which could modernise an economy, and toward seeking resource rents from the public sector. Other explanations include the volatility of commodity prices, which can negatively affect growth (van der Ploeg & Poelhekke, 2008). Manzano & Rigobon (2001) argues that the resource curse was the result of natural resources abundant countries using high commodity prices during booms as collateral for debts.

The political economy approach, in contrast, stems partly from findings that resource abundance is most likely to be a curse when the resources are concentrated rather than dispersed and when the host country's political institutions are initially weak (Bulte, Damania, & Deacon, 2005; Deacon, 2011). However, the importance of political economy has been hinted at by Gelb (1988), in one of the earliest studies on this topic. According to Gelb's (1988) study of six oil exporters, most oil windfalls were spent on investment, which conventional growth theory predicts should accelerate growth, yet growth in these countries lagged. Government and politics clearly had a role in the outcomes, since they received the windfalls that financed the investments on public infrastructure that yielded meagre returns. Therefore, government decision making was a significant factor.

The political economy approach focuses on the institutional effects of natural resources, which fosters rent-seeking behaviour (Dauvin & Guerreiro, 2017). Some studies argue that poor institutions foster the rent-seeking behaviour through the "voracity effect" (Lane & Tornell, 1996), a form of rent-seeking that occurs in a poor legal-political institution framework in which powerful groups have the ability to hijack and seize natural resources for their benefit. Similarly, Mehlum, Moene, and Torvik (2006b, 2006a) argue that more natural resources push aggregate income down when institutions are "grabber-friendly". Conversely, other studies argue that poor institutions are a result of rent-seeking behaviours, not the cause. These studies argue that rent-seeking behaviour hinders democracy (Ross, 2001), weakens property rights (Hodler, 2006), and increases corruption (Caselli & Michaels, 2013).

At least two strands of empirical studies have emerged, the first one uses cross-country data and observes the impact at the national level, and the second one uses sub-national data and local impacts (van Der Ploeg & Poelhekke, 2016). Earlier studies use cross-country data and estimate the impact of resource dependence on macroeconomic outcomes. This cross-country evidence offers various possible explanations for why resource dependence can lead to slower economic growth. The first offered explanation is the standard Dutch disease effects (Corden & Neary, 1982), which suggest that appreciation of the real exchange rate associated with natural resource exports leads to the loss of learning by doing in declining traded sectors as factors of production move out to the booming traded sector (van Wijnbergen, 1984). Other potential explanations include unsustainable policies, bad institutions, poor rule of law, ethnic fractionalisation, armed conflict, badly developed financial systems, and the crowding out of growth-promoting foreign direct investment (FDI) (as surveyed by Van Der Ploeg (2011)). These studies also point out that the diverging experiences between countries can be explained by differences in institutions (Mehlum et al., 2006a).

However, the cross-country evidence has several weaknesses, such as confounding factors and endogeneity issues in previous studies (van Der Ploeg & Poelhekke, 2016). Firstly, the use of resource dependence (ratio of natural resource export to GDP) or resource abundance (total amount of sub-soil wealth) as an explanatory variable to economic growth suffers from endogeneity issues. Secondly, the notorious volatility of commodity prices might be more important in explaining the resource curse than dependence or abundance (van der Ploeg & Poelhekke, 2010). Thirdly, cross-country regression inevitably suffers from omitted variable bias and numerous confounding variables. Furthermore, some of the variables at the cross-country level, such as institutions, financial development, and political environment are often correlated and hard to differentiate. Within-country analysis has the advantage of fewer confounding factors since there are fewer variations in legal, institutional and political explanation as compared to cross-country analysis.

In response to criticism to cross-country studies, recent studies have been using new approaches with better identification strategies and more innovative datasets. These include using new oil discoveries (for example, Arezki, Ramey, & Sheng, 2015; Tsui, 2011), within-country evidence (for example, Caselli & Michaels, 2013; Cust, Harding, & Vezina, 2017; Dube & Vargas, 2013; James, 2015), local impact (Allcott & Keniston, 2014; Weber, 2012, 2014), and geography and border (Bonfatti & Poelhekke, 2017; Cust & Harding, 2013).

Chapter 3

Indonesia, a tale of two booms

Like many other resource-rich developing countries, Indonesia has tried to harness resource wealth for economic development for a long time. It is a country that has been a resource exporter since the colonial period, before modern Indonesia was formed. While the country has changed in many ways, dependence on natural resource exports continued after it achieved its independence from the Dutch in 1945 (Figure 3.1). It is therefore familiar with the dilemma of resource booms and busts, with the share of natural resource exports rising during price booms and declining during busts.

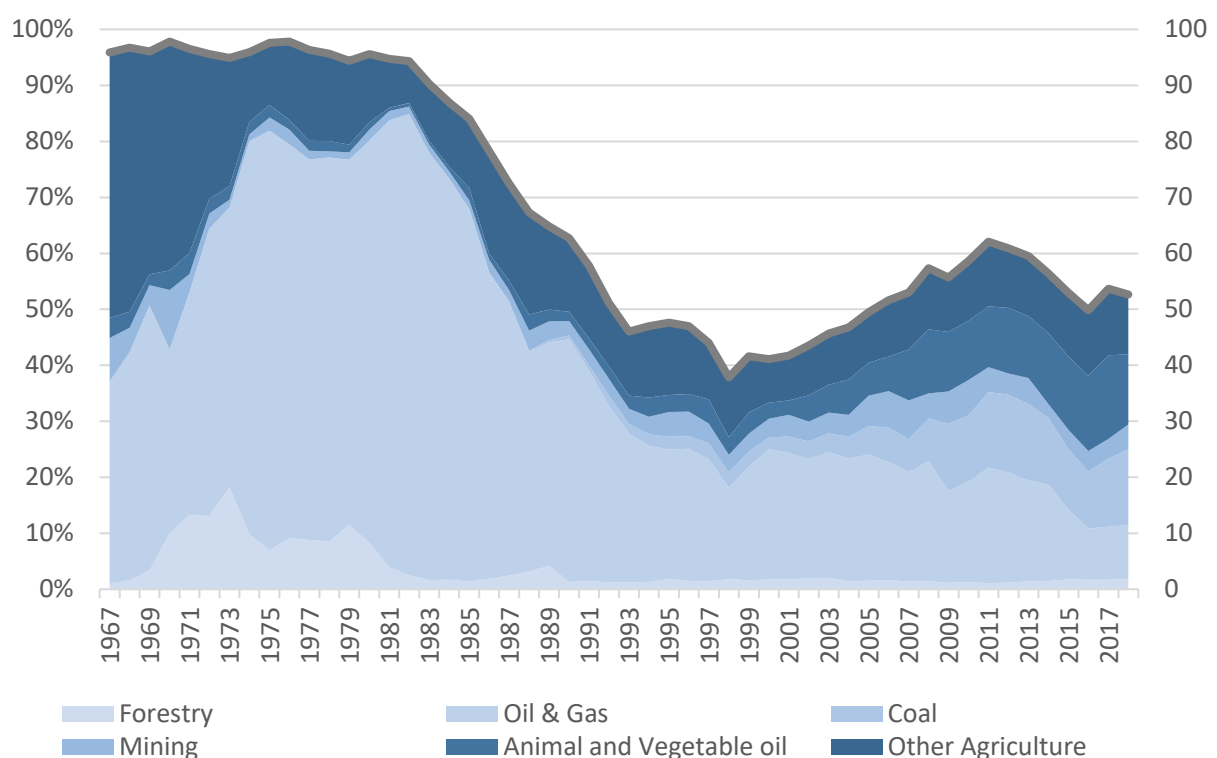


Figure 3.1. Percentage share of natural resources in Indonesia's total merchandise export 1967-2018

Source: Author's calculation based on UNCOMTRADE data. Notes: resource-based sector includes agriculture, forestry, mining, and oil and gas.

Since its independence in 1945, the country has experienced two resource-booms, the 2000s commodity boom, and the oil boom in the mid-1970s to early 1980s. Coincidentally, both booms occurred after political and economic turbulence. While the oil boom occurred after Suharto took

power during a period of economic crisis and hyperinflation in 1966, the 2000s commodity boom occurred after he stepped down in 1998 during the Asian Financial Crisis (AFC). Consequently, both booms have had a huge impact in shaping the economic structure and political setting in Indonesia. This chapter will briefly discuss the background of each boom, how Indonesia responded to it, and provide an overview of the country's economic performance.

3.1. The 1970s oil boom

Before the 1970s oil boom, there was little reason to believe that Indonesia will perform well economically. Economic mismanagement during the early years of the republic caused economic crisis and hyperinflation during the first half of the 1960s. Indonesia's manufacturing sector at the time had not had any meaningful changes since the final years of Dutch colonialism in 1941 (Thee, 2006). Remarkably, Suharto's New Order government, which came to power in 1966, achieved macroeconomic stabilisation through a series of reforms. Inflation was quickly tamed from more than 600 per cent in 1966 to 4 per cent in 1971. The exchange rate, persistently overvalued since 1955, was devalued (Gelb, 1988) and restriction on foreign exchange transactions was abolished. Budget deficits were soon curbed through the implementation of a "balanced" budget principle (although foreign aid and loans for development were counted as revenue rather than financing). Taxes collected by the central government climbed from a low of 4 per cent of GDP in 1965 to 10 per cent in 1970. GDP growth accelerated from an average of 2.1 per cent per annum between 1961 and 1966 to 7 per cent between 1967 and 1973. In short, the Indonesian government successfully stabilised the economy before the oil boom started.

The boom started in 1973, triggered by at least three factors. Firstly, the boom was preceded by strong global economic performance. The world economy grew by 5.6% in 1972 and by 6.4% in 1973 with most growth coming from OECD economies, which represented 68% of world GDP in 1973. Secondly, it was also accompanied by crop failures all over the world and saw Soviet Union grain production drop by 36 million metric tonnes. The crop failure was followed by price surges in other

agricultural commodities because producers switched to food crops which in turn resulted in falling agricultural raw materials supply (Radetzki, 2006). The final and strongest trigger for the boom was the OPEC oil cartel which caused oil prices to increase nearly eighteen fold from 1960 pre-boom price to its peak in 1980. This oil boom can be viewed as two related episodes, the first was when oil prices rose by 78% in 36 months (January 1971 – January 1974) during the 1973 OPEC embargo, and the second was when oil prices rose again by 63% in only 13 months (October 1978 - November 1979) during the 1979 Iranian revolution (Cashin, McDermott, & Scott, 2002). The boom ended with a slump phase, which lasted 80 months, largely because of the breakdown of OPEC's supply management practices.

The oil boom gave the Indonesian government an unprecedented resource windfall. Corporate tax on oil increased from merely 35 per cent of government revenue in 1973-1974 to 54 per cent in 1974-1975. Government's total revenue grew rapidly throughout the oil boom with the share of natural resource revenue in total revenue reached its peak of 71 per cent in 1981-1982. Before discussing how the government spent the resource windfalls, it is worth mentioning that Indonesia's response to the oil boom was to some extent, influenced by the Pertamina Crisis in 1975 (Gelb, 1988). Just two year into the oil boom, Pertamina, Indonesia's state oil company, failed to meet its obligations to foreign creditors. It failed to meet its obligation in 1974, and the government was forced to allocate the equivalent of two-fifths of one year's oil windfall to repay Pertamina's debt. The crisis made the government cautious of becoming too dependent on oil revenue and determined not to be excessively indebted⁴.

The government's first response to the oil windfall was to increase development spending. Gelb (1988) estimates from 1973-1974 to 1977-1978 the government allocated 49 per cent of the windfall in mining value added to public investment. Infrastructures, particularly labour-intensive public work projects undertaken through INPRES program, received 43 per cent of development spending.

⁴ For more discussion on this topic, see McCawley (1978)

Agricultural development programs, including irrigation and subsidies on fertiliser, pesticide and seed, received special attention. During the first part of the oil boom (1973-1978), the agricultural sector (including irrigation works but not fertiliser subsidies) received about 13 per cent of development spending, while fertiliser subsidies averaged 11 per cent of all domestically financed development spending. These programs contributed to the rapidly declining poverty rate throughout the country, where the national poverty rate (based on Indonesia Statistics poverty line) declined from 40.1% in 1976 to 17.4% in 1987.

However, the merit of some of the programs is debatable. Public industrial firms, including several highly subsidised projects such as aircraft and steel industries, also received public investment. Moreover, this period saw a highly protectionist trade policy with ambitious programs of heavy industrialisation (Basri & Hill, 2004; Pangestu, Rahardja, & Ing, 2015). Industrial output grew rapidly during this period, although most of the growth came from petroleum-related and heavy industries.

When the oil price started to decline in the mid-1980s, the government's oil revenue went down with it. Faced with a drop in economic growth in 1983-85, the government then decided to change course and enacted a series of tax reforms and liberalisation policies to accelerate an export-oriented industrialisation process and started to develop an economic base other than oil. Those measures were largely successful in achieving that target. The non-oil manufacturing sector grew by more than ten per cent annually between 1986 and 1996, while the economy as a whole grew by an average of 7.1 per cent. Oil and gas exports also declined rapidly, from more than ninety per cent of national export⁵ in 1981 to less than forty per cent in 1998. Export growth was driven more by manufacturing exports, particularly in textiles, machinery and furniture. This export-oriented industrialisation generated a rapid, broad-based growth which increased demand for labour and wages. Moreover, the national poverty rate continued to decline, reaching 11.3% in 1996.

⁵ Includes oil and gas, forestry, mining, and agriculture

At this point, it is fair to say that Indonesia managed to escape the curse of natural resource wealth during the oil boom. Indonesia did better in managing the windfall than other resource-rich countries such as Nigeria (Gelb, 1988; Pinto, 1987; Scherr, 1989) or Mexico (Scherr, 1989; Usui, 1997). Gelb (1988) attributed the good performance to three distinctive features of Indonesian economic policy at the time: flexible exchange rate policy, prudent macroeconomic management, and broad development strategy that emphasised raising rural incomes. Others attribute it to the importance of recycling the mechanism of resource windfall into productivity-enhancing investment in the traded sectors, notably agriculture and manufacturing (Coxhead, 2007; Coxhead & Li, 2008; Pinto, 1987).

3.2. The Asian Financial Crisis and *Reformasi*

The progress was suddenly brought to a halt in 1998 by the AFC, which led to the fall of Suharto. The AFC had catastrophic effects on Indonesia's economy. Economic growth dropped to -13.6 per cent in 1998 and, due to the fact that monetary authorities temporarily lost control of monetary aggregates, the inflation rate reached 65 per cent. Bank Indonesia also lost control of the Rupiah, which was pegged to the US dollar up until this point. The currency depreciated from 2,500 Rupiah per US dollar in July 1997 to 17,500 in May 1998. The poverty rate (based on World Bank's \$1.9 PPP poverty line) jumped to 66.7 per cent in 1998, removing nearly a decade of progress in poverty reduction. Politically, the fall of Suharto marked the start of the *Reformasi* era, where the political system transformed from a centralised autocracy into a decentralised democracy almost overnight.

In the spirit of decentralising power from the centre to the regions, some stark policy changes were made. The new decentralised system gave some authority to the regional governments, especially the district (*Kabupaten*) government, to grant natural resources concessions to the private sector. The changes in policy are different for each kind of resource, with stricter regulation in the oil and gas, as well as the mining sectors, but relatively lax in the forestry and cash crops plantation sectors.

These changes to regulations and the differences between sectors had profound implications for the composition of Indonesia's resources extraction and exports during the 2000s commodity boom.

The natural resources sector is not the only sector that experienced changes during the Reformasi era. Significant changes also occurred in other areas including the exchange rate regime, labour laws, as well as in trade policy. The exchange rate regime shifted to a managed floating regime, which still allows for central bank intervention but generally let the Rupiah fluctuate. Although the Rupiah never recovered in nominal term to its pre-crisis level, Bank Indonesia managed to lower inflation from 72% in 1998 to just 2% in 1999 and maintained an average annual inflation rate of 8% between 2000 and 2015, with occasional jumps due to adjustments in government subsidised fuel prices. In many ways, labour laws become stricter during Reformasi. Regional minimum wages continue to rise rapidly throughout the country, while employment contracts are becoming much less flexible compared to during the New Order period. As part of the IMF package, the country also liberalised its trade regime, lowering import tariffs on most commodities.

3.3. The second boom

Outside of Indonesia, the global economy was also rapidly changing. Another commodity boom started in 2004, triggered by a surge in commodity demand. Similar to the 1970s oil boom, the 2000s commodity boom was preceded by strong global economic growth. However, instead of being driven by developed economies, the main driver in the 2000s commodity boom was China, and to a lesser extent, India. In 2004, the year when commodity prices rose substantially, economic growth in the OECD area was at a historical high of 3.2%, while growth in developing Asia was 8.5%. By then, China's economy had been growing at unprecedented rates for several decades. Its economic size was already large enough to affect the global economy, and it was about to join the WTO in 2005. This is important to the commodity market because China was passing through a development stage which is much more commodity-intensive than the dematerialising OECD economies (Radetzki, 2006).

From 2000 to 2015, China's economy grew by an average of 9.7% per annum. This rapid economic growth simultaneously increased competition in the global manufacturing output market, supported the rise of highly complex production networks in East and Southeast Asia, and triggered a sharp increase in global commodity demand. Demand acceleration in the early 2000s took commodity suppliers by surprise, leading to supply shortage which drove the increase in prices. Although it eventually encouraged suppliers to increase production, the response was not instant. It took years until global commodity production could fulfil the increase in demand. The boom was briefly interrupted by the Global Financial Crisis in 2008, which reduced commodity demand in developed countries but not in China and India. Supported by the consistently growing commodity demand in developing Asia, commodity prices recovered quickly, and by 2010 they had climbed back to pre-crisis levels (Figure 3.2). The price hike continued until 2013 when it reached its peak.

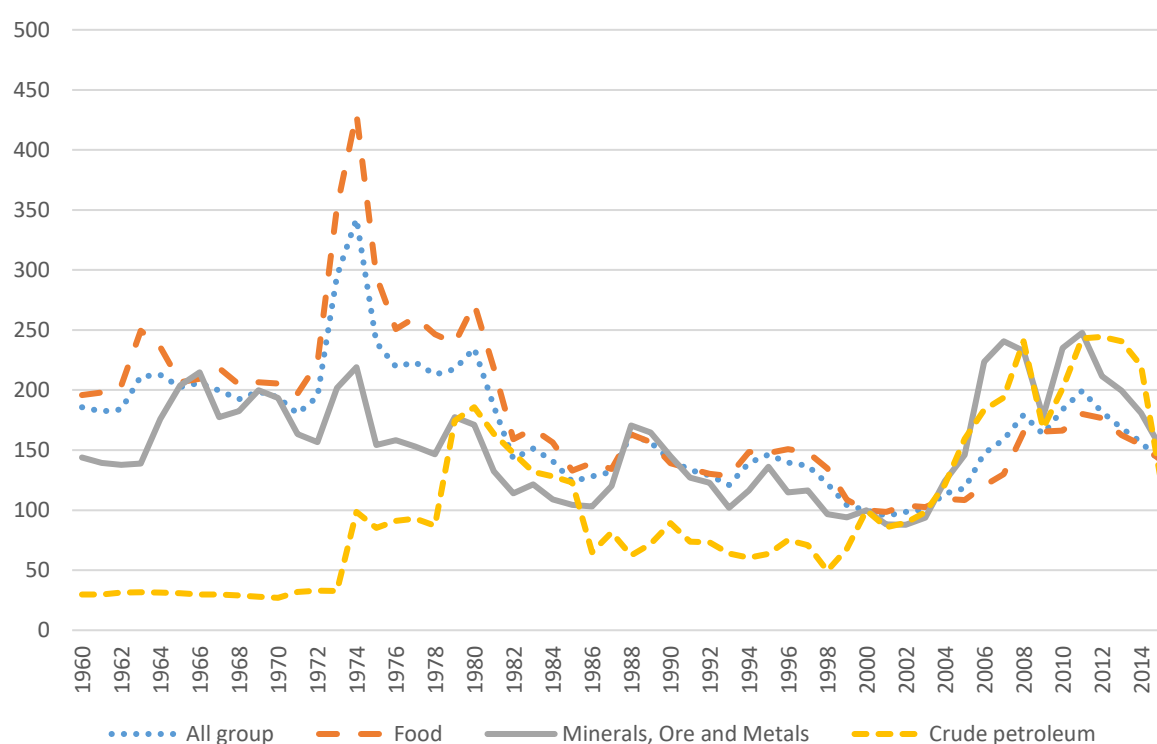


Figure 3.2. Commodity price indices, USD price, inflation-adjusted (2000=100)

Source: UNCTAD. Note: Food group includes wheat, maize, rice, sugar, soybean meal, vegetable oil (soybean oil, groundnut oil, sunflower oil, copra oil, coconut oil, palm oil, palm kernel oil, cottonseed oil), banana, beef, fish, coffee, tea, and cocoa. Mineral, ore and metals group includes iron, aluminium, copper, nickel, lead, zinc, tin, tungsten, gold, and silver. Crude petroleum group is a simple average of UK Brent, Dubai, and Texas.

The internal changes during the Reformasi era, coupled with global trends, contributed to significant changes in Indonesia's economic structure during the Reformasi era. Just as the Rupiah became weaker and new regulation started to hinder manufacturing growth, the commodity demand boom offered new opportunities. These factors started Indonesia's rapid re-specialization in exports of resource-intensive commodities. Since the AFC, the economy has been growing slower than the pre-crisis average. Average economic growth dropped from 6.8 per cent per year between 1986-96 to 5.3 per cent between 2000-15. Manufacturing, which used to be the engine for growth between 1986-96, never grew faster than the economy as a whole. Meanwhile, merchandise exports more than tripled in value from 2001 to 2011, driven by commodity exports, the share of which in total merchandise exports grew from 41.7% to 62.1%. This time however, it was not oil that contributed to the country's commodity exports growth, as oil production has been steadily declining during the 2000s. Instead, coal and palm oil became the two most important sources of export growth.

3.4. Comparison and overview

There are fundamental differences between the 1970s oil boom and the 2000s commodity boom. Firstly, the characteristics of the commodities that drove each boom are different. Each commodity has distinct characteristics, but in terms of how it affects the economy during a boom, at least three factors are important: concentration, production technology, and ownership. These differences may have distributional impacts in the producing region, which can then affect wages, inequality, and economic structure in general. While oil and coal sectors are concentrated in a few regions, palm oil plantations are dispersed across the country, particularly in Sumatra and Kalimantan (*Borneo*). Oil and gas, as well as the mining sector in general, are also more capital intensive than the plantation sector. This is especially the case in Indonesia palm oil sector, which employs numerous farm labourers because it still uses labour-intensive production process. In terms of ownership, the oil and gas sector has always been owned by a small number of multinational companies and the national oil company, Pertamina. Coal mining companies during the 2000s commodity boom are mostly

locally registered foreign companies, whose ownership has been mostly localised to domestic investor between 2000-09 (Lucarelli, 2010). Oil palm plantations, in contrast, are owned by a mix of multinationals, domestic corporations, government plantation company (PTPN) and a large number of small holders, who own more than thirty per cent of total oil palm plantation land⁶. These differences will be discussed further in Chapter 6.

The second difference between the two booms is their impacts on government budgets. This is partly because the government has been gradually relying more on non-resource tax revenues since the end of the oil boom in 1985. However, it is also because the government collects the rents from each resource differently. Oil companies have to pay the production sharing and non-tax royalty obligation on top of income tax, coal mining companies need to pay corporate income tax and non-tax royalties, and palm oil plantation-manufacturing companies only need to pay corporate income tax. As a result, the windfall of the 2000s resource boom was comparatively smaller than the 1970s oil boom. This can be observed, albeit only partly, in non-tax revenue from natural resources during the two booms (Figure 3.3).

⁶ In 2016, based on Directorate General of Estate Crops (2017) data.

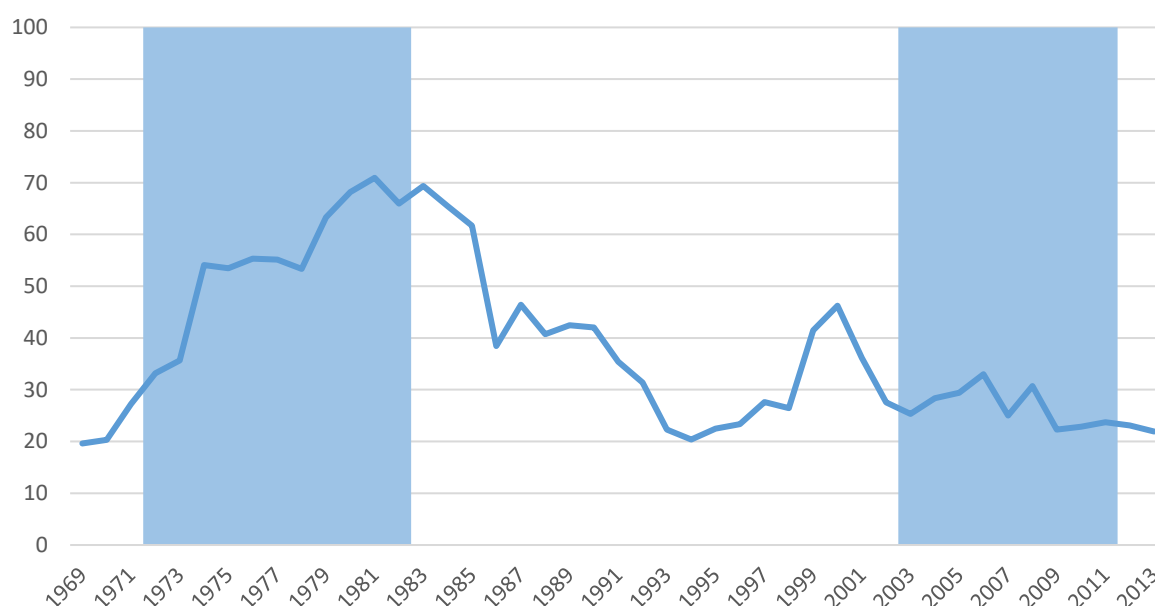


Figure 3.3. Share of central government revenues from natural resources related revenues (%)

Source: Ministry of Finance, Note: Shaded areas are resource boom periods. Before 2000, these revenues consist only of non-tax revenues from natural resources. Starting from 2000, it includes oil and gas income taxes and non-tax revenues from natural resources.

Moreover, unlike during the oil boom, some of these resource revenues are allocated in the districts and provinces where the resources are extracted. This further limits the impact of the commodity boom on the central government budget. While it is possible to quantify non-tax revenue from natural resources, corporate income tax data for natural resources companies are not publicly available. Therefore, it is not possible to know how much of the increase in corporate income tax revenue comes from the natural resources sectors.

The third difference is the way the government recycles the natural resources windfall. This is partly an implication of the second difference. With smaller natural resources windfall, the government cannot spend as much as it did during the oil boom on programs that may improve the economy. Consequently, during the 2000s commodity boom, Indonesia did not see any comparable large government projects as it did during the 1970s oil boom. Instead, a large share of government spending was spent on fuel subsidies. From 2001 to 2014, fuel subsidy as a share of total government expenditure hovered between 8 per cent and 21 per cent (Figure 3.4). Several adjustments to the subsidy were made during the period, which, together with the global oil price,

explain the fluctuation in the share of fuel subsidy in total expenditure. However, since the subsidy was a politically sensitive issue in the young democracy, it was kept throughout most of the 2000s commodity boom. This significantly limited the government ability to recycle the resource windfall on any meaningful projects.

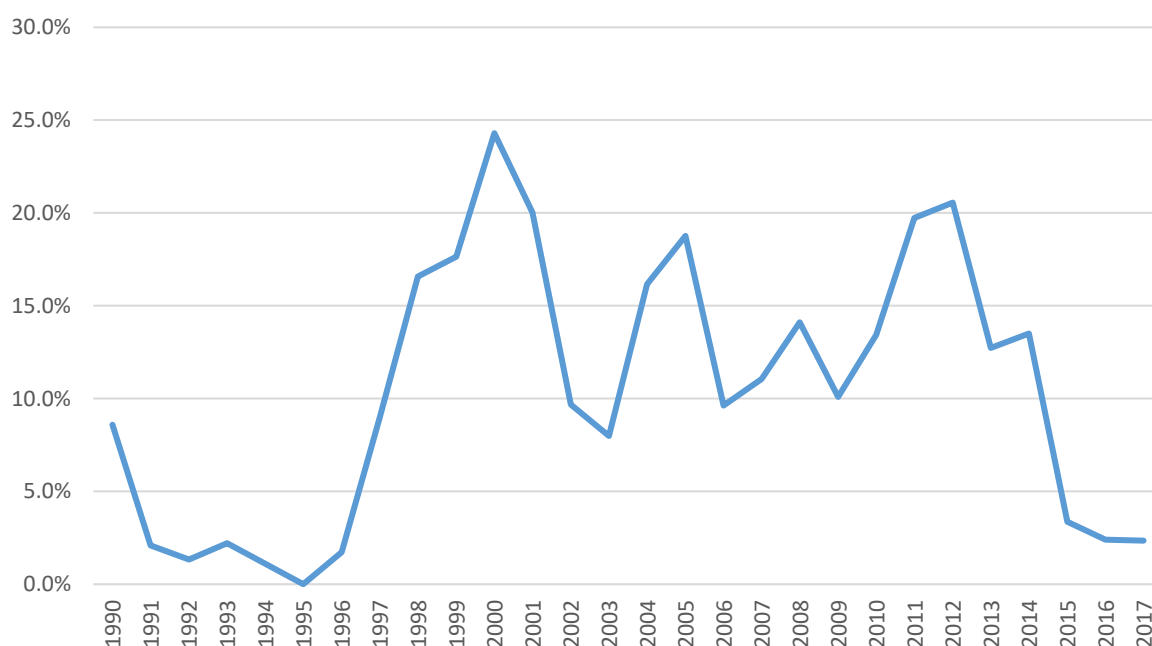


Figure 3.4. Fuel subsidy as a share of central government budget

Source: Ministry of finance

By any standard, Indonesia's economic performance throughout natural resource booms and busts has been respectable. It is not easy to compare Indonesia with other countries since it has always been unique in many aspects, but several attempts to do so have been made. During the oil boom period, Indonesia has been compared to Nigeria⁷ or Mexico⁸ (Figure 3.5). In both cases, Indonesia is viewed as a success story, where the government managed to produce good economic policies in response to the oil boom, which resulted in a relatively good economic performance and welfare improvement.

⁷ See Bevan, Collier, & Gunning (1999), Gelb (1988), Pinto (1987), Scherr (1989)

⁸ See Scherr (1989), Usui (1997)

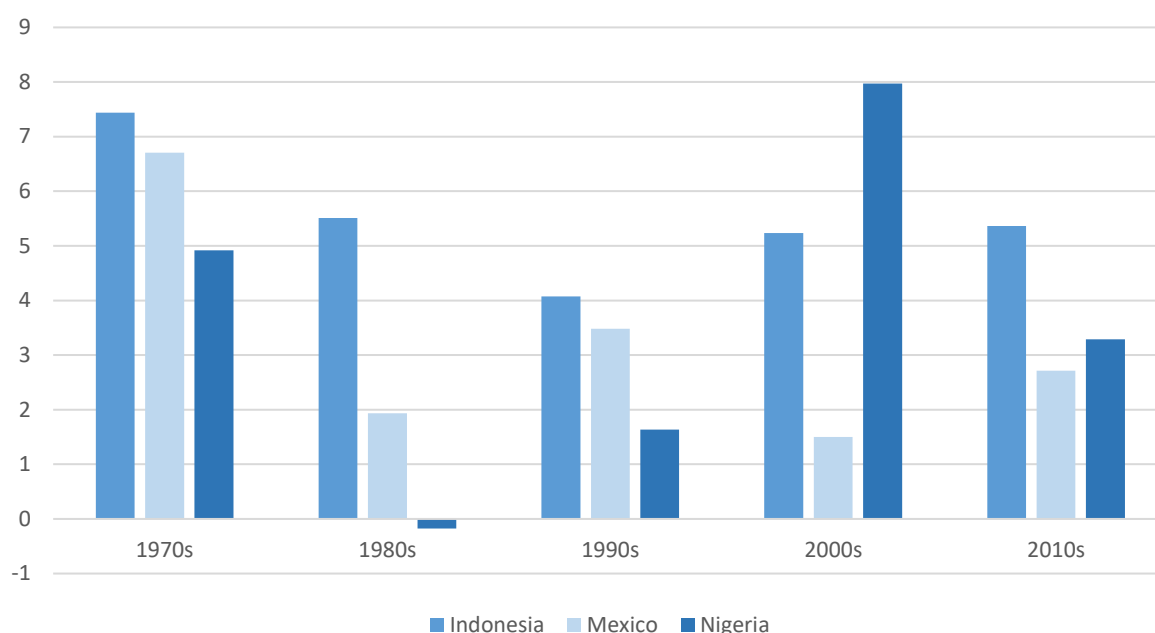


Figure 3.5. The average annual economic growth of Indonesia, Mexico, and Nigeria by decades 1970-2010 (in percentage)

Source: Author's calculation based on World Bank (2019) World Development Indicator

Among other resource-rich developing countries, Indonesia's economic growth is decent. The country's poverty reduction record is noteworthy, albeit not as rapidly as its high performing neighbours, such as Thailand or Vietnam. In 2017, the absolute poverty rate based on the World Bank's \$1.90 PPP measure had declined to 5.7 per cent, down from 71.4 per cent in 1987. Inequality has been relatively stable throughout its seventy-year history and has not been an issue, at least until the peak of the 2000s commodity boom. While the country has experienced some internal conflicts, especially in the form of separatist movements, it has managed to survive and has not succumbed to large scale civil war. It is not obvious whether the country's relatively good economic performance is thanks to or despite its reliance on natural resources. However, it is clear that natural resources have played an important role in shaping the country's economic and political system.

Chapter 4

Measuring the Dutch disease in Indonesia: the real exchange rate and relative prices

4.1. Introduction

One of the most common indicators to measure the impact of a resource boom and bust is the real exchange rate (RER), a measure of one country's overall price level to another country's (Engel, 1999). RER data is publically available in the websites of international organisations such as the International Monetary Fund (IMF) or the Bank for International Settlements (BIS). The reason behind this is partly the Dutch disease mechanism, which states that in an economy with a booming commodity sector, the real exchange rate will appreciate, while the non-booming traded sector will contract and the non-traded sector will expand (Corden & Neary, 1982). The real exchange rate discussed in the theory, however, has a specific definition which differs to those indices published by international organisations. In the Dutch disease theory, RER is defined as the ratio between the domestic price of non-traded to domestic price of traded goods. In this chapter, I investigate the implications of this definition difference, specifically in measuring the Dutch disease, using an Indonesian case study.

In the traditional real exchange rate theory, which dates back to the work of Cassel (1918) and Pigou (1922), all movements in the real exchange rate between two countries are due to fluctuations in the bilateral relative price of non-traded to traded goods. RER is defined as the quantity of domestic basket of goods and services which can be exchanged for an equivalent basket of goods and services from a foreign country. In practice, it is calculated as the trade-weighted nominal exchange rate (NER) adjusted for the ratio between world price indices to domestic price indices:

$$RER = \frac{NER * P^{world}}{P^{domestic}},$$

Where RER denotes the real exchange rate, NER denotes the nominal exchange rate, P^{world} is an index of foreign prices, and $P^{domestic}$ is an index of domestic prices.

RER theory has been empirically tested in various studies, such as by Engel (1999) in his influential paper. Engel (1999) shows that almost all of the variance in the bilateral RER between the United States and a number of OECD countries is explained by fluctuations in the relative price of traded goods and almost none is attributable to fluctuations in the relative price of non-traded goods. His findings are then contradicted by Betts and Kehoe (2008), who find the relation between RER and the relative price of non-traded to traded goods is strong on average, reconfirming the traditional theory. However, Betts and Kehoe (2008) find significant deviations from the law of one price for a basket of traded goods, and these deviations play a large role in RER fluctuations. Another study by Chen et al. (2015) finds that the relative price of traded goods dominates RER movement for horizons up to two decades, but over the longer horizons, non-traded relative price plays a more important role.

Aside from the macroeconomics debate, the debate on the relation between RER and the relative price of non-traded goods also has implications for the Dutch disease measurement. In contrast to the macroeconomic debate, in the Dutch disease literature, the real exchange rate is explicitly just another name for the relative price of non-traded to traded goods. According to the theoretical framework of the Dutch disease (Corden, 1984; Corden & Neary, 1982), an extractive sector boom in a small open economy will lead to a “crowding out” effect of other growth-promoting sectors through the so-called “resource movement effect” and “spending effect.” The *resource movement effect* refers to the movement of factors of productions from non-booming sector to the booming sector, while the *spending effect* is the effect of increased income which expands demand for traded

and non-traded goods (services). Both of these effects contribute to real exchange rate appreciation, here defined as the relative price of non-traded to traded goods.⁹

Although the RER's definition and formula are different from the relative price of non-traded to traded goods, trade-weighted RER is used in some empirical studies as the primary tool to measure the Dutch disease. One recent study by Garnaut (2015), which discusses Indonesia's second resource boom in comparison with other resource-producing countries, uses RER cross-country comparison to show how the proceeds of a higher terms of trade induced by the 2000s resource boom put upward pressure on the RER. Using the Dutch disease framework, Garnaut (2015) suggests that the RER appreciation was then followed by a general decline in international competitiveness which contributed to the slowing down in Indonesia's labour-intensive exports.

Athukorala (2003) suggests that the trade-weighted nominal exchange rate based RER is just a proxy for the relative price of non-traded goods in the absence of readily available indices of traded and non-traded goods prices. Its usage as a proxy is understandable, especially when one is attempting a cross-country empirical study on the Dutch disease, and the task of dichotomizing traded and non-traded sectors in multiple countries is not feasible. Nevertheless, this practice may lead to a misdiagnosis of the magnitude of the Dutch disease in economies experiencing a resource boom. Even if the RER is to be employed to measure the impact of a resource boom, the various methods of calculating the RER may lead to differences in the measured impacts of a resource boom.

Against this backdrop, this study will compare methods to measure the relative price of non-traded goods and RER and then analyse the implication for the size of the Dutch disease in Indonesia. Indonesia is an interesting case for the Dutch disease measurement because, in the last fifty years, it has experienced two resource booms in radically different environments. A related study by Warr (1984) constructs a non-traded to traded good relative price index using selected commodity prices

⁹ To clarify, from this point I will use the term 'real exchange rate' (RER) for trade weighted nominal exchange rate and use the term 'relative price of non-traded goods' for non-traded to traded goods price ratio.

to measure the impact of exchange rate policy in Indonesia in the context of the 1970s oil boom. This paper will construct a similar index with a longer time horizon so that a comparison between the last two resource booms can be made. This longer-term perspective offers a unique case of a country which experiences multiple resource booms, albeit with differing characteristics. This study will also compare the RER calculated by the author with those published by several institutions which have been used in other studies.

It is important to remember that the present chapter is a component part of this dissertation and should be viewed as a building block for the following chapters in the dissertation. The next section will discuss the Indonesian context during each boom, followed by a theoretical discussion of the Dutch disease and the real exchange rate. Section 4 will discuss the method, and Section 5 will discuss the findings. The paper closes with the summary and conclusion.

4.2. Indonesia: two booms, two Dutch diseases?

Indonesia is familiar with the dilemma of resource boom and bust. Although the country's natural resources endowment relative to population and the capital stock is not among the highest in the world, it has always been a resource-exporting country. Since its independence in 1945, the country has experienced two resource-booms, the 2000s commodity boom, and the oil boom in the mid-1970s to early 1980s. As discussed in Chapter 3, both booms have had huge impacts in shaping the economic structure and political settings in Indonesia. This section will briefly discuss the background of each boom and Indonesia's responses.

There were three triggers to the 1970s and early 1980s oil boom. The first trigger was strong global macroeconomic performance in 1972 and 1973. The second trigger was widespread crop failure which drove food prices to their highest recorded levels in recent history (Figure 4.1).¹⁰ The final, and by far the most important trigger was the sharp oil price increases instituted by OPEC oil cartel, which caused oil price to increase nearly eighteen fold from 1960 pre-boom price to its peak in 1980.

¹⁰ For the same data in inflation adjusted term, see Figure 3.3.

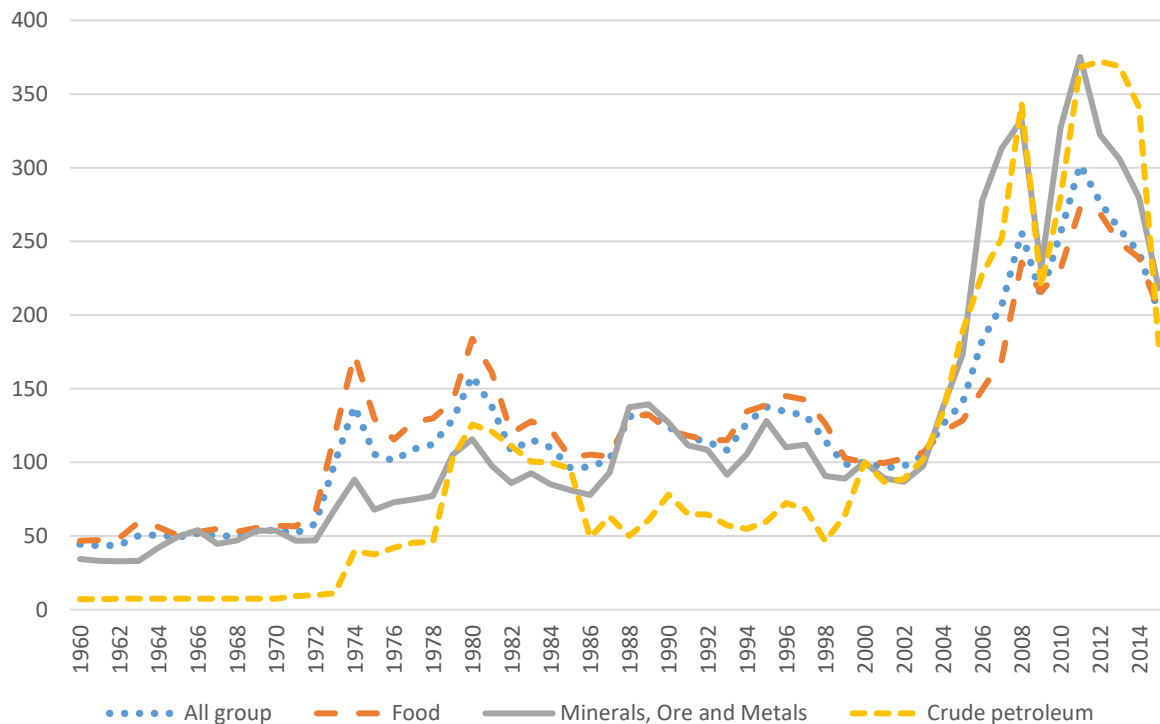


Figure 4.1. Commodity price indices at current USD prices (2000=100)

Source: UNCTADstat (2019). Note: Food group includes wheat, maize, rice, sugar, soybean meal, vegetable oil (soybean oil, groundnut oil, sunflower oil, copra oil, coconut oil, palm oil, palm kernel oil, cottonseed oil), banana, beef, fish, coffee, tea, and cocoa. Mineral, ore and metals group includes iron, aluminium, copper, nickel, lead, zinc, tin, tungsten, gold, and silver. Crude petroleum group is a simple average of UK Brent, Dubai, and Texas.

When the boom started, Indonesia was in a period of recovery from economic crisis and hyperinflation. Suharto's New Order government, which came to power in 1966, quickly restored macroeconomic stability through a series of reforms: inflation was tamed, the rupiah was devalued, and restriction on foreign exchange transaction was abolished. The oil boom, which happened a few years later, boosted the government's revenue, which allowed them to greatly increase development spending. Throughout the boom, public investment in infrastructure, education, and agricultural development increased sharply.

The extra revenue also allowed the government to spend on expensive import substitution industrial policy. Heavy industry firms, including (among others) government-owned aircraft and steel industries, were highly subsidised. To support industrial policy, the government also raised tariffs on most manufacturing goods (Basri & Hill, 2004; Pangestu et al., 2015). Although these policies did not

manage to make these industries competitive, industrial output grew rapidly during this period, mainly from petroleum-related and heavy industries.

By the mid-1980s, the global oil price already plunged (Figure 4.1) and with that, the government petroleum revenue. Indonesia was faced with a near-crisis condition where growth dropped from 7.0 per cent in 1984 to 2.5 per cent in 1985. It took three years (1983-1985) for the government to change its policy course. The government liberalised trade and investment policies and reformed the tax system. These changes were largely successful in bringing growth back and promoting an export-oriented, non-petroleum related industrialisation.

The Indonesian economy performed relatively well during and after the boom, especially compared to other resource-abundant countries. Gelb (1988) attributes this good performance to three distinctive features of Indonesian economic policy at the time: flexible exchange rate policy, prudent macroeconomic management, and broad development strategy that emphasised raising rural incomes. Others attribute it to the importance of the recycling mechanism of resource windfall into productivity-enhancing investment in the traded sector, notably agriculture and manufacturing (Coxhead, 2007; Coxhead & Li, 2008; Pinto, 1987).

The post-reform growth was brought to a sudden halt by the AFC in 1997 when the country's economy contracted by 13 per cent. The crisis brought down Suharto's New Order regime and the political system switched from a centralised autocratic system into a decentralised democracy almost overnight. Understandably, restoring growth under a radically different system was challenging for the newly elected democratic government. However, the sixth president, Susilo Bambang Yudhoyono, managed to achieve stable growth during his first term (2004-2009). At the time, the global commodity boom had just started, and it offered an opportunity for rapid growth through resource-intensive economic development.

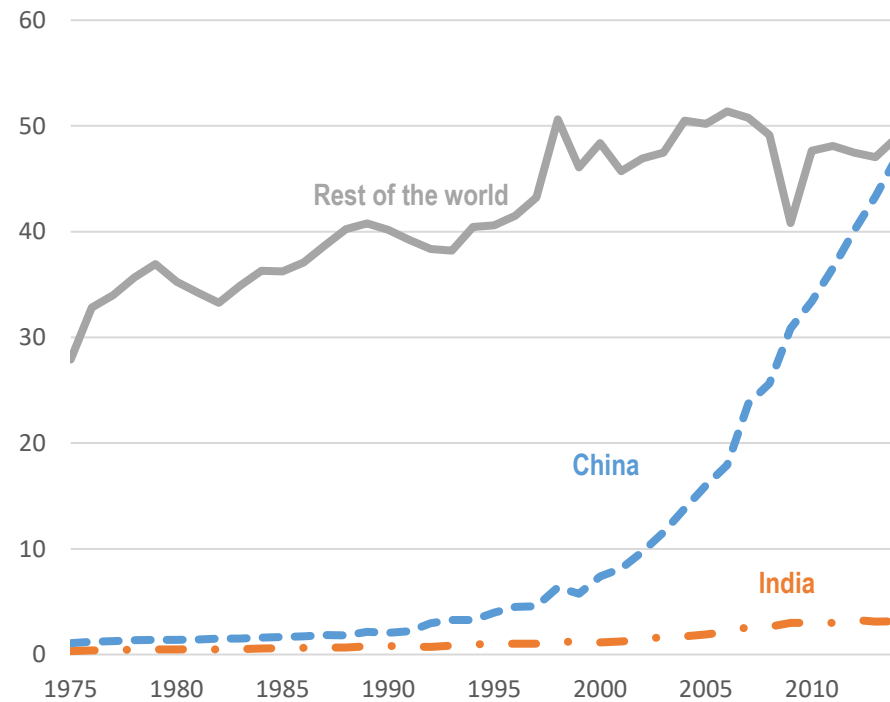
Similar to the 1970s oil boom, the 2000s commodity boom was preceded by strong global economic growth, especially in developing economies in Asia. This rapid growth in developing Asia had

enormous impacts on the commodity market because these countries, particularly China (Figure 4.2), were passing through a development stage which is much more commodity-intensive than the dematerialising OECD economies (Radetzki, 2006). Demand acceleration in the early 2000s took commodity suppliers by surprise, leading to supply shortage which drove the increase in prices. The boom was briefly interrupted by the Global Financial Crisis in 2008, which dropped commodity demand in developed countries but not in China and India (Figure 4.2). Supported by the consistently growing commodity demand in China and India, commodity prices recovered quickly, and by 2010 they have climbed back to pre-crisis level (Figure 4.1).

Indonesia readily took the opportunity, which then started a rapid re-specialization in exports of resource-intensive commodities. Merchandise export more than tripled in value from 2001 to 2011, while the share of commodities exports grew from 41.7% to 62.1%. Coal and palm oil replaced oil as the two most important sources of export growth. The characteristics of coal and palm oil are very different from oil, especially in term of ownership, production technology, and fiscal impacts. These differences may have distributional impacts in the producing region, which can then affect wages, inequality and economic structure in general. Fiscally, the impact of the 2000s resource boom was smaller than the 1970s oil boom.¹¹ See Figure 3.3.

¹¹ It is important to note that government revenue from corporate tax increased greatly during the boom period, which might be the channel by which the resource boom increases government revenue.

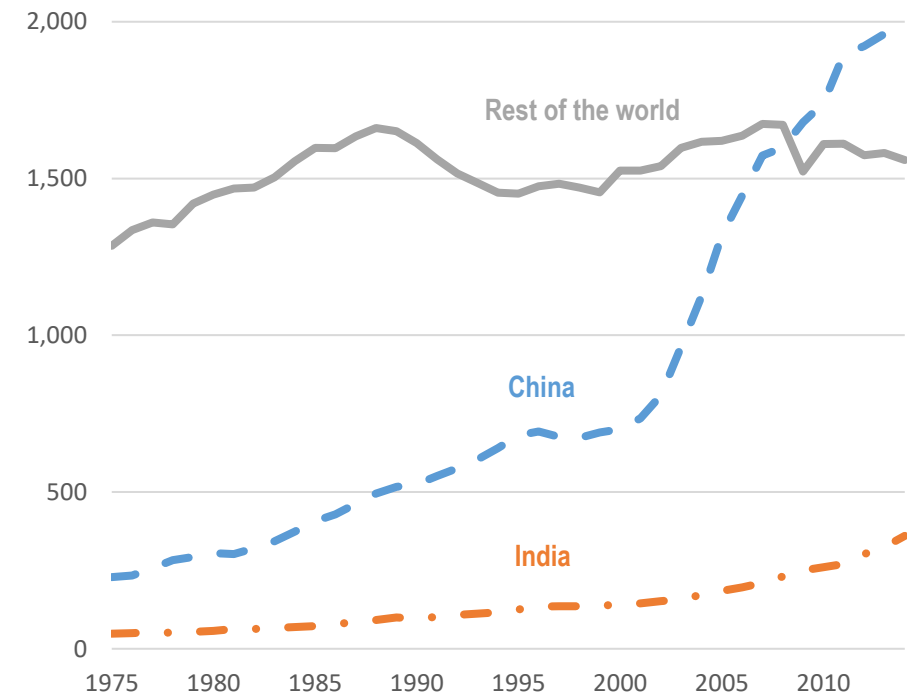
Metal consumption of China, India and rest of the world (in million metric tons)



Source: World Bureau of Metal Statistics

Note: Last observation is 2014. Data in million metric tons, includes six metals: aluminium, copper, lead, Nickel, Tin and zinc.

Coal Consumption of China, India and rest of the world (in million tons of oil equivalent)



Source: BP Statistical Review

Note: Last observation is 2014. Data in million tons of oil equivalent

Figure 4.2. Metal and Coal consumption of China, India, and rest of the world

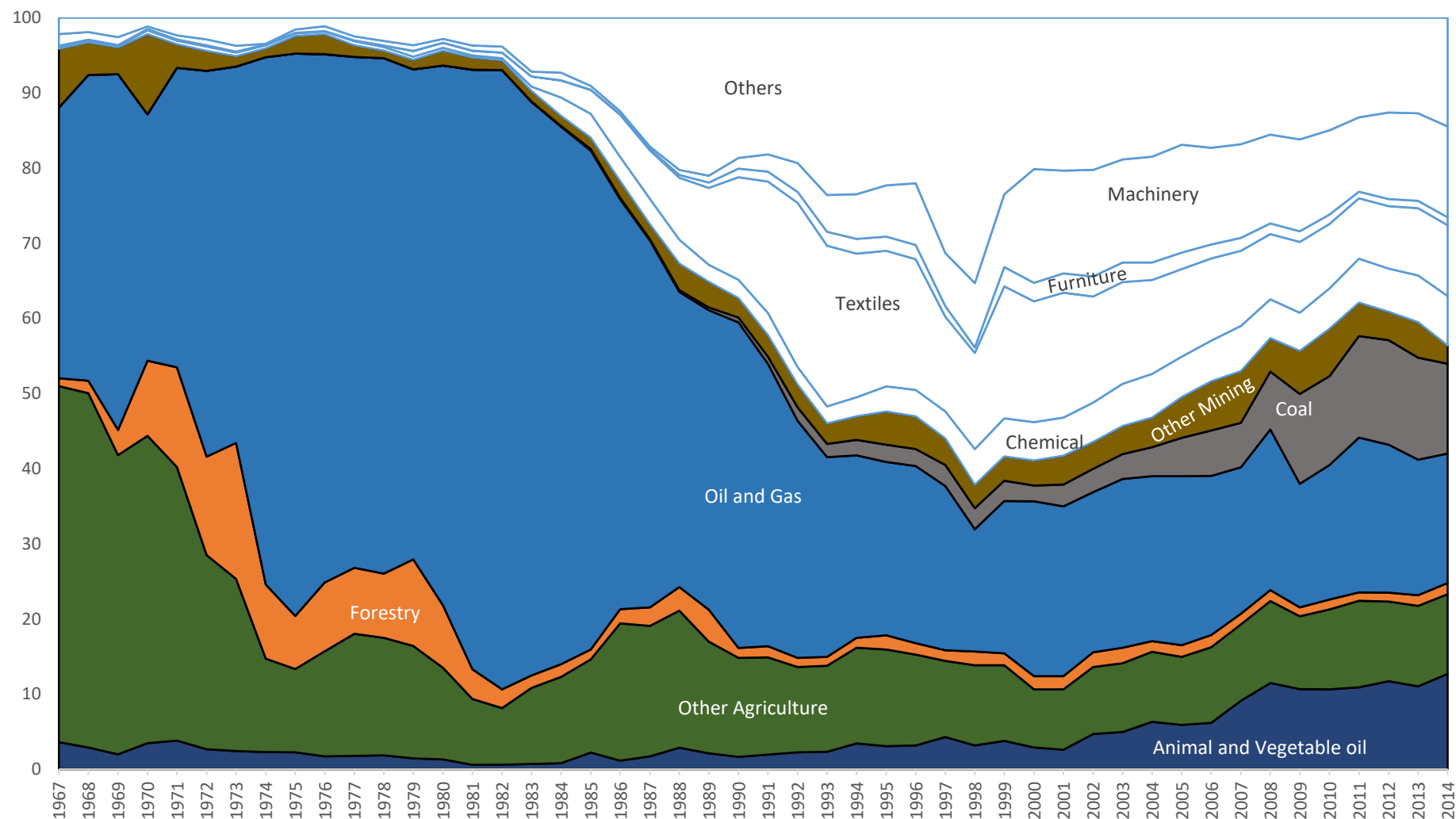


Figure 4.3. Composition of Indonesia merchandise export by sector 1967-2014 (%)

Source: Author's calculation from UNCOMTRADE data. Note: the coloured area represents resource-based sectors.

The changes in export proportion are mirrored in Indonesia economic structure as a whole, albeit in a more subtle manner. The manufacturing output trend followed the economy as a whole, with the caveat that the former's growth declined from slightly above the economy-wide average to slightly below it (Aswicahyono, Hill, & Narjoko, 2010). This slower growth in manufacturing output means that the sector's role in the economy declines after the crisis. Meanwhile, the services sector (including trade, communication, construction, etc.) rises in importance as a share of the total GDP. These three trends: rising specialisation of resource-related exports, a smaller role of manufacturing, and a bigger role of the services sector, all indicate that the country may have experienced a Dutch disease during the second commodity boom.

Policy-wise, there are differences and similarities between the 2000s boom and the 1970s oil boom.¹² The differences mainly stem from the significant changes in the country's political settings since the end of the New Order regime, such as the shift from a highly centralised government into a decentralised one. This has many ramifications in various aspects of the economy. On the fiscal side, the starkest difference is in the significantly larger share of transfer to regional governments from the central government. On the monetary side, one of the most important differences is in the exchange rate regime, which changes from a fixed exchange rate to a (managed) floating exchange rate. On top of those differences, the whole political-economic process of policymaking has also changed, which gives way to more populist policies. These populist tendencies can be observed in industrial and trade policy which saw increasing protectionism tendency during the period (Basri & Patunru, 2012) and also in the increasing influence of vested and populist interest in general, particularly during Yudhoyono's second term (Garnaut, 2015). Interestingly, the trend of increasing populist tendency and highly protectionist trade policy is one of the few similarities between the two booms, albeit for different reasons.

¹² For a more detailed discussion on the comparison between the two booms, refer to Chapter 3 section 3.4 (p. 36).

As a resource-dependent country, Indonesia always faces the risks that come with resource booms and busts, including the Dutch disease. Although Indonesia was able to escape the 'curse' of natural resource wealth during the oil boom, the same thing cannot be said with any certainty in regard to the recent commodity boom. Garnaut (2015, p. 189), for example, argues that the 2000s boom has "boosted Indonesian growth and diverted the policy focus from the productivity-rising reforms that are necessary for broad-based growth." Garnaut (2015) also points out the appreciation of Indonesia real exchange rate as a result of the resource boom, which could adversely affect the country's competitiveness. However, an analysis of the real exchange rate movement and impacts, as well as a comparison with the previous oil boom, is still needed.

4.3. The Dutch disease and the real exchange rate

4.3.1. The Dutch disease

Corden and Neary (1982) and Corden (1984) develop the core theoretical model of the Dutch disease phenomenon in a small open economy with a booming extractive sector. Their model assumes three sectors in the economy: traded extractive sector, traded manufacturing sector, and non-traded services sector. There are two factors of production, i.e. capital and labour, but the extractive sector only shares labour with the other two sectors and has its specific kind of capital which can only be used in the extractive sector. The effects of the booms take two forms: resource movement effect and spending effect. The *resource movement effect* refers to the reallocation of factors of productions from non-booming and non-traded sector to the booming sector. *Spending effects* refer to the effect of increased income which expands domestic aggregate demand. While traded goods can be imported at the international price, non-traded goods have to be produced domestically. As a result, spending effects increase the relative price of non-traded goods to traded goods (defined as real exchange rate appreciation in this literature), further drawing resources away from the non-booming traded sector.

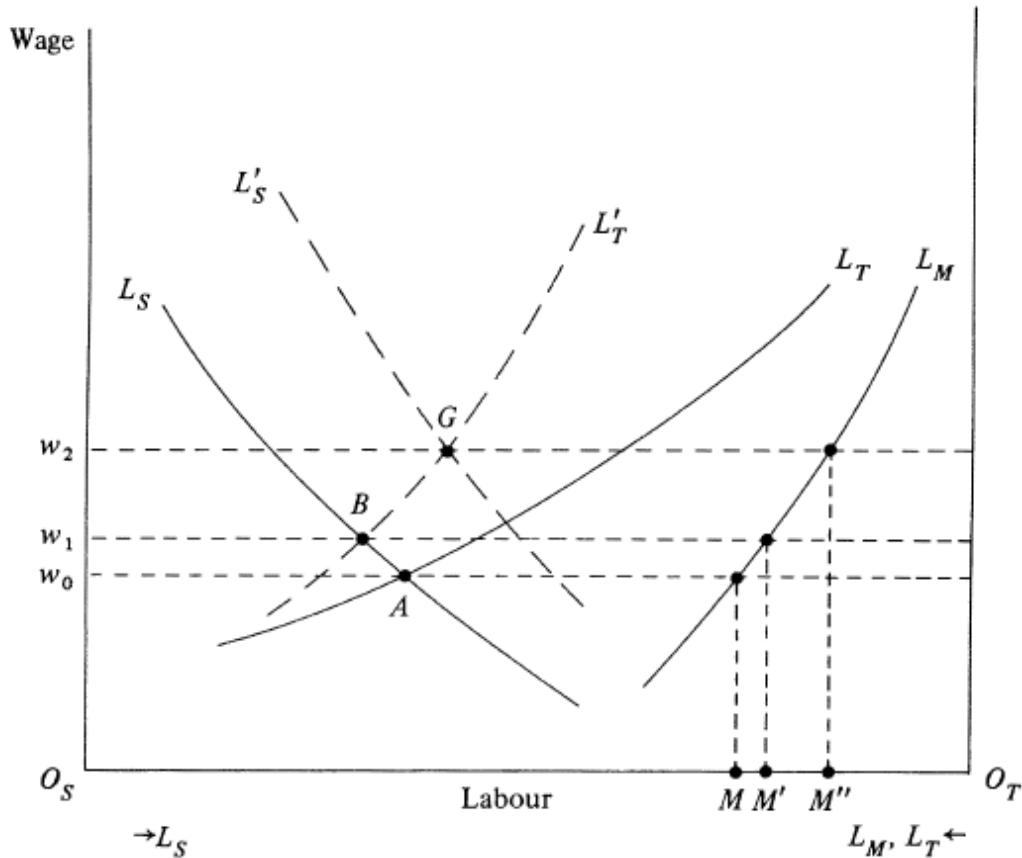


Figure 4.4. Effect of resource boom on the labour market

Source: Corden and Neary (1982)

Figure 4.4 illustrates a labour market with the traded sector (T) and non-traded services sector (S). The wage rate (on the vertical axis) is measured in terms of manufacturing goods, and the economy's total labour supply is given by the horizontal axis $O_S O_T$. Labour input into services is measured by the distance from O_S while distances from O_T measure labour input into two traded sector goods (manufacturing and extractive goods). Demand for labour in each sector is a decreasing function of the wage rate relative to the price of the sector's output. L_M is the labour demand schedule for the manufacturing sector, and by laterally adding to this the initial labour demand schedule for the extractive sector we obtain L_T , the pre-boom labour demand schedule for the two traded goods sector combined. Likewise, L_S is the initial labour demand schedule for the services sector, drawn for the initial price of services. Point A is the initial full-employment equilibrium, where L_T intersects L_S , with initial wage rate w_0 .

When the boom starts, the extractive sector's labour demand schedule shifts upwards by an amount proportional to technological progress: the latter acts in exactly the same way as a price increase, rising profitability and the demand for labour in the extractive sector at a given wage rate. This is the resource movement effect. This, in turn, causes the composite labour demand schedule L_T to shift upwards to L'_T , and so a new equilibrium at B is attained. Wage rate in the new equilibrium is w_1 , which is higher than the initial w_0 at a constant real exchange rate. The higher wage rate then causes labour to move out of both manufacturing and services sector. Since this causes employment in manufacturing to fall from $O_T M$ to $O_T M'$, we may say that the resource movement effect gives rise to *direct deindustrialisation*. Furthermore, because the resource movement effect moves labour out of the services sector, assuming income elasticity of demand to be zero, the effect leads to excess demand for services. To restore the equilibrium, the price of services has to increase (i.e. appreciation of the relative price of non-traded to traded goods). The increase in the price of services will eliminate the excess demand, switching demand away from services and dampening the fall in the sector's output induced by the resource movement effect. This, however, cannot reverse the fall in the services sector output.

Next, consider the spending effect. Provided the demand for goods and services rises with income, demand at the initial price level increases with the increase in the wage rate. This causes an excess demand for services, but not for traded manufactured goods, which can be imported. This, again, must be followed by an appreciation of the relative price of non-traded goods to restore equilibrium. In effect, labour demand schedule for services sector shifts upwards to L'_S , moving the final equilibrium to point G and as a result, causing wage to increase further to w_2 . The spending effect, therefore, increases the output of services compared with the initial situation.

Together, both effects contribute to an increase in the relative price of non-traded goods.¹³ While the spending effect tends to increase non-traded sector output, the resource movement effect tends to lower it, and there is no presumption as to which will dominate. This ambiguity of output, however, does not apply to the non-booming manufacturing sector. While the resource movement effect lowers manufacturing output directly through the movement of factors of production, the spending effects contribute indirectly through expansion in non-traded goods demand. Thus, the boom gives rise to both direct and indirect deindustrialisation.

In this model, the declining non-booming traded sectors (i.e. manufacturing and agriculture) are regarded as the ‘learning by doing sector’ (Krugman, 1987; van Wijnbergen, 1984), which historically has been the vehicle for technological progress. Krugman (1987) argues that this phenomenon can only be regarded as a ‘disease’ if the manufacturing sector does not rebound after the resource boom. Furthermore, the idea of the Dutch disease can be applied to any sector which become the primary generator of foreign exchange in a country, such as remittances (Acosta et al., 2009; Amuedo-Dorantes & Pozo, 2004; Lartey et al., 2012) and foreign aids (Rajan & Subramanian, 2011; van Wijnbergen, 1986; Younger, 1992).

To conclude, the Dutch disease theory is based on the sectoral impact of a booming extractive sector. While there are two mechanisms by which the ‘disease’ contracts a resource-dependent country, both mechanisms work through the appreciation in the relative price of non-traded goods. Therefore, measurement of the size of the Dutch disease should be done using the relative price of non-traded to traded goods.

4.3.2. Real exchange rate (RER) and the relative price of non-traded goods

In the Dutch disease theory, RER is explicitly defined as the relative price of non-traded goods to traded goods within a single country (Corden & Neary, 1982, p. 827). Although the term *real*

¹³ Although Corden and Neary (1982) use the term real exchange rate in their publication, I use the term relative price of non-traded goods for reasons discussed further in this section.

exchange rate and the relative price of non-traded goods are closely related, they are not exactly the same. By definition, the real exchange rate is a measure of one country's overall price level to another country's. In other words, it measures the number of domestic basket of goods which can be exchanged for one foreign basket of goods. The relative price of non-traded goods to traded goods, on the other hand, is the domestic price ratio between the prices of non-traded goods and the prices of traded goods. To understand the connection between the two ratios, we have to begin with the concept of purchasing power parity (PPP), a theory of exchange rate determination that is widely used in policy-making deliberations and serves as a conversion factor in transforming currency values from one denomination to another. Before the two influential articles by Balassa (1964) and Samuelson (1964), the PPP "doctrine" was commonly regarded in its 'absolute interpretation': in the absence of all frictions, the ratio of consumer goods prices for any pair of countries would tend to approximate the equilibrium exchange rate. Therefore, absolute version of PPP holds when price levels in the two countries are equal when expressed in a common currency (Asea & Corden, 1994).

To illustrate, let p_i and p_i^* denote the price of i -th good at home and abroad respectively. Define the nominal exchange rate, e , as the number of units of domestic currency per unit of foreign currency. Let P_i and P_i^* be the aggregate price level at home and abroad quoted in their respective currencies. Consequently, the domestic price index is $P = h(p_1, \dots, p_i, \dots, p_n)$ and the foreign price index is $P^* = f(p_1^*, \dots, p_i^*, \dots, p_n^*)$. Using these notations, the real exchange rate is denoted by $RER = P/eP^*$. If the same goods enter each country's market basket with identical weights, then the law of one price extends to aggregate price levels, yielding $e = P/P^*$. An absolute version of PPP predicts that in the absence of all frictions the prices of a common basket of goods in the two countries measured in a common currency will be the same at all times, i.e., $RER = P/eP^* = 1$.

Balassa (1964) and Samuelson (1964) independently provide an explanation as to why the absolute interpretation of PPP is flawed as a theory of exchange rates. The explanation lies in the

productivity-growth differentials between traded and non-traded sectors which alter a country's internal price structure. Balassa and Samuelson argue that developed countries are technologically more advanced than developing countries. Yet, the technological advantage is not uniform across sectors, and the technological advantage of developed countries is more pronounced in the traded sector than in the non-traded sector. By the law of one price, the prices of traded goods will be equalised across countries through arbitrage. However, this would not be the case in the non-traded sector. Increased productivity in the traded sector will increase real wages and as a result, lead to an increase in the relative price of non-traded goods to traded goods. Differences in the relative price of non-traded goods across countries then translate into differences in overall price levels, with countries having higher productivity in producing traded goods will have higher overall price level. Long-run productivity differentials would thus lead to trend deviations from PPP. The insight is summarised in the following proposition:

PROPOSITION 1 (Balassa, 1964). *The greater are productivity differentials in the production of tradable goods between countries, the larger will be differences in wages and in the prices of services and correspondingly the greater will be the gap between purchasing power parity and the equilibrium exchange rate.*

Proposition 1 highlights two basic predictions of the Balassa-Samuelson model, (i) productivity differentials determine the domestic relative price of non-traded goods to traded goods, and (ii) deviations from PPP reflect differences in the relative price of non-traded goods (between countries). This is where the connection between real exchange rate and the relative price of non-traded goods is established. The gap between purchasing power parity and the equilibrium exchange rate caused by the productivity differentials means the RER is not equal to one (i.e., $RER = P/eP^* \neq 1$). Therefore, according to the Balassa-Samuelson model, the long-run movements in RER are caused by changes in the relative price of non-traded goods.

Discussion about the relation between RER and the relative price of non-traded goods continues to this day. One such discussion is by Engel (1999), who advances the empirical debate by showing that the relative price of non-traded goods does not explain RER movement, at least in the short and medium run. Engel (1999) shows this by decomposing the RER through real exchange rate accounting process as follows:

Consider a price index for a country that is a weighted geometric average of traded and non-traded goods prices.

$$p_t = (1 - \alpha)p_t^T + \alpha p_t^N \quad (1)$$

Where p_t is the log of the overall price index, the super-scripts T and N refer to traded and non-traded respectively, and α is the share of non-traded in the price index of the economy. Let an asterisk represents a foreign country, so Equation (1) can be written as

$$p_t^* = (1 - \beta)p_t^{T*} + \beta p_t^{N*} \quad (1a)$$

where β is non-traded goods share in the foreign price index. Engel (1999), and later Chinn (2006) decompose the RER (denoted in log form by q_t) as follows:

$$q_t = x_t + y_t \quad (2)$$

Where

$$q_t = s_t + p_t^* - p_t$$

$$x_t = s_t + p_t^{T*} - p_t^T$$

$$y_t = \beta(p_t^{N*} - p_t^{T*}) - \alpha(p_t^N - p_t^T).$$

Let s_t denote the log of domestic currency price of foreign currency (i.e. the nominal exchange rate). Equation (2) decomposes the log of RER (q_t) into two parts: (i) the relative price of traded goods between countries (x_t) and (ii) a weighted difference of the relative price of non-traded to traded goods prices on each country (y_t). Furthermore, note that the y_t term is a relative-relative price: the

relative price of non-traded to traded goods ratio in one country relative to that relative price in another country.

Note that in Equation (2), changes in the nominal exchange rate (s_t) will change the x_t term but not the y_t term when prices are fixed in the domestic currency. If nominal prices are sticky and nominal exchange rates (s_t) fluctuates greatly, then short term movements of the RER can be dominated by movement in traded prices component (x_t). As prices adjust in the long run, the relative price of the non-traded goods component (y_t) becomes more important. Engel (1999) then proposes that the time horizon differences in RER can be observed using a mean squared error (MSE) ratio. Through this method, Engel (1999) finds that relative price of non-traded goods (y_t) has little importance for understanding RER movement in U.S. case over the short and medium run. L. Chen et al. (2015), however, find that the MSE measurement used in Engel (1999) for RER accounting are biased and they corrected the measure. By doing so, L. Chen et al. (2015) find that in accordance to Engel (1999), price of traded goods (x_t) dominates RER movement for horizons of up to two decades, but over the longer horizons, the relative price of non-traded goods are more important (y_t). Similarly, Betts and Kehoe (2008) find that although there are significant deviations from the law of one price, the relative price of non-traded to traded goods still play a significant role.

Both the theoretical and empirical considerations discussed so far have shown that trade-weighted RER cannot be assumed to equal or be used as a proxy for the relative price of non-traded goods. Furthermore, since the Dutch disease theory states that appreciation of traded to non-traded goods price ratio as one of its measurable impacts, the Dutch disease measurement should be based on this ratio, not the trade-weighted RER. The relative price of non-traded goods also has an advantage that it explicitly measures the relative return of operating in a sector compared to the other sector. This advantage is particularly useful when the objective is to measure the sectoral impact of the Dutch disease in the three sectors model (i.e. booming sector, non-booming traded sector, and non-traded sector).

Nevertheless, the relative price of non-traded goods has its own shortcomings, especially in its empirical aspect. For one, the dichotomy between traded and non-traded sector is not a simple matter. Any method to distinguish between the two has some degree of arbitrariness. Multiple studies have constructed the ratio for various countries, but there is no consensus on which method is the most appropriate. While De Gregorio et al. (1994) explicitly define a sector as tradable if more than 10 per cent of total production is exported, Engel (1999) defines it as all sectors except for services and housing. How traded and non-traded sectors are defined becomes more important when we consider the within-sector-dynamic. For instance, communication and transportation, which might be considered as a non-traded sector, has been experiencing slow or even declining prices for years due to improvement in technology, and in Indonesia's case, increased competition.

Despite the theoretical and empirical criticism of the trade-weighted RER in measuring the Dutch disease sectoral impact, the RER still tells an important story about resource-rich economies because it can explain the changes in the trading pattern of resource-rich countries, along with changes in their terms of trade. Therefore, trade-weighted RER should still be observed in discussions about resource-rich economies. To this end, this study constructs both the relative price of non-traded goods and trade-weighted RER and then compare the dynamics

4.4. Method and Data

4.4.1. Trade-weighted RER

This chapter will compare the trade-weighted RER of Indonesia with various methods of measuring the relative price of non-traded goods. There are several other methods to calculate RER, which mostly vary in terms of the method used to weight each trading partner in constructing the index. The index is often called "real effective exchange rates" (REER) as this index measure one country's real exchange rate to a basket of trade partners by putting weight on each trading partner based on their share in the home country's export. Some of the most widely used RER indexes are those

published by BIS, World Bank, and the IMF. Aside from these indexes, Darvas (2012) creates a comprehensive database of the real effective exchange rate for 178 countries by using a time-invariant matrix of weight constructed by Bayoumi, Lee and Jayanthi (2006), which considers not only exports and imports but also competition in third markets. The time-invariant weight, however, has a disadvantage in that it cannot capture the constantly changing economic size and importance of various countries. The rising importance of China since the 2000s, for example, cannot be captured if the weight is time-invariant.

In this study, I use 1967 to 2014 annual CPI data from IMF's IFS (for comparability reason with trade partner), annual average currency rate from World Bank's WDI, weighted by each year export share to main trade partner using UNCOMTRADE data. RER is calculated as:

$$RER_t = \frac{NER_t * CPI_t^{domestic}}{CPI_t^{foreign}} \quad (3)$$

$$NER_t = \prod_{i=1}^N S(i)_t^{w_t^{(i)}}$$

$$CPI_t^{foreign} = \prod_{i=1}^N CPI(i)_t^{w_t^{(i)}}$$

Where

RER_t is the real exchange rate for the domestic country at time t;

$CPI_t^{domestic}$ is the consumer price index in the domestic country;

NER_t is the geometrically weighted average of $S(i)_t$, the nominal bilateral exchange rate between the domestic country and its trade partner i (measured as the foreign currency price of one unit of domestic currency);

$w_t^{(i)}$ is the export share to country i at time t and N is the number of trading partners considered;

$CPI_t^{foreign}$ is the geometrically weighted average of CPI indices of trading partners;

$CPI(i)_t$ is the consumer price index of trading partner i.

In contrast to Darvas (2012), this study uses time-variant weighting based on export destination share each year. This choice is made because one of the focuses of this study is to observe the long-

term changes in Indonesia and the world economy, including, for example, the dramatic increase of China's share in Indonesia's trade since the 2000s. Hence, time-invariant weight is not appropriate. The resulting index will be compared with the BIS index and Darvas (2012) index in the next section.

4.4.2. The relative price of non-traded to traded goods

To construct the relative price of non-traded goods, I employ two methods: consumer price index based ratio and GDP deflator based ratio. The idea of both methods is straightforward: to construct price indexes for traded and non-traded goods and create a ratio between the two indexes to get the relative price of non-traded to traded goods. The CPI-based ratio uses Indonesia Statistics monthly data from January 1966 to July 2016. The weighting for traded and non-traded components is based on Engel (1999) with some modifications. All items in the CPI basket are grouped into four: Food and foodstuffs (FF), Housing and utilities (HU), Clothing (C), and Miscellaneous expenditure (M) (includes health, education, recreation, and transportation). The grouping is necessary in order to use the older available inflation data (pre-1990) because older CPI index does not have a detailed classification.¹⁴ From 1966 to 1983, monthly CPI data are only available at the very aggregate level, FF, HU, C, and M. While the highly aggregated nature of the grouping may not be ideal to construct the price ratio, it is the only way for the study to make pre-1983 data comparable to more recent data. Based on this grouping, the traded basket of goods is composed of FF and C, while the non-traded basket of goods is composed of HU and M. The weights in the index is based on equation (1), constructed from the regression

$$\Delta \ln CPI = \theta_1 \Delta \ln FF + \theta_2 \Delta \ln HU + \theta_3 \Delta \ln C + \theta_4 \Delta \ln M + \varepsilon \quad (4)$$

Where Δ is the first-difference operator, so that all variables are in terms of natural logarithm change. Then I construct

$$p^T = \left(\frac{\theta_1}{\theta_1 + \theta_3} \right) \cdot \ln FF + \left(\frac{\theta_3}{\theta_1 + \theta_3} \right) \cdot \ln C$$

¹⁴ This grouping might change in the future if I gain access to more detailed inflation data.

And

$$p^N = \left(\frac{\theta_2}{\theta_2 + \theta_4} \right) \cdot \ln HU + \left(\frac{\theta_4}{\theta_2 + \theta_4} \right) \cdot \ln M \quad (5)$$

This regression process to calculate the weights follows Engels' (1991) method. The coefficients from the regression are a measure of relative importance between the components of CPI. They are needed to give the proportion for each component of the traded and non-traded indexes. In this study, the coefficients also help synchronise the changing methods of CPI measurement across the whole observation period. The coefficients are then used in equation (5) to create the new traded and non-traded indexes.

The relative price of non-traded goods is then calculated as a ratio between the non-traded goods price index and traded goods price index. That is, the relative price of non-traded to traded goods prices (R) is

$$R = p^N - p^T \quad (6)$$

The aggregation process has a clear weakness in that the classification is made arbitrarily based on the traditional classification of traded and non-traded sector. Moreover, the traded or non-traded status for goods and services might change with time. Considering the 50-year time span of this study, some goods and services which were not traded in the past may have become traded at some point. Goods which have short shelf life, such as food and foodstuffs, may be non-traded in the 1970s but have become increasingly traded in the 2000s due to technological progress and trade liberalisation. Additionally, as argued by Engel (1999), consumer prices should be thought of as the price of a joint product. A traded-good might use marketing service, which is probably closer to being non-traded. Conversely, some of the items in the non-traded category, such as financial services, are probably traded. However, as has been discussed in the previous section, this weakness is unavoidable to some extent. As an alternative method, I also use a ratio between import goods prices in the Wholesale Price Index and the non-traded price index from equation (5). Several ratios

constructed from selected CPI components and residential property price indexes are also used presented in the next section to give more depth to the analysis.

The GDP deflator based ratio uses Indonesia Statistics quarterly data from March 1983 to December 2014. I limit the observation period to after 1983 because GDP data prior to 1983 do not have a specific classification for the oil and gas-related manufacturing. This distinction matters because the Dutch disease measurement of the relative price of non-traded sector should only consist of the non-booming sector. For sector tradability, I apply the definition used by De Gregorio et al. (1994) and Engel (1999) with a modification. I define non-traded sector as sectors which, firstly, have less than 10 per cent of its total consumption comes from imports, and secondly, less than 10 per cent of its output is exported.¹⁵ Both criteria need to be fulfilled to be categorised as a non-traded sector. The first criterion is to capture goods and services which are met mainly by domestic production, while the second criterion captures goods and services which are mainly produced for domestic consumption. This is different from the definition used by De Gregorio et al. (1994), which only uses the 10 per cent threshold on export proportion. By adding the share of total consumption, the ratio is expected to represent both sides of the country's trade pattern better. This is also in line with the theoretical Dutch disease assumption of the law of one price in traded goods through imports. This definition is applied using Input-Output data from World Input-Output Database¹⁶ by simply averaging the sector shares from 1995 to 2011.

Table 4.1 shows the process of selecting sectors which fall within either one of the requirements. Using this definition, the following sectors are defined as non-traded sector: Agriculture, Hunting, Forestry and Fishing; Electricity, Gas and Water Supply; Construction; Wholesale Trade and Commission Trade; Except of Motor Vehicles and Motorcycles; Retail Trade, Except of Motor

¹⁵ *i. e.* $\frac{import}{(output - export + import)} < 10\% \text{ AND } \frac{export}{output} < 10\%$

¹⁶ Indonesia Input-Output table in WIOD is based on Indonesia Statistics' Input-Output table in 2000, 2005, and 2010

Vehicles and Motorcycles; Repair of Household Goods; Hotels and Restaurants; Post and Telecommunications; Financial Intermediation; Real Estate Activities; Renting of Machine and Equipment and Other Business Activities; Public Admin and Defence, Compulsory Social Security; Education; Health and Social Work; and Other Community, Social and Personal Services. Most of these sectors are generally considered as services, which are often assumed to be non-traded. However, it is rather surprising that the Agriculture, Hunting, Forestry and Fishing sector is categorised as non-traded considering Indonesia's reputation as an agricultural and forestry products exporter. The rest of GDP components which are not categorised as non-traded are categorised as the traded sector.

Real Estate and Renting of Machines and Equipment and other business activities are treated as special cases and classified as non-traded. Real Estate export suddenly jumped from near zero to more than 20% from 2005. While this might indicate a transformation from non-traded to traded, a sudden increase to 20% of the sector consumption imported appears highly unlikely. Therefore, I decided to classify it as non-traded. Similarly, the share of import in Renting of Machines and Equipment were less than 5% in most years but more than 20% in a few years. Nevertheless, the impact of excluding or including these two sectors are of low consequence because their proportions in GDP are relatively small.

Table 4.1. Sectors with less than 10 per cent share in either import share of consumption or export share of output

Sector	Import share of consumption	Export share of output
Agriculture, Hunting, Forestry and Fishing	5.00%	3.26%
Electricity, Gas and Water Supply	0.98%	0.00%
Construction	0.12%	0.00%
Wholesale Trade and Commission Trade, Except Motor Vehicles and Motorcycles	1.52%	0.52%
Retail Trade, Except Motor Vehicles and Motorcycles; Repair of Household Goods	0.68%	0.52%
Hotels and Restaurants	7.79%	10.42%
Post and Telecommunications	4.48%	2.97%
Financial Intermediation	7.33%	5.66%
Real Estate Activities	10.51%	4.01%
Renting of Machine and Equipment and Other Business Activities	12.96%	3.46%
Public Admin and Defence; Compulsory Social Security	3.03%	1.51%
Education	5.13%	1.81%
Health and Social Work	2.50%	0.44%
Other Community, Social and Personal Services	6.90%	5.24%
Food, Beverages and Tobacco	7.50%	13.43%
Wood and Products of Wood and Cork	2.12%	29.12%
Other Non-Metallic Mineral	9.31%	14.75%
Transport Equipment	20.18%	6.67%
Inland transport	10.55%	6.12%

Source: Author's calculation based on WIOD database (Timmer, Dietzenbacher, Los, Stehrer, & de Vries, 2015).

GDP deflator, which is the ratio of GDP in current value to its constant value, is calculated for each sector (non-traded and traded). Similar to the CPI-based method, the relative price of non-traded goods is then calculated as a ratio between the non-traded GDP deflator and traded goods GDP deflator. It is important to note that the booming sectors (i.e. mining and manufacturing of oil and gas) are excluded from the relative price calculation because the objective is to measure the Dutch

disease impacts on relative prices.¹⁷ This follows the Dutch disease theory where a commodity boom is predicted to appreciate the relative price of non-traded sector to non-booming traded sector.

4.5. Findings and discussion

4.5.1. Trade-weighted real exchange rate

Figure 4.5 presents the comparison between RER index constructed in this study with BIS REER index and Bruegel database (Darvas, 2012). Although based on differing weighting methods, these indexes clearly move in the same direction with relatively minor differences after the 1998 AFC. The similarity between them is expected, because the lists of trade partners for the weighting process are relatively similar, only their relative importance changes. The differing magnitude between this study's index and the Bruegel database index in the earlier years of the observation period is most likely caused by the time-variant and time-invariant characteristics of each index weighting method. The differing weighting process also explains why the differences disappear in the later period, as the weighting between the two methods converges. Other than the difference in magnitude, both indexes tell a very similar story regarding Indonesia's experience with resource booms and busts.

In the 1970s oil boom period, much of the ups and downs in the RER index are related to the country's fixed nominal exchange rate regime. For example, the first RER depreciation from 1970 to 1972 was mainly caused by exchange rate devaluation in April 1970 and in August 1971. After the OPEC oil embargo in October 1973, which triggered the first oil boom, the RER appreciated by 67 per cent in four years until it reached the highest level of RER in Indonesia economic history. The appreciation only ended in 1978 when the government decided to devalue the currency by 50 per cent. The devaluation was due to the widely held view that the non-oil traded sector of the economy should be shielded from the general equilibrium effect of the oil boom (Warr, 1984). Warr (1984) argues that by late 1978 the contractionary effect of the oil boom on the non-oil traded goods

¹⁷ Agricultural based booming sector, such as palm oil, is still not excluded from the traded sector index due to data limitation.

producing sectors of the Indonesian economy was very apparent and that the profitability of import-competing sectors, in particular, had declined significantly. The subsequent depreciation, however, did not last very long as the second round of oil boom was just about to start in 1979, following the Iranian Revolution. The oil price reached its peak in 1980 while global consumption of oil started to decline in response to the high price.

To put the resource boom in Indonesia into perspective, Figure 4.6 shows RER comparison between Indonesia, Australia and Brazil. During the 2000s resource boom period, RER appreciation in Australia and Brazil are higher than in Indonesia. If, for comparability purposes, the year 2000 is picked for the benchmark pre-boom year and the year 2011 as the peak of the boom, during the whole boom period Indonesia RER appreciated by 56.3 per cent, while Australia's and Brazil's RER appreciated by 64.2 per cent and 80.6 per cent respectively. However, Australia and Brazil do not seem to be good comparators for Indonesia during the 1970s oil boom. Due to the characteristic of the 1970s boom, which was primarily an oil-based boom, Australia did not experience RER appreciation during the boom. Brazil, on the other hand, experienced 40.4 per cent appreciation from 1972 to 1977 while Indonesia experienced 52.7 per cent appreciation during the same period.

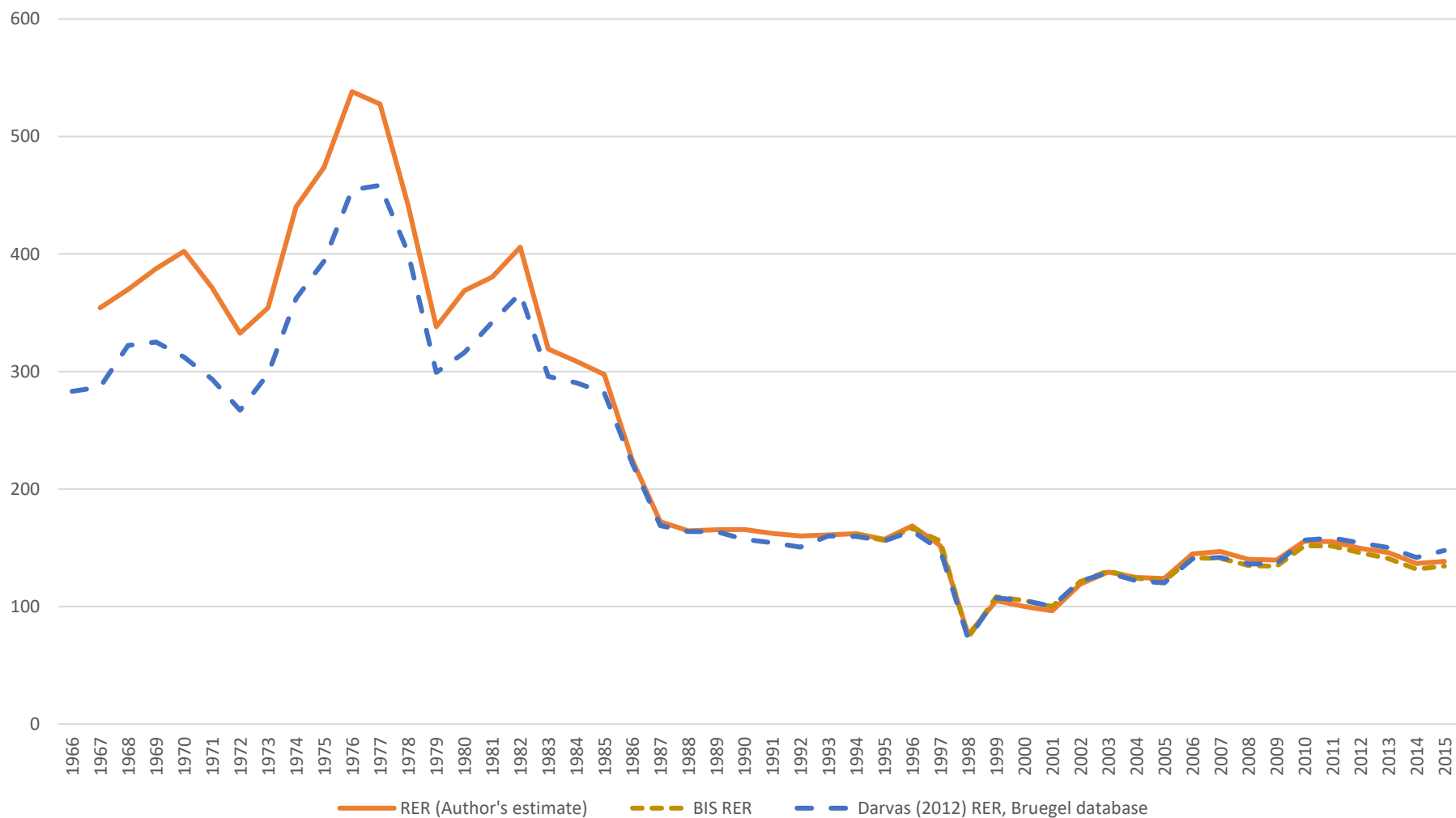


Figure 4.5. Indonesia trade weighted-real exchange rate Index (2000=100)

Source: Author's calculation based on IMF IFS database and World Bank WITS database, BIS REER database, Darvas (2012) Bruegel database.

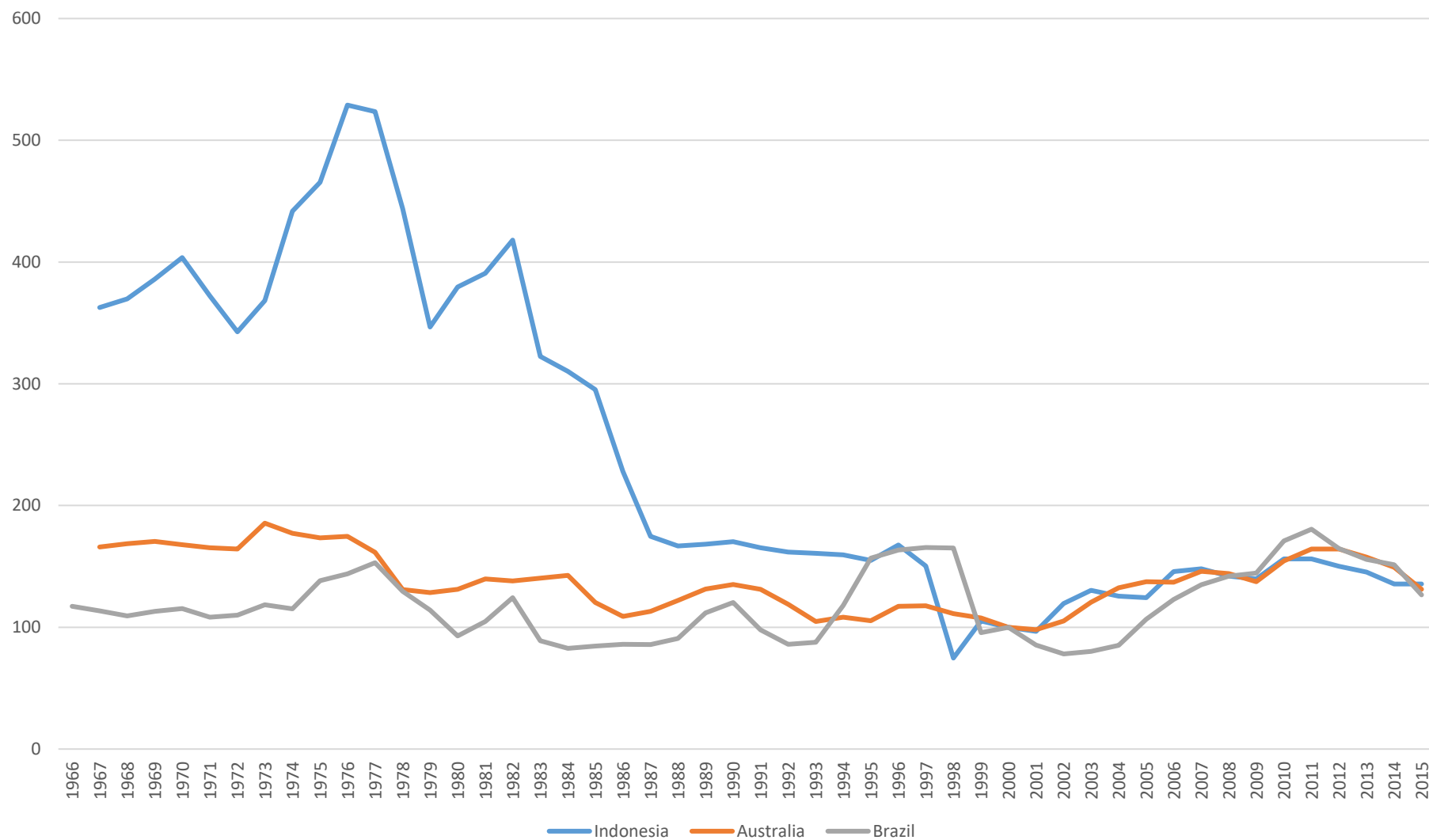


Figure 4.6. Indonesia, Australia and Brazil trade weighted-real exchange rate Index (2000=100)

Source: Author's calculation based on IMF IFS database and World Bank WITS database

The RER, on the other hand, was still rising until 1982 and only stopped after the rupiah was devalued twice in one year in March and September 1983. This time it was done mainly for the balance of payment considerations. The oil price continued to decline and then collapsed in 1986, prompting the last exchange rate devaluation by 30 per cent against the US dollar in September. The RER then stabilised until 1996, during which the government has launched a series of reform measures in the banking system, tax, as well as trade and investment liberalisation to revive growth and increase non-oil export. The Asian financial crisis in 1997-1998 brought down the RER to its lowest level. The rupiah was floated in August 1997, which was followed by a sharp depreciation from around 2500 IDR per USD in early 1997 to 17,500 IDR per USD in July 1998. In October 1998, year on year inflation reached 82.6%, its highest point since the 1960s. After the crisis, the RER gradually increased despite the relatively stable nominal exchange rate and inflation stabilised. This rise in RER might be attributable to the improvement in terms of trade brought by the commodity boom since 2003. The RER increased continuously until 2011, only briefly interrupted by the 2008-2009 Global Financial Crisis (GFC). As the commodity boom reached its peak in 2012, the RER went down with it until 2014.

Overall, the trade-weighted RER has been able to capture the relationship between the Indonesian economy and resource booms and busts. On the comparison between the two booms, the RER shows that the 2000s commodity boom is smaller compared to the 1970s oil boom. The size of the RER appreciation, however, is not as big as it appears in Figure 4.5. The RER appreciation in the 1970s oil boom from pre-boom 1972 level to its peak in 1976 is 62.2%, while the appreciation during the 2000s commodity boom from pre-boom 2000 to its peak in 2011 is 56.3%. Therefore, the changes of the RER are relatively similar in both booms.

Despite Indonesia's transformation from an oil-dependent economy during the first oil boom into a diversified one up until before the 2000s boom, the size of RER appreciations in both booms are surprisingly similar. However, it is too early to conclude that the 2000s commodity boom has caused

a re-specialisation into resource-producing and caused the RER to appreciate. Furthermore, on the question of the size of the Dutch disease, the RER might not be a good tool to answer it. It is tempting to conclude that the country's non-booming traded sector loses competitiveness due to RER appreciation caused by the boom. However, to analyse the Dutch disease phenomenon, the appropriate measure of the relative price of non-traded goods should be used instead of the trade-weighted RER.

4.5.2. The CPI-based relative price of non-traded goods to traded goods

The CPI-based relative price of non-traded goods is presented in Figure 4.7. From the weighting regression in equation (4), the coefficients are as follow:

Table 4.2. Weighting of CPI components, based on regression results

Items	Coefficient
Food and foodstuffs ($\Delta \ln FF$)	0.57
Housing and utilities ($\Delta \ln HU$)	0.10
Clothing ($\Delta \ln C$)	0.05
Miscellaneous expenditures ($\Delta \ln M$)	0.22

Source: author's calculation

With the traded goods price index consists of FF and C, around 90 per cent of the movement in the traded goods price index is due to changes in the FF price index while the remaining 10 per cent is caused by movement in the C price index. For the non-traded goods price index, 69 per cent of its movement is due to changes in the M price index while the remaining 31 per cent is from HU price index. As discussed in the previous section, the main weakness of this ratio is in the arbitrariness of classifying traded and non-traded items in the CPI. This is particularly important in the case of food and foodstuffs component, which effectively drives nearly all of the movements in the traded goods price index by having 90 per cent weight in the traded goods price index. Nevertheless, the CPI-based relative price offers a starkly different picture from what the trade-weighted RER paints.



Figure 4.7. The relative price of non-traded goods to traded goods, CPI Based (2000=100)

Source: Author's calculation based on Indonesia Statistics CPI data

Although the food and foodstuffs component has a central role in the traded goods price index, it is arguably less important to the Dutch disease discussion. This is because the Dutch disease mainly focuses on the non-booming traded sector, while food and foodstuff component is only a small part of the non-booming traded sector. Moreover, the tradability of food and foodstuffs may be relatively low. While technology and transport cost had prohibited food and foodstuffs from being traded in the 1970s and 80s, protectionist policies for food crops had accomplished the same results since 2001 (Basri & Patunru, 2012). Therefore, alternative methods to construct the relative price of non-traded to traded goods are needed. One possible alternative, which is also applied in Warr (1984), is to use the imported price index from the Wholesale Price Index (WPI) to proxy traded goods price index. Another possible alternative is to select specific items in the CPI to proxy the traded and non-traded items. For the first alternative method, I construct the traded goods price index using only the clothing component and then calculate the relative price of non-traded to traded goods with the non-traded goods price index based on the weightings in Table 4.2 (Figure

4.8). I use clothing price index because import price index from the WPI is only available from 1984 and because clothing sector arguably fits more into the non-booming traded sector classification. However, to enrich the analysis, this study also presents relative price indexes based on the imported price index from WPI and selected items from more detailed CPI classification, which are only available after 1984.



Figure 4.8. Non-traded goods to clothing price ratio (2000=100)

Source: Author's calculation based on Indonesia Statistics CPI data

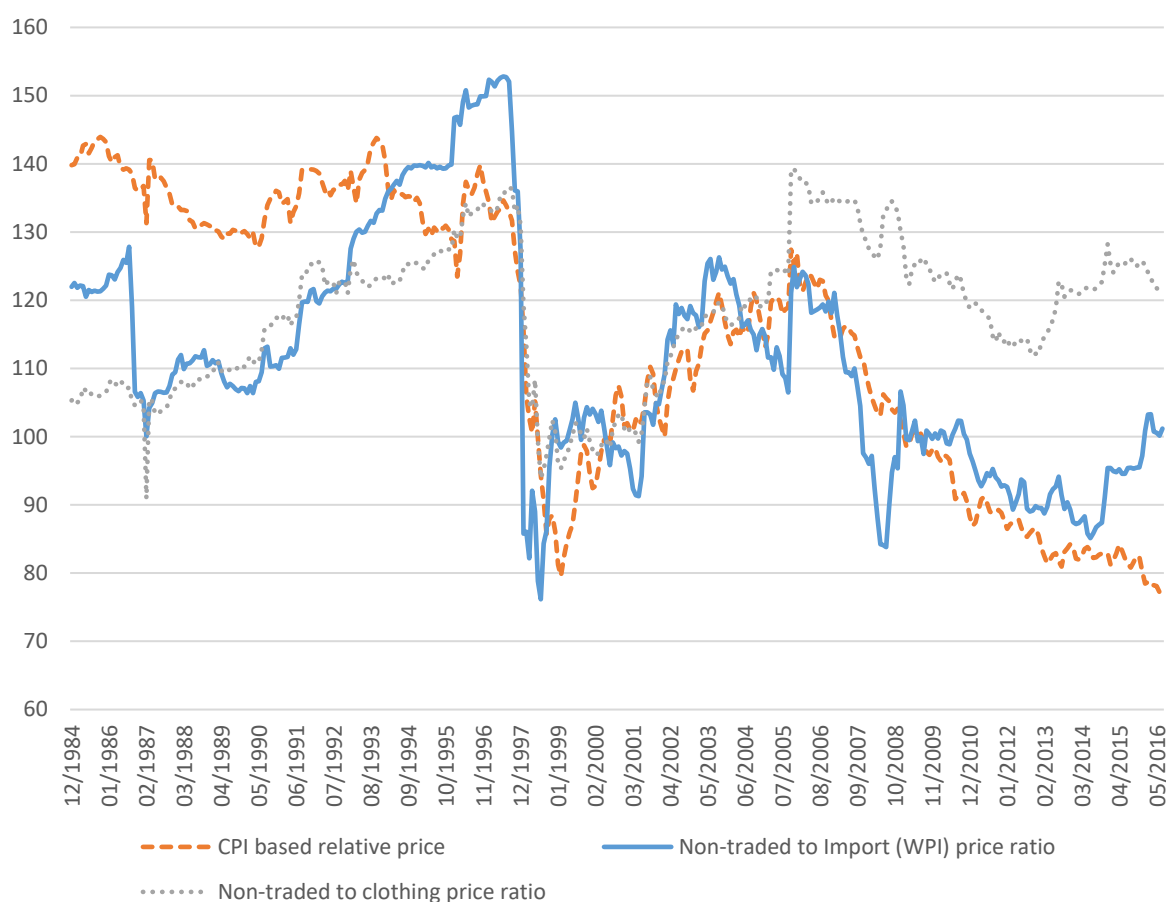


Figure 4.9. Comparison between three alternative methods to measure the relative price of non-traded to traded goods (2000=100)

Source: Author's calculation based on Indonesia Statistics CPI and WPI data

Both Figure 4.7 and 4.8 will be used to analyse the 1970s oil boom. Based on Figure 4.7, there is no obvious appreciation in the relative price of non-traded goods during the 1970s oil boom (5 per cent appreciation from October 1973 to December 1978) nor during the 2000s commodity boom. Figure 4.8, on the other hand, shows a moderate appreciation during the 1970s oil boom (24.7 per cent appreciation from October 1973 to December 1978). This appreciation, however, cannot be interpreted as the impact of resource boom or an indication of the Dutch disease because the appreciating trend continues well into non-booming period. The difference between Figure 4.7 and 4.8 highlights the role of food price in determining the relative price of non-traded to traded goods. Whereas the relative price in Figure 4.7 shows a depreciation trend in the long term, the non-traded to clothing price ratio in Figure 4.8 shows an appreciation trend in the long term.

The high fluctuation in the 1966 to 1972 period (Figure 4.7 and 4.8) is most likely due to the stabilisation process after the 1965 regime change. As has been discussed in the previous section, the period between 1966 and 1972 was a recovery period. Year on year inflation rate reached 600 per cent in 1965 and was still in triple digits up until November 1968. Several important policies were implemented during the period. The government restructured its debt in October 1966, liberalised foreign investment in 1967 and domestic investment in 1968, abolished the double exchange rate system and devalued the Rupiah twice: in April 1970 and August 1971. These policies, especially the exchange rate policies, were bound to have some effects on the price movement and can explain some of the fluctuations in the period. Figure 4.7 shows that each devaluation was followed by a short period of higher inflation rate in the traded goods price index.

The unstable period was prolonged until early 1974 because of crop failure all over the world, which also affected Indonesia through high food inflation.¹⁸ Since food and foodstuffs have a dominant weight in the traded goods price index, it is no wonder that Figure 4.7 shows substantial depreciation of the relative price of non-traded to traded goods in 1972. When food prices are excluded, the significant depreciation disappears, as shown in Figure 4.8. The relative price of non-traded to traded goods only stopped falling in 1973, not because food inflation fell, but because non-traded goods inflation also increased. The 1970s oil boom, which started in October 1973, coincided with the crop failure. It is unclear how large the oil boom affected the relative price of non-traded to traded goods, but high food inflation was soon followed by inflation in other goods. As inflation spread from food to other items in the consumer basket of goods, the relative price of non-traded to traded goods became relatively stable, but overall inflation stayed in the double-digit area until 1978.

The November 1978 devaluation was soon followed by 16.2 per cent inflation in 1979, driven by food and clothing subindexes, both of which were part of the traded goods price index. This drove

¹⁸ Year on year food inflation reached double digits in September 1972 and reached its peak of 60.95% in July 1973

the relative price of non-traded to traded goods to depreciate. The pattern of a surge of inflation after devaluation occurred again after the 1983 devaluation was carried out. Warr (1984), in the discussion about the effect of 1978 and 1983 devaluations on the real exchange rate and relative price, concludes that the effect of devaluation was only temporary and that in the long-run relative prices are determined by real forces of supply and demand. From 1979 to 1985, which was the second part of the 1970s oil boom, the relative price of non-traded goods rose by 26.5 per cent (Figure 4.7) and non-traded to clothing price ratio rose by 44.4 per cent (Figure 4.8).

For the period after 1986, comparison can also be made with the non-traded to import price ratio (Figure 4.9). The oil price crashed in 1986, and the government responded by devaluing the IDR by 30 per cent in September 1986. This devaluation was the last one as each devaluation is found to be destabilising by increasing inflation in each subsequent period. The three indexes can complement each other in describing what happened after the devaluation. Non-traded to import price ratio dropped right after the devaluation and kept falling until February 1987. The aggregate CPI-based relative price and the non-traded to clothing price ratio, on the other hand, both decline after the devaluation although at a slower pace compared to the non-traded to import price ratio. This shows that the impact of increased import prices after devaluation took several months to be channelled into consumer basket of goods. By February 1987, both non-traded to import price ratio and non-traded to clothing price ratio reversed and started to appreciate while aggregate CPI-based relative price of non-traded to traded goods continued to depreciate. Contrary to the prediction of the Dutch disease theory, throughout the non-boom period from 1987 until the onset of the Asian Financial Crisis in 1997, both the non-traded to import price ratio and the non-traded to clothing price ratio steadily appreciated. This appreciation was driven by the housing expenditure price index, which is part of the non-traded goods price index, which more than doubled during the period (119 per cent increase from February 1987 to August 1997). While the reason for this increase in housing expenditure is beyond the scope of this paper, this is why the relative price of non-traded to traded goods did not follow the prediction of the Dutch disease framework.

When the AFC started, and the Rupiah depreciated drastically in 1997-1998, all of the three relative price indexes depreciated with the currency, driven mainly by the increased import prices. As the Rupiah stabilised and inflation was brought down, the post-crisis period saw steady appreciation in all three relative price indexes until they reached their peak in 2005. Some of the changes in the relative price of non-traded to traded goods in the post-AFC period, including the large appreciation in late 2005, were related to changes in the gasoline price, which was set by the government. The gasoline price had such an important role because its changes always have a large impact on the transport prices in the CPI, which was part of the non-traded basket of goods. Therefore, each time the government increase (decrease) the gasoline price, the relative price of non-traded to traded goods appreciated (depreciated).

After 2005, all of the three relative price indexes gradually depreciated with varying degree until the end of the observation period. This development is unexpected from the Dutch disease viewpoint because the period coincided with the second resource boom, which started in 2003. During the GFC, the non-traded to import price ratio depreciated in a “V” shaped pattern before it resumed to its longer-term depreciation pattern. The “V” shaped pattern, however, was not found in the relative price of non-traded to traded goods nor the non-traded to clothing price ratio. This difference was arguably caused by the Rupiah nominal depreciation during the GFC, which was more pronounced in the imported basket of goods than the consumer CPI.

A more detailed observation to the relative price of non-traded to traded goods indicates that non-traded goods prices, including housing, fuel and utilities, health, education and recreation, and transport, communication and finance, consistently grew slower than overall CPI, except for several spikes in transport price due to fuel subsidy reforms.¹⁹ While the low inflation in transport and communication price index might be explained by development in communication technology and increased competition in the transport sector, the explanation behind low housing, fuel, and utilities

¹⁹ From 2006 to 2015, the price index for overall CPI; housing, fuel and utilities; health; education and recreation; transport, communication and finance increased by 6.84%, 5.69%, 4.65%, 5.32%, 6.00% respectively.

inflation is not clear. Even when the comparison uses the cost for housing index instead of the more general ‘housing, fuel and utilities price index’, the annual inflation in the subindex is still lower than the overall CPI.²⁰ This is also confirmed by Bank Indonesia’s Residential Property Price index in the major cities, which increased slower than the overall CPI except for a brief period between September 2012 and September 2014 (Figure 4.10).

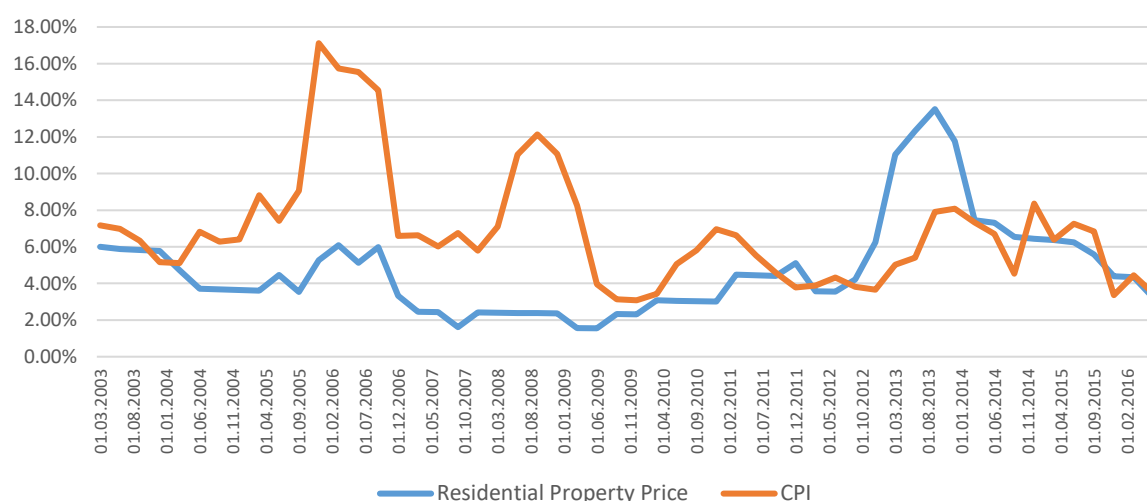


Figure 4.10. Year on year change in CPI and Residential Property Price in major cities

Source: Author’s calculation based on Bank Indonesia data and Indonesia Statistics CPI data

The low inflation in the housing price index might be caused by the aggregation process at the national level. Figure 4.11 plots the difference between the cost of housing index in each city and the national level. Cities which are closer to resource-producing activities (i.e. Medan, Pekanbaru, Samarinda) appear to have relatively higher inflation in cost for housing index compared to the national level. On the contrary, bigger cities, especially those in Java (i.e. Jakarta, Surabaya, Bandung), experienced lower cost for housing inflation. This subnational dynamic complicates the analysis even further, as the relative price of non-traded goods within one country is not uniform. Nevertheless, the comparatively low housing inflation is interesting because it was the opposite of the pre-2005.

²⁰ Average inflation in cost for housing index from 2006 to 2015 is 4.96%

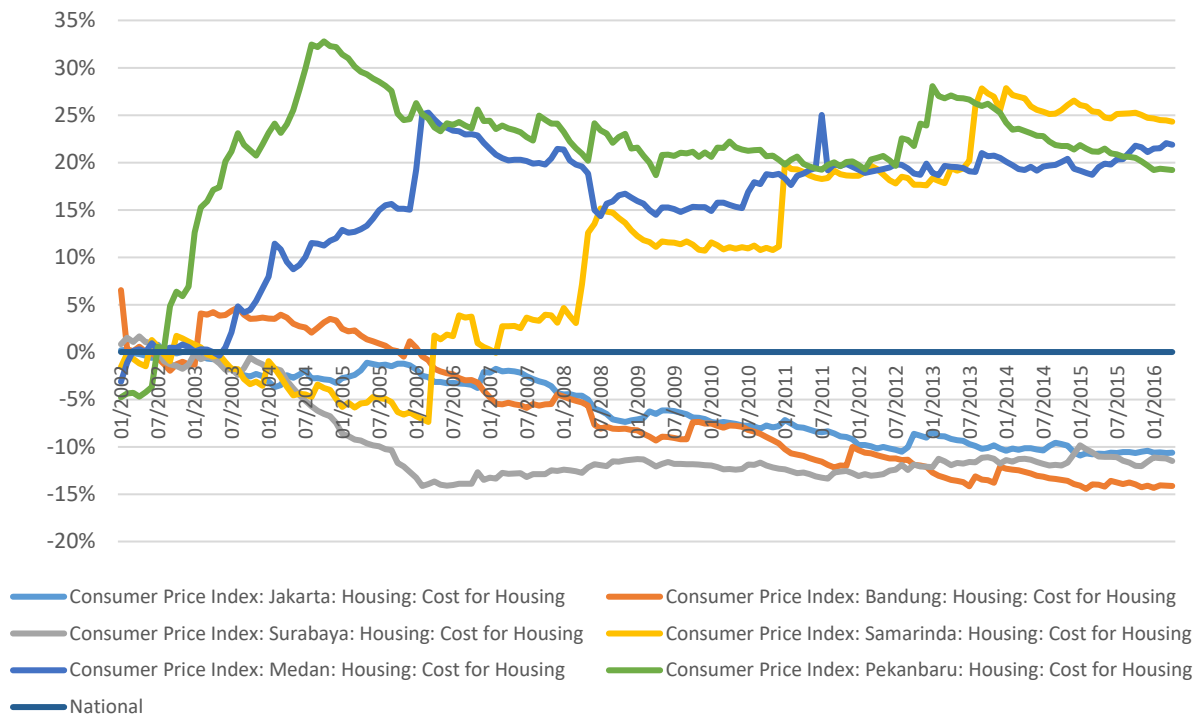


Figure 4.11. Cost for housing index in six cities relative to the national average (% difference to the national average)

Source: Author's calculation based on Indonesia Statistics CPI data

Another possible explanation for the depreciation is related to the food and foodstuff component in the traded basket of goods. The food and foodstuff inflation has been consistently higher than overall CPI inflation since 2006 (Figure 4.12), hence the depreciation in the relative price of non-traded goods. There are two possible explanations behind the higher than overall inflation in the foodstuff component. Firstly, protectionism has begun to creep back since 2001, especially for food crops (Basri & Patunru, 2012). With such protectionism in place, the foodstuff component is increasingly becoming a non-traded good, which is confirmed by the input-output table criteria discussed in the Method section. Secondly, even if foodstuff commodities are still traded, many commodities in the foodstuff index are part of the commodity boom, which means their prices increase as the boom develop. Although the increase in food prices in the international market is comparatively smaller compared to oil and minerals, the price still rose more than manufactured goods price index. In fact, both explanations might have a role in explaining the high food inflation.

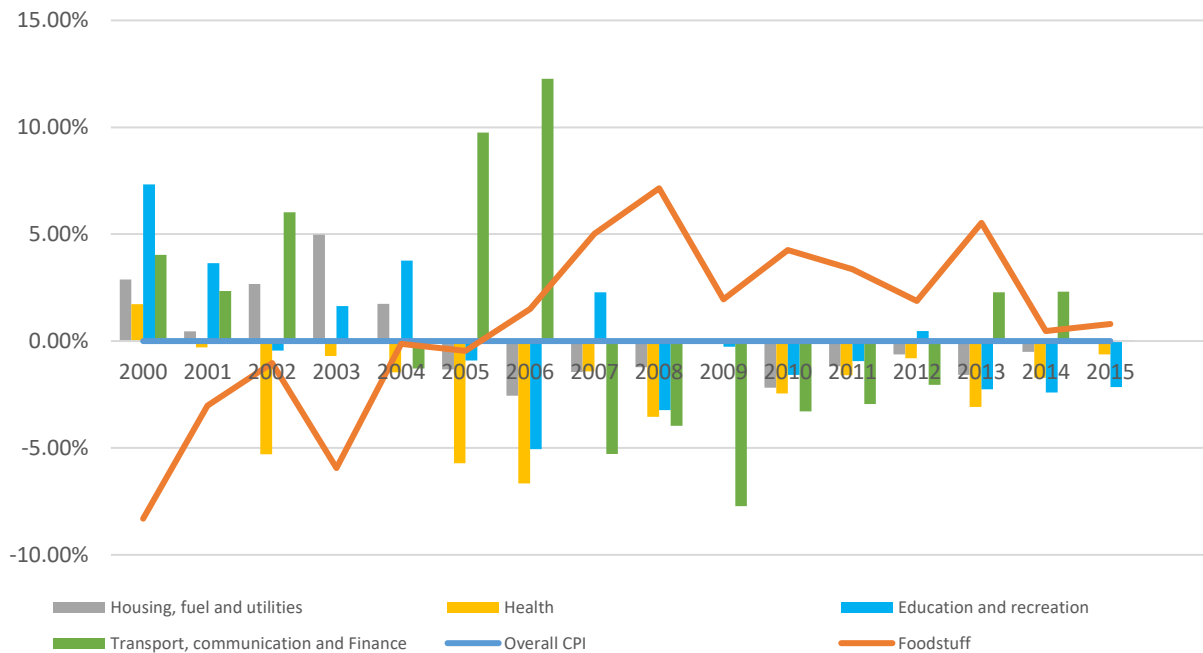


Figure 4.12. Difference between year on year CPI inflation and its component (% difference relative to overall CPI)

Source: Author's calculation based on Indonesia Statistics CPI data

To conclude, the CPI-based relative price of non-traded goods does not show a clear sign of the Dutch disease phenomena in the 1970s oil boom nor the 2000s commodity boom. In contrast to the trade-weighted RER, the comparison between boom and non-boom period using the CPI-based relative price of non-traded to traded goods does not demonstrate any specific pattern of appreciation and depreciation. The index, however, was able to capture the effect of several important events in the economy, including currency devaluation, financial crisis, and gasoline price changes.

Moreover, it is not easy to explain the relative price depreciation since 2005 considering the rising commodity prices since 2003. The low inflation in the non-traded basket of goods is of particular interest, especially for the cost of housing, which is usually viewed as a non-traded sector with relative certainty. It also appears that the resource boom effect did not necessarily translate into higher non-traded goods prices in the consumer basket of goods. While it is not within the scope of this paper to answer why non-traded goods inflation was lower than the overall CPI, but several

factors, including technological changes, competition, government regulation, and labour market dynamics, might have played some role. On the other hand, trade policy might have affected the relative price through higher food inflation, and in effect, increased the traded goods inflation. As I note in the Method section, there are also problems in measuring the relative price related to the difficulty of classifying between traded and non-traded expenditure within the CPI basket of goods.

4.5.3. GDP deflator based relative price of non-traded goods

Figure 4.13 presents the GDP deflator based RER. The observation period starts in 1983, which means much of the oil boom period had already passed, and the boom was coming to an end. Nevertheless, the series appears to capture much of the appreciation and depreciation dynamic of the relative price during resource booms and busts. The relative price continued to rise until reaching its top on March 1984, only briefly interrupted in December 1983. This is in contrast with the trade-weighted RER which was already declining since 1982 and with the CPI-based relative price, which was still appreciating until 1985. The effect of the central bank's efforts to improve the balance of payment by devaluing the currency twice in 1983 was only visible in the following year. The relative price of non-traded goods started to depreciate in 1984 and continued until 1987-1988, followed by a brief appreciation in 1989 before proceeding to depreciate until 1992. This depreciation was caused more by the lower inflation in the non-traded sector than by the high inflation in the traded sector. The services and the construction sectors, both part of the non-traded sector, had negative year-on-year inflation for four quarters from 1986 to 1987.

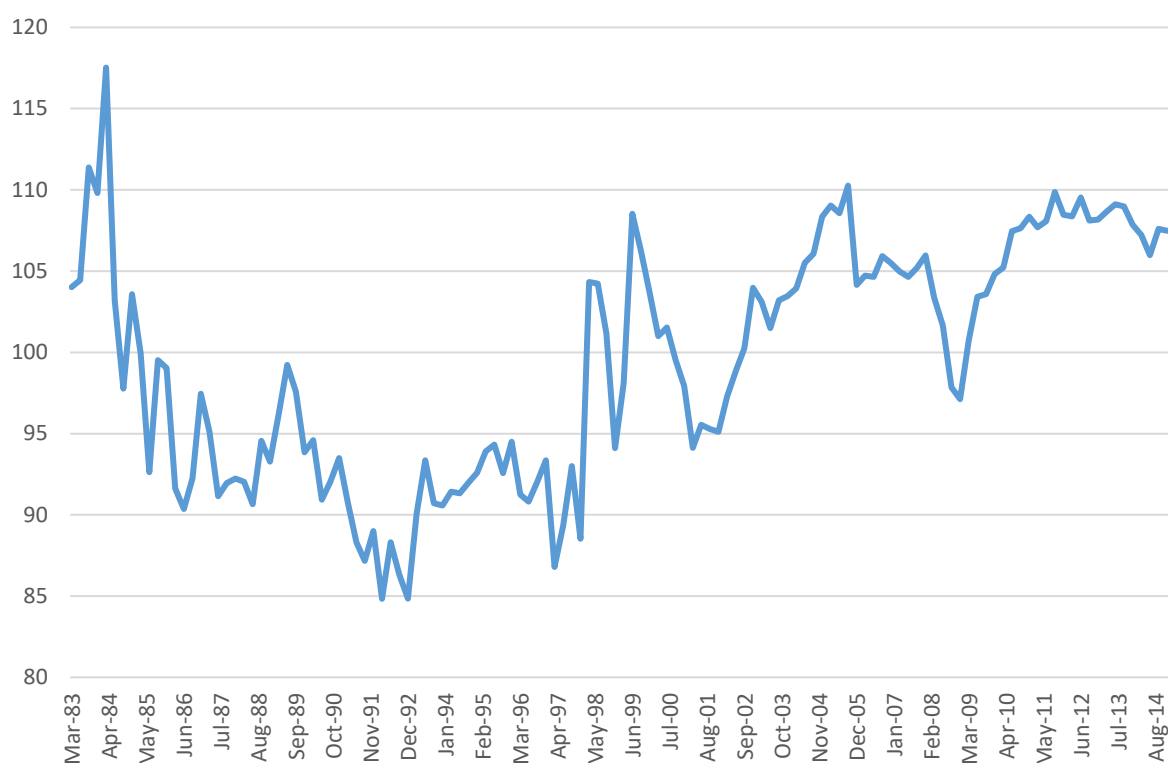


Figure 4.13. GDP deflator based relative price of non-traded goods (2000=100)

Source: Author's calculation based on Indonesia Statistics GDP data

As the oil price stabilised in the early 1990s, so did the relative price of non-traded goods, which stays between the ranges of 90 to 100 until the AFC in 1998. Surprisingly, instead of depreciation, as depicted by RER and CPI-based relative price, GDP deflator based relative price appreciated during the AFC. A more detailed observation shows that, on December 1998, the trade, hotel, and restaurant sector deflator increased by 111 per cent compared to previous year deflator, the construction sector deflator increased by 120 per cent, while the non-oil manufacturing sector deflator increased by 'only' 88 per cent. This is unexpected because the nominal exchange rate extreme depreciation at the time should have increased the price of traded goods prices (i.e. non-oil manufacturing) more than non-traded goods (i.e. trade, hotel and restaurant and construction).

The immediate period after the AFC was relatively unstable such that it is not easy to pinpoint which event was related to which changes in the relative price. However, the general trend after this was an appreciation of the relative price up until its peak in September 2005. This is similar to the finding

in CPI-based relative price, in which the relative price peaked in 2006. After 2005, the GDP based and CPI-based relative price progressed in different trajectories. While the CPI-based relative price continues to decline, the GDP deflator based relative price only dipped during the GFC and then rapidly surge to beyond pre-GFC level until 2012, the year when the boom ended. Overall, the GDP deflator based relative price can give a clearer picture of the Dutch disease phenomena compared to the CPI-based one.

One thing that has to be stressed again is that the whole dynamic of the relative price index depends on how the traded and non-traded sector is defined. To compare the implications of altering the definition, I use one-to-one ratios between subsectors instead of creating different combinations of subsectors. For example, Figure 4.14 presents a comparison between construction to traded sector relative price and 'trade, hotel and restaurant' (THR) to traded sector relative price. It is immediately evident that the construction sector and the THR sector had faced starkly different trajectory since the boom started in 2003. While the construction to traded sector relative price appreciated, the THR to traded sector relative price depreciated throughout the commodity boom period. Although the GDP deflator of the construction sector grew by double the rate of THR sector (12.56% and 6.79%), their real growth is relatively comparable (7.18% and 6.64%).

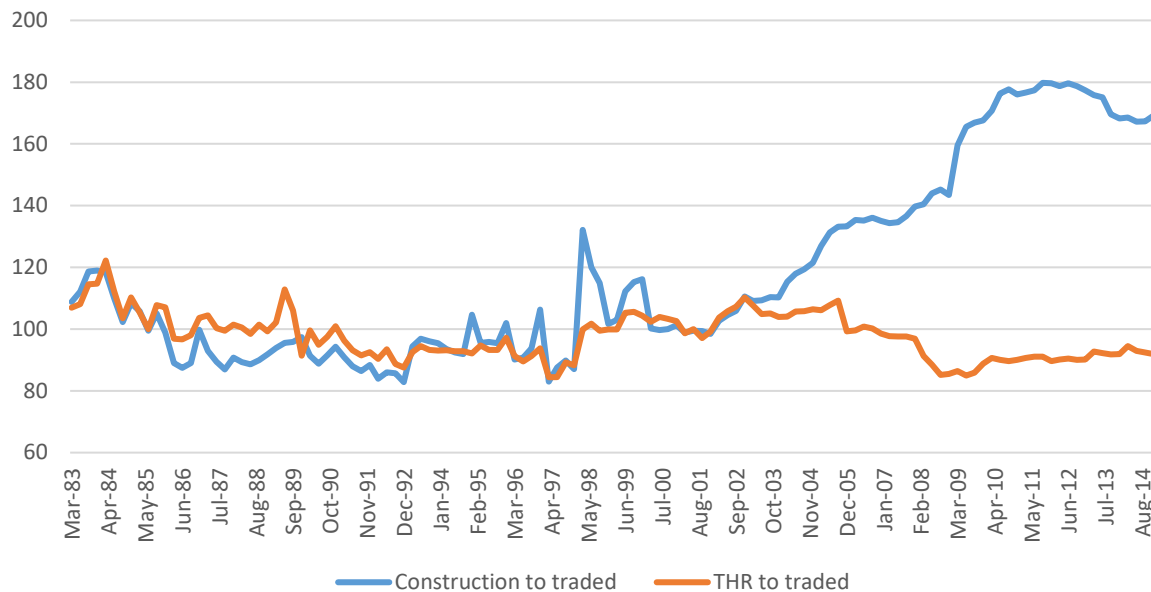


Figure 4.14. Subsector relative price comparison (2000=100)

Source: Author's calculation based on Indonesia Statistics GDP data

There are multiple factors which might have triggered the high price increase in the construction sector (such as changes in interest rates in the banking and finance sector, and regulation in the construction sector) and they are not necessarily directly related to the commodity boom. The overlapping period with the boom, however, suggest that the commodity boom may have a role in this. If analysed through the Dutch disease framework, both sectors are non-traded and are exposed to the income effect. Van Wincoop (1993) expands the Dutch disease model by adding the construction sector and observe the theoretical implications of a positive terms of trade shock. Van Wincoop (1993) describe the construction sector as a non-traded investment good producing sector. Van Wincoop (1993) finds that the outcome of a favourable terms of trade depends on the relative factor intensity of each sector. Out of the six possible scenarios of relative capital intensity, Van Wincoop (1993) argues that the most likely factor intensity is $k^I < k^T < k^N$, where k^I denotes construction sector capital-labour ratio, k^T denotes non-booming traded sector capital-labour ratio, and k^N denotes non-traded sector capital-labour ratio. Under this scenario, the outcome is no immediate changes in the relative price of construction to traded goods nor the relative price of non-traded to traded goods. In term of sectoral size, the construction and non-traded sector expand

at the expense of the traded sector. Van Wincoop (1993) argues that this scenario is plausible because, first, only if $k^T < k^N$ does a favourable terms of trade shock lead to the observed construction boom,²¹ and second, the construction sector does not use much non-traded capital itself, and is therefore likely to be the least intensive in non-tradable capital.

The outcome predicted by Van Wincoop (1993), however, only partly fits the pattern in Indonesia. While output in both the construction and non-traded sector had been growing faster than the non-booming traded sector, their price dynamic does not fit the pattern. Instead of a constant relative price in both construction and non-traded sectors, only the relative price of construction sector increased during the boom. This trend cannot be fully explained using the factor intensity framework proposed by Van Wincoop (1993), because the two relative prices move in the same direction in all scenarios. Sector-specific or country-specific explanations or a combination of both might be able to explain the relative price difference, but this is not within the context of this paper.

Overall, the GDP deflator based relative price confirms much of the findings in the RER dynamics. Furthermore, this approach offers more detailed information about the sectoral dynamic beneath the overall relative price. For the purpose of the Dutch disease measurement, the detailed information gives this method an advantage over the other methods. This is because the Dutch disease as a theoretical framework stresses the importance of inter-sectoral interaction between the booming sector, non-traded booming sector, and non-traded sector. Unfortunately, the explanation behind the differing relative price dynamic between construction and the non-traded sector still needs to be found. Moreover, a longer observation period is still required to compare the two resource booms accurately.

²¹ This statement refers to the scenarios proposed by Van Wincoop (1993). If $k^T < k^N$, demand for capital in the steady state will rise since the relative factor prices will not. Consequently, the steady state capital stock will increase. The capital stock then slowly rises to its higher steady state level, so that investment must rise in response to the shock.

4.6. Summary and Conclusion

This study discusses the comparison between the trade-weighted real exchange rate and the relative price of non-traded goods in the context of measuring the Dutch disease impacts. Despite the usage of the term “real exchange rate” in the Dutch disease literature, the theoretically appropriate term is the relative price of non-traded goods. Several studies have shown that the relative price of non-traded goods does not explain RER movement (Chinn, 2006; Engel, 1999), at least not in the short or medium-term (Chen et al., 2015). The aim of this study is not to empirically test the difference between these measures, as these have been tested by Engel (1999), Chinn (2006), and Chen et al. (2015).²² Instead, the aim is to determine which method is the most appropriate to measure the existence and size of Dutch disease impact based on the theoretical framework and provide a narrative that explains their differences using the case of Indonesia from 1966 to 2015.

Three different methods are compared: the trade-weighted RER, CPI-based relative price of non-traded goods, and GDP deflator based relative price. The merits of these methods are determined by how much they can measure the theoretical components of the Dutch disease, especially the inter-sectoral interaction between the booming, traded and non-traded sectors in the economy. Furthermore, by using fifty years observation period, this study can compare the sizes of the last two commodity booms experienced by Indonesia. Although any approach in classifying the traded and the non-traded sector inevitably contains a certain degree of arbitrariness, this study concludes that the appropriate method to measure the existence and size of the Dutch disease is the GDP deflator based relative price of non-traded goods. This section will discuss a brief summary of each method and its ability to measure the Dutch disease.

Firstly, the trade-weighted RER appears to be highly influenced by changes in the Terms of Trade and the monetary policy, especially in the pre-AFC period. In other words, an increase in oil price was responded by RER appreciation while a devaluation of Rupiah was followed by RER depreciation.

²² Engel (1999), Chinn (2006), and Chen et al. (2015) analyse US real exchange rate to its trade partners, particularly its European counterpart.

Although the RER appreciation during the 1970s oil boom seemed to be larger than the one during the 2000s boom, the percentage changes were quite similar (62.25% in 1972-1976 and 56.3% in 2000-2011). The length of the appreciation from pre-boom to peak, however, was shorter in the 1970s oil boom compared to the 2000s commodity boom. Even though the pattern shown by the RER during the two resource booms fits the prediction of the Dutch disease, it is highly influenced by the monetary policy in response to the booms. The method is also unable to explain the interaction between the booming, traded and non-traded sectors during and after the booms.

Secondly, the CPI-based relative price of non-traded goods does not exhibit a Dutch disease pattern of appreciation during commodity booms nor depreciation during busts. One of the problems is the heavy weight given to the foodstuff component in the traded basket of goods, whose inflation is consistently higher than overall inflation since 2005. To mitigate this problem, I complement the analysis with the non-traded to clothing price ratio and non-traded to import (WPI) price ratio. When combined, the three indices complement each other in explaining the changes in the economy during resource booms and busts. During the 2000s commodity boom, the inflation in non-traded expenditure, particularly the cost of housing expenditure, has been lower than the overall inflation throughout the 2000s booms. This might be caused by the aggregation to the national level, as resource-producing regions saw higher than the overall cost for housing inflation during the booms. Comparison between CPI-based relative price and trade-weighted RER shows that these series do not move together and has been driven by different factors. Based on this method, it cannot be concluded that Indonesia had a Dutch disease in either boom. The level of aggregation that needs to be done to determine the tradability, especially for the longer-term analysis, makes this method not ideal for measuring the Dutch disease. The method is also unable to clearly show sectoral changes during and after the resource boom periods.

Thirdly, in contrast to the CPI-based relative price of non-traded goods, the GDP deflator based one shows a pattern which is much closer to what the Dutch disease literature predicted. Unfortunately,

because the data needed for detailed relative price construction is only available since 1983, a full comparison between the last two booms is not possible. Nevertheless, the relative price depreciation after the oil boom and the modest appreciation in the 2000s commodity boom is observable. This method has a lower degree of arbitrariness as compared to the CPI-based one because an objective indicator is set to determine the classification of each sector. Interestingly, sensitivity test by using combinations of specific sectors within the non-traded classification to construct the relative price shows substantially differing patterns between sectors. While the relative price of construction to the traded sector steadily appreciated during the 2000s commodity boom, the relative price of Trade, Hotel and Restaurant to traded sector depreciated. This method's ability to show the interaction between sector during and after resource boom periods is its biggest strength relative to the other methods. Combined with its relative clarity to distinguish traded and non-traded sector, this method is arguably the most appropriate to measure the Dutch disease.

Comparing the 1970s oil boom and the 2000s commodity boom using the three methods provides a comprehensive narrative for Indonesia's economic development. While the real exchange rate has an advantage over other measurement methods regarding comparability between countries and longer available data, the relative price of non-traded to traded goods, both CPI-based and GDP-deflator based, can complement the analysis with more detail on domestic economic changes. The RER shows that during both periods of booms, the RER appreciated by similar rate of changes. Each period of boom was also followed by a period of RER depreciation. Moreover, non-booming period, such as the period between the end of 1970s boom and the AFC (i.e. 1987-1996), saw a relatively stable RER. On the other hand, the CPI-based relative price shows that during both booms, the relative price of non-traded to traded goods did not appreciate any more than during the non-resource boom period. Instead, food prices, financial crisis, and monetary and exchange rate policies, are more influential in determining the changes in the relative prices. Lastly, while the shorter observation period of the GDP deflator-based relative price did not allow us to make a comparison between the two booms, it confirms the predicted pattern of relative price depreciation

after the 1970s oil boom and relative price appreciation during the 2000s commodity boom. However, the appreciation and depreciation pattern depend a lot on the changes within each sector. The dynamics within the communication and transportation sector, for instance, was very different compared to the construction sector, although they are both parts of the non-traded sector. These unique sectoral dynamics are especially important in analysing the Dutch disease because sectoral changes (i.e. booming sector, non-booming traded sector, and non-traded sector) are central to the Dutch disease theory.

In conclusion, through comparison between the trade-weighted RER, CPI-based relative price of non-traded goods, and GDP deflator based relative price of non-traded goods, this study has shown that each method has its advantages and disadvantages. However, if the objective is to measure the Dutch disease impacts, GDP deflator based relative price is preferred to the other methods. The method allows us to use clearly defined criteria to distinguish between the traded and non-traded sectors. It also provides more detailed information about sectoral changes during and after the resource booms, which are essential to measure the Dutch disease. Although the method has its weaknesses, it is arguably more appropriate to use when measuring the Dutch disease than the widely used trade-weighted RER or the CPI-based alternative.

4.7. Appendix

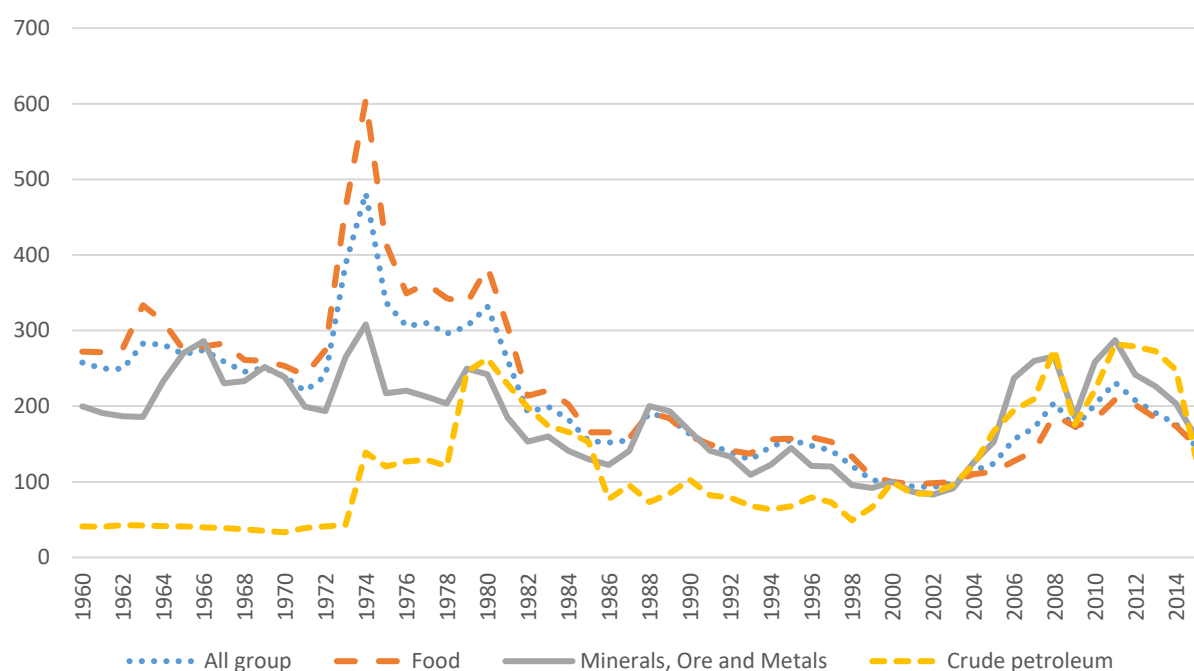


Figure 4.15. Commodity Price indices, adjusted to US CPI (2000=100)

Source: UNCTAD. Note: the inflation-adjusted value is adjusted using US CPI. Food group includes wheat, maize, rice, sugar, soybean meal, vegetable oil (soybean oil, groundnut oil, sunflower oil, copra oil, coconut oil, palm oil, palm kernel oil, cottonseed oil), banana, beef, fish, coffee, tea, and cocoa. Mineral, ore and metals group includes iron, aluminium, copper, nickel, lead, zinc, tin, tungsten, gold, and silver. Crude petroleum group is a simple average of UK Brent, Dubai, and Texas.

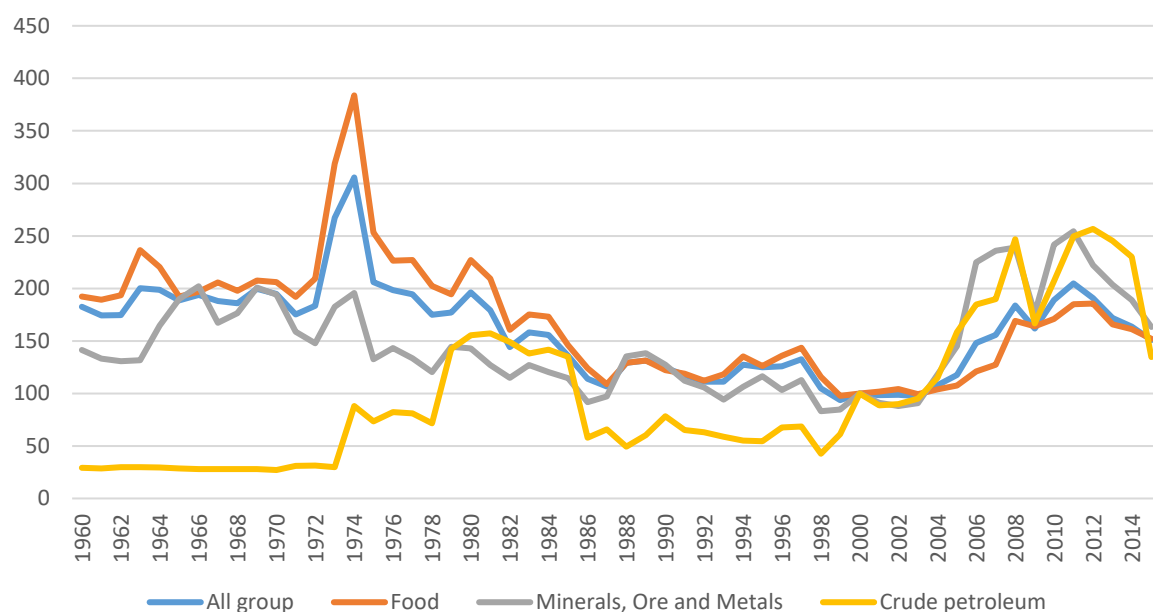


Figure 4.16. Commodity Price Indices, adjusted to unit price of manufactured goods export by developed countries (2000=100)

Source: UNCTAD. Note: the inflation-adjusted value is adjusted using UNCTAD manufacturing goods export price index. Food group includes wheat, maize, rice, sugar, soybean meal, vegetable oil (soybean oil, groundnut oil, sunflower oil, copra oil, coconut oil, palm oil, palm kernel oil, cottonseed oil), banana, beef, fish, coffee, tea, and cocoa. Mineral, ore and metals group includes iron, aluminium, copper, nickel, lead, zinc, tin, tungsten, gold, and silver. Crude petroleum group is a simple average of UK Brent, Dubai, and Texas.

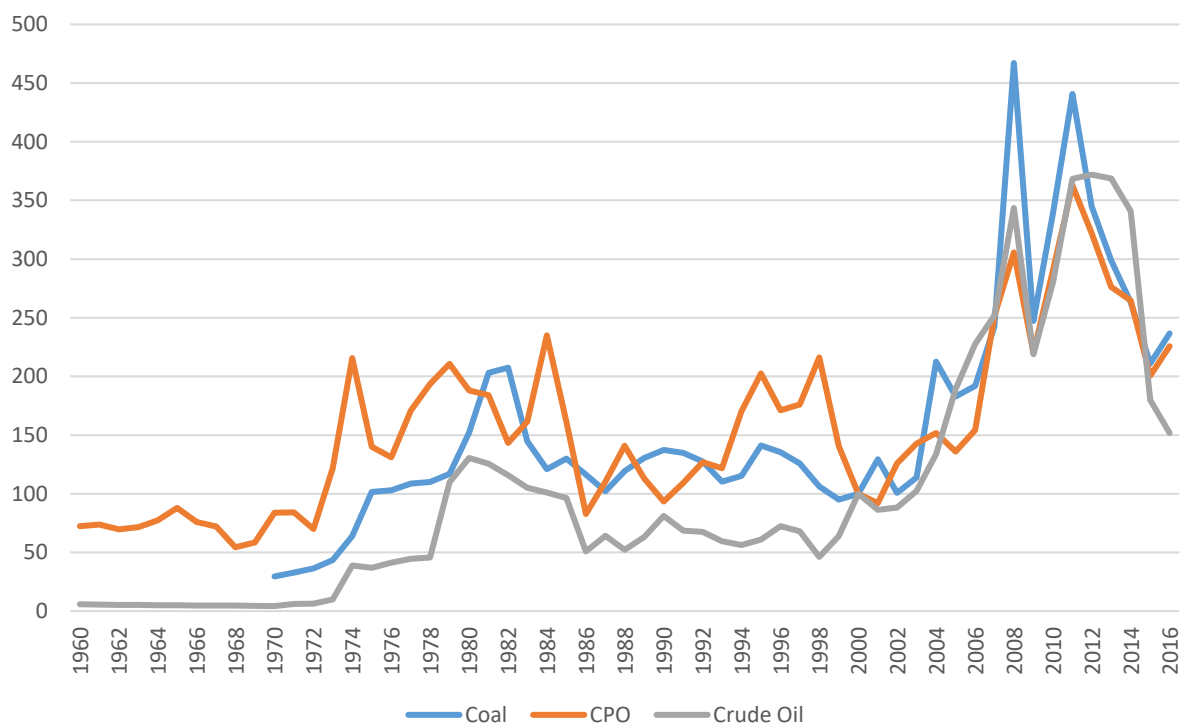


Figure 4.17. Coal, CPO and Crude oil price indices at current USD (2000=100)

Source: World Bank (2017)

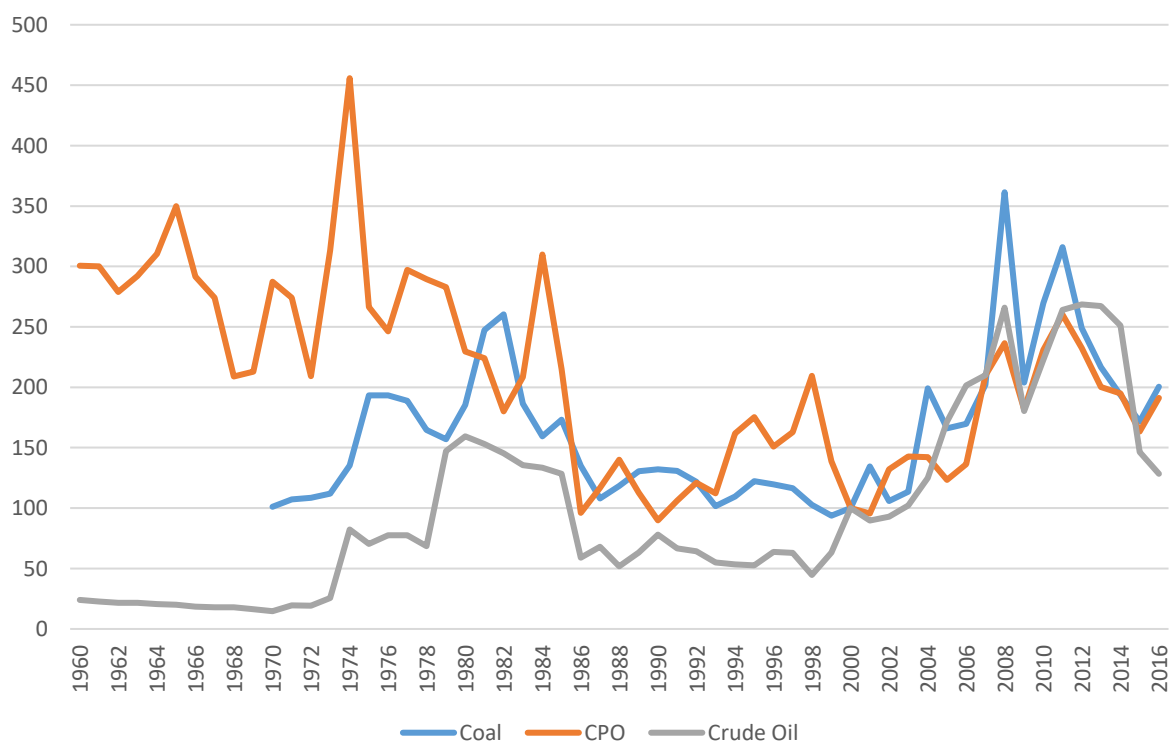


Figure 4.18. Coal, CPO and Crude oil price indices at real USD price (2000=100)

Source: World Bank (2017)

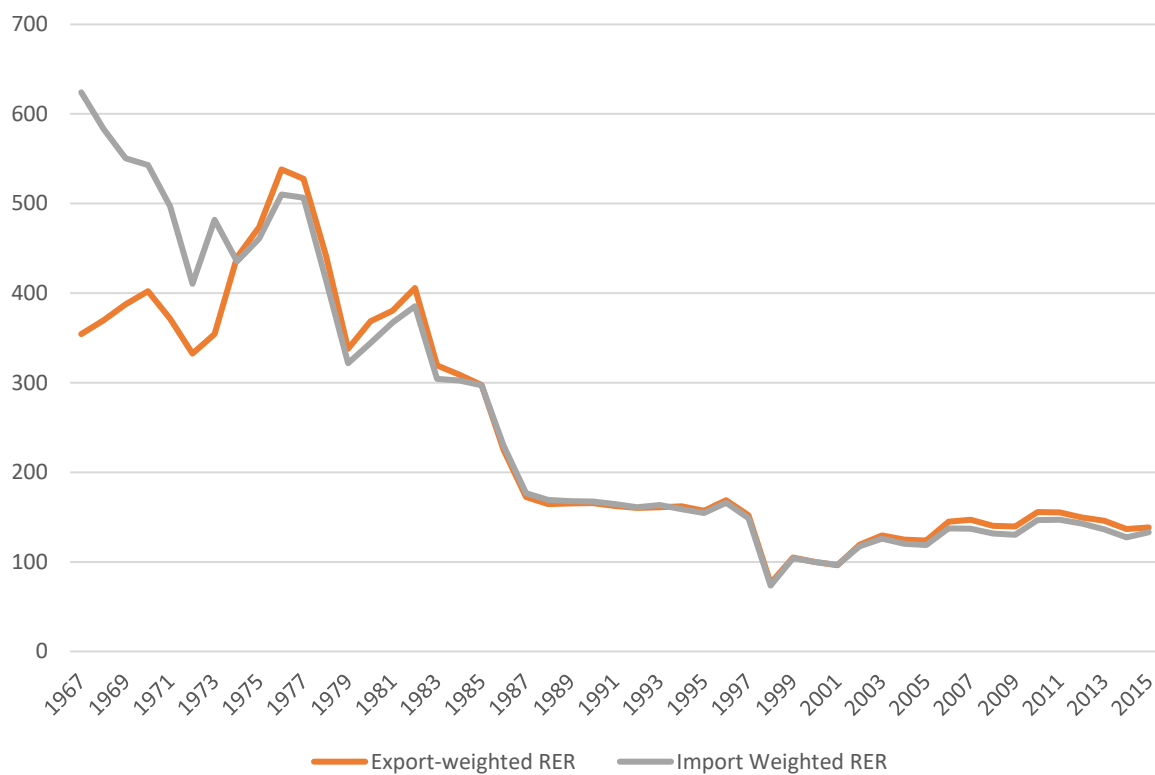


Figure 4.19. Comparison between export-weighted and import weighted RER (2000=100)

Source: Author's calculation based on IMF IFS database and World Bank WITS database

Chapter 5

Testing the Dutch disease: the impact of natural resources extraction on the manufacturing sector

5.1. Introduction

After decades of debate, it is still unclear whether natural resource wealth is a curse or a blessing. This question is especially important after the collapse of commodity prices in 2014, which was followed by economic stress in resource exporting countries, including Russia, Brazil, Nigeria, and Venezuela. These countries are part of a long list of countries which might have experienced the “Natural Resource Curse,” a thesis introduced by Sachs and Warner (1995, 1999, 2001). Although there are many possible explanations for the curse, one of the most widely discussed is the impact of resource exports on the manufacturing sector in resource-rich countries. This interest in the manufacturing sector can be attributed to the idea of industry-specific learning-by-doing spillover effects that are external to the firms (Krugman, 1987; van Wijnbergen, 1984). This idea is supported by recent literature which shows that manufacturing plants exert positive productivity spillover on other nearby plants (Ellison et al., 2010; Greenstone et al., 2010; Kline & Moretti, 2014). Therefore, if natural resources extraction crowds out manufacturing, it will reduce productivity spillover, and in turn, reduce long-term overall growth (Allcott & Keniston, 2014). This possible chain of events is usually called the “Dutch disease”. Indeed, Sachs and Warner (2001) argue that the Dutch disease is the reason behind their empirical finding of slower growth in resource-abundant countries.

The Economist coined the term Dutch disease to describe the woes of the Dutch economy after the discovery of vast gas reserves in 1959 (The Economist, 1977). Gas exports led to an influx of foreign currency, which increased demand for the guilder and thus made it stronger. That made other parts of the economy less competitive in the international market. From 1970 to 1977, unemployment

soared from 1.1% to 5.1%. The experience of the Netherlands spread fears of similar incidences in other industrialised countries with energy resources, including the United Kingdom, which saw shrinkage in manufacturing in the late 1970s. A few years later, W. Max Corden and J. Peter Neary published a paper which provides the theoretical explanation for the Dutch disease (Corden & Neary, 1982). Although it is called a “disease,” the Dutch disease in itself does not have any direct welfare implications. Theoretically, the Dutch disease is a resource reallocation process away from less profitable non-booming traded sectors (manufacturing) to more profitable non-traded sectors. For the Dutch disease to have negative welfare implication, it has to lower long-term growth by limiting the learning-by-doing effect and, as Krugman (1987) argues, the manufacturing sector does not recover after the resource boom ends.

Following Sachs and Warner (2001), countless studies have used cross-country and panel-data econometric analysis to document the impact of natural resource dependence (typically defined as the ratio of natural resource exports to GDP) on the rate of economic growth after controlling for income per capita, past investments, trade openness and a host of other variables. Moreover, a host of literature has sprung up to offer potential explanations for the impact of natural resource dependence on economic growth. Other than the Dutch disease, potential explanations include unsustainable policies, bad institutions, poor rule of law, ethnic fractionalisation, armed conflict, badly developed financial systems, and a crowding out of FDI (Van Der Ploeg & Poelhekke, 2016). However, the empirical evidence for the Dutch disease and the natural resource curse, especially in cross-country studies, is not very strong as there are many confounding factors and endogeneity issues (van Der Ploeg & Poelhekke, 2016).

The objective of most empirical papers on the impact of natural resources wealth is to test the resource curse thesis. Therefore, most of these studies measure the outcome in terms of economic growth and other welfare outcomes, such as poverty, education or health. As such, although many studies have tested the impact of resource wealth, few have measured the impact on the

manufacturing sector. This study, on the other hand, empirically measures the impact of resource gains on the size of the manufacturing sector.

Although the theoretical foundation of the Dutch disease has been established for a long time, the empirical evidence for impacts on manufacturing is limited. Several studies find that positive terms of trade shocks have an appreciating impact on the real exchange rate (Cashin et al., 2004; Y. Chen & Rogoff, 2003; Spatafora & Warner, 1999), but they fail to find contraction in the manufacturing sector. Other studies find evidence of manufacturing contraction associated with resource windfalls, either in the cross-country analysis (Ismail, 2010) or in the sub-national analysis (Allcott & Keniston, 2014). However, there is evidence that indicates the international migrations of labour and capital can mitigate the symptoms of the Dutch disease (Beine, Coulombe, & Vermeulen, 2015). On the other hand, there are also studies that suggest a productivity spillover effect between the resource extracting sector and the rest of the economy (Bjørnland & Thorsrud, 2016).²³ If productivity spillovers from the resources sector are accounted for, the structural effects of the Dutch disease do not necessarily mean a decline in the manufacturing sector.

Moreover, most of the empirical studies on manufacturing impacts focus on country-level analysis. One study that uses cross-country analysis is by Ismail (2010), who investigates the Dutch disease effects on the manufacturing sector at the global level using industry-level data. Microeconomic (industry, firm or plant level) data has an advantage over macroeconomic data in that it has information about trend growth when sectors are heterogeneous and thus have different growth trend. However, the study only uses oil as the source of windfall and does not consider the endogeneity issues that may arise from his model.

A standard approach to estimate the impact of resource rents on the manufacturing sector size would be to model the value-added of the manufacturing sector as a function of the resource windfall. However, this might result in biased estimates if the resource output is partly a function of

²³ Highly technical resource extraction processes, such as the development of offshore oil, often demands complicated technical solutions. This can generate positive knowledge externalities that benefits other sectors.

the size of the manufacturing sector. As the manufacturing sector size increases, it might require more natural resources, for example. Another possibility would be the resource allocation problem (in this case the allocations of factors of production, not the natural resources) where the manufacturing sector and the natural resource sector compete for the same pool of capital and labour. This means a manufacturing sector expansion could lead to a natural resource sector decline. Either way, a relationship between the resource windfall and the manufacturing sector value added will not necessarily tell us about the causal impact of resource windfalls on the size of the manufacturing sector. To accurately estimate the causal impact, the model needs to address these endogeneity issues.

In this study, I will investigate the impact of natural resources rents on the manufacturing sector value-added using an instrumental variable approach. While macroeconomic data have weaknesses and are not detailed, the number of countries included in the analysis is vastly larger than microeconomic data (149 countries) and can cover a more extended period (1970-2014). I use natural resource rents data to measure resource windfall because it includes windfall from oil, natural gas, coal, and the mineral resources sector. To address the endogeneity issues that may arise, I utilise the variation in each country's resource export prices as an instrument. Therefore, this study measures the elasticity of manufacturing value-added to changes in the natural resources rents that emerges through changes in exported resource prices.

This study contributes to the resource curse and the Dutch disease literature in at least three ways. Firstly, it focuses on the impact of resource windfall from price changes instead of discoveries and explorations. Although the definition of a resource boom also includes new resource explorations, the manifestation of resource booms in the global context is often triggered by changes in resource prices. However, only a handful of studies explore the price part of a natural resource boom and the Dutch disease. Secondly, this is the first study that measures the Dutch disease using natural resource rents from multiple natural resources. Other empirical cross-country studies on the Dutch

disease only focus on one resource, usually oil, and measure the windfall in terms of oil revenue (Ismail, 2010). By using natural resources rent from multiple natural resources, this study offers a more accurate measurement of the effects. Thirdly, by using IV panel regression, this study avoids endogeneity issues that are often found in other studies that explore the impact of natural resources using panel cross-country regression (van Der Ploeg & Poelhekke, 2016).

The results suggest that contrary to the theoretical prediction, a one per cent increase in natural resource rent (in 2010 USD) in an economy increases the size of its manufacturing sector by 0.045 per cent. Furthermore, a percentage point increase in the size of natural resource rent as compared to GDP increases the size of a country's manufacturing sector by 0.020 per cent. These results are robust when tested using several different specifications. Therefore, this study finds a mild positive, but highly inelastic, elasticity of manufacturing value-added to the natural resources rents that emerge through exported resource prices. I do not find evidence for the Dutch disease in the manufacturing sector. Instead, I find that the manufacturing sector benefits, albeit only marginally, from resources price booms through an increase in resource rents. Possible explanations for these results include sterilisation policy of the commodity windfall, and the productivity spillover from the technologically advanced resource sector.

I explore several extensions to the model to help explain these results. These modifications include IV panel regression using sub-samples based on certain categories (geographic region, GDP per capita, manufacturing share in GDP, and sub-period) and by measuring the elasticities for the services sector. I find that once the Middle East and Sub-Saharan Africa region are excluded from the sample, the estimated impact of resource rents on the manufacturing sector becomes considerably smaller. Furthermore, I find that differences in the initial GDP per capita level and initial manufacturing share of GDP do not result in a significantly different impact of resource rents. I also find that the sign of the estimated impacts of natural resources rents has changed from period to period. The sign is positive and significant during the first resource boom period (1970-1984), not

significant during the non-boom period (1985-2002), and negative and significant during the second resource boom period (2003-2014). Lastly, I find that the elasticity of the services sector to changes in the natural resource rents is also positive and significant, but smaller than the estimated impact on the manufacturing sector.

In the next section, I will discuss the theoretical prediction of the Dutch disease and the review the empirical literature. I then introduce the empirical method in section 3 and explain the data. I discuss the results in section 4, along with the extensions and robustness check. In section 5, I offer some specific country examples to demonstrate varying experience of resource-rich countries with the manufacturing sector.

5.2. Literature review

According to the core Dutch disease theory, a resource exporting country might experience a decline in the size of the non-booming traded sector during a resource boom period (Corden, 1984; Corden & Neary, 1982). This decline can happen through two effects: *the resource movement effect* and *the spending effect*. The *resource movement effect* refers to the reallocation of factors of production away from non-booming sectors to the booming resource sector. The *spending effect* refers to the effect of increased income that expands domestic aggregate demand. While traded goods can be imported at the international price, non-traded goods have to be produced domestically. As a result, spending effects increase the relative price of non-traded goods to traded goods (defined as real exchange rate appreciation in this literature), further drawing resources away from the non-booming traded sector. Although there are many reasons why a boom might occur, Corden and Neary (1982) focus on the case of once-and-for-all Hicks-neutral improvement in technology, which is analogous to a resource price increase.

Together, both effects contribute to an increase in the relative price of non-traded goods. While the spending effect tends to increase non-traded sector output, the resource movement effect tends to lower it, and there is no presumption as to which will dominate. This ambiguity of output, however,

does not apply to the non-booming traded sector. While the resource movement effect lowers the traded sector output directly through the movement of factors of production, the spending effects contribute indirectly through expansion in non-traded goods demand. Although there are no strict criteria to determine the tradability of a sector, the manufacturing sector – and to a lesser extent, the agriculture sector – tend to be the focus of the Dutch disease analysis.²⁴ Thus, the boom is expected to give rise to both direct and indirect deindustrialisation.

While the deindustrialisation effect of resource extraction has been the focus of theoretical literature of the Dutch disease, there are also arguments for the reverse effect. Resource-based industrialisations (RBI) argument, the idea that resource-processing manufacturing can contribute to growth, employment and equity, has been around even before the Dutch disease theory was formalised.²⁵ Some evidence also shows that linkages between the manufacturing sector and the resource extraction sector can promote manufacturing growth and export, such as in Sub-Saharan Africa (Morris, Kaplinsky, & Kaplan, 2012), Ghana (Bloch & Owusu, 2012), and the United States (Arezki, Fetzer, & Pisch, 2017).

Testing for the effect of resource booms on the manufacturing sector is the focus of this paper. While I acknowledge that the Dutch disease effects may happen through various channels, such as the real exchange rate and backward or forward linkages, this study will investigate the total effects. Gelb (1988) provides the first extensive empirical cross-country study of the Dutch disease. The study observes the effect of oil windfall on oil exporters, most of which have spent large amounts of the windfall they gained after the 1973 oil boom. Gelb (1988) finds evidence of the Dutch disease, the weakening of non-booming traded sector, in Ecuador, Iran, Nigeria, and Trinidad and Tobago over the period of 1972-1981. On the contrary, non-oil traded sector became stronger in Indonesia, Algeria, and Venezuela. However, the evidence on the Dutch disease is mainly due to the decline in agriculture, with virtually no evidence of a decline in manufacturing. One possible explanation is that

²⁴ The issue of tradability is discussed extensively in Chapter 4.

²⁵ Roemer (1978) criticises the RBI arguments and disputes that RBI inspired policies can fulfil its promises

the manufacturing sector was initially too small. Furthermore, the governments of these countries enacted policies that actively promote the manufacturing sector, such as price control, subsidies, and other direct support to the sector. By covering a more extended period, this study can test whether the Dutch disease effect changed over the period as most countries have developed a more sizeable manufacturing sector relative to the case in 1972.

Several studies find evidence of real exchange rate appreciation effects (Cashin et al., 2004; Y. Chen & Rogoff, 2003; Spatafora & Warner, 1999), but these are not always accompanied by manufacturing contraction. Spatafora and Warner (1999) find that terms of trade shocks in oil-exporting countries have a positive effect on real exchange rate appreciation as well as public sector expenditure. They also find evidence of a long-run positive effect on output, particularly in non-traded sectors. However, they do not find evidence of contraction in traded sectors, either in the agriculture or the manufacturing sectors, in these countries. These findings indicate that the “spending effect” was operational, as shown by the real exchange rate appreciation and non-traded sector expansion. They suggest that the absence of the Dutch disease symptoms might be partly explained either by the compression of oil output during the 1970s oil boom or by the sector’s characteristic as an enclave sector which does not participate in the domestic economy.

On the other hand, several studies do find evidence of manufacturing contraction. These studies measure the contraction in terms of manufacturing value added (Allcott & Keniston, 2014; Ismail, 2010) or employment (Beine et al., 2012). Other related factors, such as openness to capital mobility and the capital intensity of the manufacturing sector, appear to have important effects on the size of manufacturing contraction (Ismail, 2010). However, manufacturing contraction does not necessarily mean that the sector is crowded out. Estimates in the case of a local coal boom in the US show that manufacturing productivity is unaffected by natural resource booms. Therefore, there is neither forgone learning-by-doing effects nor the Dutch disease effects (Allcott & Keniston, 2014).

Furthermore, there is also evidence that the Dutch disease symptoms might be mitigated or even reversed by internal migration of labour and capital (Beine et al., 2015).

Modifications to the Dutch disease model can yield expected impacts that are different from the original model. If the model allows for the possibility of productivity spillover effects between resource-extracting sector and the rest of the economy, the structural effects of the Dutch disease do not necessarily mean a decline in the manufacturing sector (Bjørnland & Thorsrud, 2016). This spillover effect was evident in both Australia and Norway (Bjørnland & Thorsrud, 2016). While the net impact in Norway was an expansion in employment and value-added, the picture was gloomier for Australia, which faced a crowding out and decline in manufacturing. Another possible explanation for the difference of outcome between Australia and Norway is the large size of Norway's government sector and its sovereign wealth fund which allow for countercyclical policy.

5.3. Method and data

5.3.1. Method

To estimate the structural effects of changes in natural resource rents (NRR), I construct a panel fixed-effect cross-country model with the log of manufacturing value-added as a function of log natural resource rent, both in constant 2010 US dollars (Equation 1). The estimates use data from 149 countries over the period 1970-2014, covering the last two global resource booms (1970s oil boom and 2000s commodity boom).

$$\ln(\text{ManVA})_{i,t} = \alpha_i + \beta_t + \gamma \ln \text{NRR}_{i,t} + X_{i,t}\delta + u_{i,t} \quad (1)$$

In Equation (1), α_i are country fixed effects that capture time-invariant country-specific unobservable and β_t are year fixed effects that capture common year shocks. $u_{i,t}$ is an error term that is clustered at the country level. γ is the variable of interest which captures the elasticity of the size of the manufacturing sector to natural resource rent. X is a vector of control variables, including log GDP

per capita, log squared GDP per capita, log population, log squared population, GDP growth and trade to GDP ratio.

These control variables are included to account for factors that affect manufacturing demand and growth. GDP per capita is included to account for the fact that wealthier economies tend to have larger manufacturing sectors. Its squared form is included to allow for the declining manufacturing size in wealthier economies. Economies with larger populations also tend to have larger manufacturing demand and labour pool, which may affect manufacturing sector size. GDP growth rate accounts for the possibility that the manufacturing sector responds to changes in the size of the economy, while trade to GDP ratio accounts for the economy's reliance on foreign trade.

To deal with the possible endogeneity problems of reverse causality between NRR and manufacturing value-added, I use an instrumental variables method. The method uses a country-specific commodity price index as an instrument for the natural resources rents. The index utilises the fluctuation of world resource prices, which is arguably exogenous to individual countries, weighted by each country's exposure to the resource in terms of export share to GDP. Because of this weighting process, the index is unique for each country. I construct this index using a similar methodology to that of Collier and Goderis (2008) and Burke and Leigh (2010).

By using the index as an instrument, we can test the causal implication of NRR changes to the manufacturing sector and observe the structural implications of the natural resource rents.

$$ComIndex_{i,t} = \left(\prod_{c \in C} ComPrice_{c,t}^{\theta_{i,c}} \right) \times \theta_i \quad (2)$$

Where *ComPrice* is the price of commodity *c* at year *t*, θ is the average (time-invariant) value of exports of commodity *c* in the total commodity export of country *i*, and θ is the average (time-invariant) share of commodity export in country *i* GDP. This index is a geometrically weighted natural resource prices index, then reweighted with respect to natural resource export share in GDP. The first weighting process is to weight the resource prices based on the spectrum of natural resources

that the country exploits, while the second weighting process is to reweight the resulted index based on the importance of natural resources exports in the economy. Both of these weights are the average for the whole period in each country, which means they are time-invariant. Although the share of each commodity and its importance changes constantly, I use the average value because the variation in the index should only come from resource prices changes. This is important because the index needs to be exogenous to each country and not determined by each country's yearly fluctuations in resource exports.

In the estimate, *ComIndex* is transformed into log form to instrument for log NRR. This method of constructing the index, with varying degree of modifications, have been used in prior global studies as instruments for economic growth and as the dependent variable as a proxy for resource windfall.²⁶ However, to the best of my knowledge, this is the first study which uses this approach to measure the Dutch disease structural effects on a panel cross-country setting. There are several reasons why these instruments are used. Firstly, these instruments have a clear effect on NRR. Resource prices fluctuation is one of the components of NRR variation, aside from the other two components. Therefore, commodity prices have a clear positive relationship with NRR. Secondly, changes in resource prices happen at the regional or international market, which means most countries do not have control over the price fluctuations of their resource exports. In other words, most countries take their exported resource prices as given or exogenous. Thirdly, these instruments mainly affect the manufacturing sector size through the NRR. Since the index is weighted to resource export share in GDP, it should not affect the manufacturing sector through input cost. Therefore, I argue that the instruments mainly affect the manufacturing sector through the NRR, which measures the economy-wide gain of resource extractions. While we cannot be entirely sure that there is no chance for the exclusion restriction to be broken, using this instrument addresses some of the potential bias in the panel fixed effect regression.

²⁶ For other examples of similar instruments, see Burke & Leigh (2010), Arezki & Brückner (2012).

To check whether the structural effects of NRR depend on the share of the resource rent in GDP instead of the level value of the resource rents, I modify Equation (1) to use NRR to GDP ratio as the dependent variable (Equation(3)).

$$\ln(ManVA)_{i,t} = \mu_i + \tau_t + \theta NRRtoGDP_{i,t} + X_{i,t}\varphi + u_{i,t} \quad (3)$$

The only difference between Equation (1) and Equation (3) is that Equation (3) uses the NRR to GDP ratio instead of the log dollar value of resource rents. Moreover, based on the same arguments for Equation (1), Equation (3) also uses the same instruments, constructed from Equation (2), for the NRR to GDP ratio. Therefore, the variable of interest, θ , is interpreted as the percentage change of manufacturing value-added caused by one percentage point change in NRR share in GDP.

5.3.2. Data

Data for manufacturing value-added, natural resource rents, and the control variables are taken from the World Bank's World Development Indicators (WDI) database (The World Bank, 2017). I use manufacturing value-added in constant 2010 US dollars for all countries and drop countries that do not have the value in constant 2010 US dollars. Considering the sample still includes 149 countries, the sample size is arguably large enough for a cross-country panel regression. However, the results still need to be interpreted carefully since the data are highly unbalanced. The list of countries and relevant descriptive statistics are presented in the chapter Appendix.

It is important to note that some of the manufacturing sector value added comes from the natural resources-related manufacturing sector. The WDI database does not separate the natural resource processing sector from the rest of the manufacturing sector. These sectors include petroleum and gas refineries, and other natural resource processing. Therefore, this allows for the possibility of RBI from manufacturing linkages with the natural resources sector. Those processing activities can even be regarded as part of the *booming sector* in the Dutch disease model because the price of their outputs are directly related to the fluctuations of the commodity prices and rely more on the natural

resources as the main factor of production. Considering the estimated impact of NRR will include both the Dutch disease and RBI effects, the expected estimated impact can be either positive, negative or neutral.

To measure the natural resources windfall, I use the natural resource rents (NRR) instead of other possible measures such as total natural resources revenue or exports value from natural resources. The World Bank (2011) defines NRR as the difference between the price of a commodity and the average cost of producing it. This is done by estimating the world price of units of specific commodities and subtracting estimates of average unit costs of extraction (including a normal return on capital). These unit rents are then multiplied by the physical quantities countries extract or harvest to determine the rents for each commodity as a share of gross domestic product (GDP). The World Bank categorises resource rent into several categories: mineral rents, oil rents, natural gas rents, and coal rents. These resources are considered non-renewable resources. Therefore, they do not include agricultural resources, such as farmed and plantation-based commodities.

There are several reasons why NRR is a better measure of resource windfall than extracted value or exports of natural resources. Firstly, it measures each country's earnings from natural resources in terms of rents – revenues above the cost of extracting the resources. This is a better measure of gains because it only includes the value of the extracted resources instead of the usual quantity multiplied by price for each commodity. This also recognises that each country might face different costs and therefore, different sizes of gains for the same amount of resources extracted. Secondly, NRR includes resources windfall from multiple sources. Instead of focusing on one particular natural resources, I can estimate the impact of the whole natural resources sector.

Another benefit of using NRR is its consistent availability for most countries over a long observation period (1971-2015). This rich dataset allows a long-term cross-country comparison which would not be possible with other datasets. To my knowledge, this study is the first study that uses NRR for the purpose of measuring the impacts of natural resources on manufacturing. Since this study's use of

NRR data is new, there is a risk that the NRR has not been subjected to rigorous scrutiny. Therefore, the results need to be interpreted carefully.

The NRR in the WDI database is provided in the form of its share in GDP. While it is used in this form in Equation (3), it needs to be transformed into constant US dollar terms to be used in Equation (1). The transformation process is straightforward, that is by multiplying the NRR share in GDP with the country's GDP in constant 2010 USD. The process is done to all countries for all years in the sample. This effectively deflates the NRR into constant 2010 USD using the GDP deflator. I use this approach because the estimate has to account for the effect of resource price changes instead of only the production (quantity) effect. The GDP deflator accounts for inflation in the whole economy but not for resource price changes that are specific to the resource sector. Therefore, the coefficient of the NRR will measure the impact of nominal changes in NRR (but in constant 2010 US dollars) to real changes in manufacturing value-added. By instrumenting the NRR using the price index, the coefficient of NRR in the IV results is the effect of changes in the NRR that emerges via the impact of changes in resource prices. For the control variables (GDP per capita, population, GDP growth, and trade to GDP ratio), I use data from the WDI (The World Bank, 2017).

Figure 5.1 shows the natural resource rent of Australia, United Kingdom, Indonesia, and India. I choose these countries to show examples from relatively resource-rich developing and developed countries as well as relatively resource-poor developing and developed countries. As resource-rich countries, Australia and Indonesia have larger NRR share in GDP and higher NRR fluctuations than their relatively resource-poor counterparts. Figure 5.2 shows the transformed version of NRR in constant 2010 US dollar.

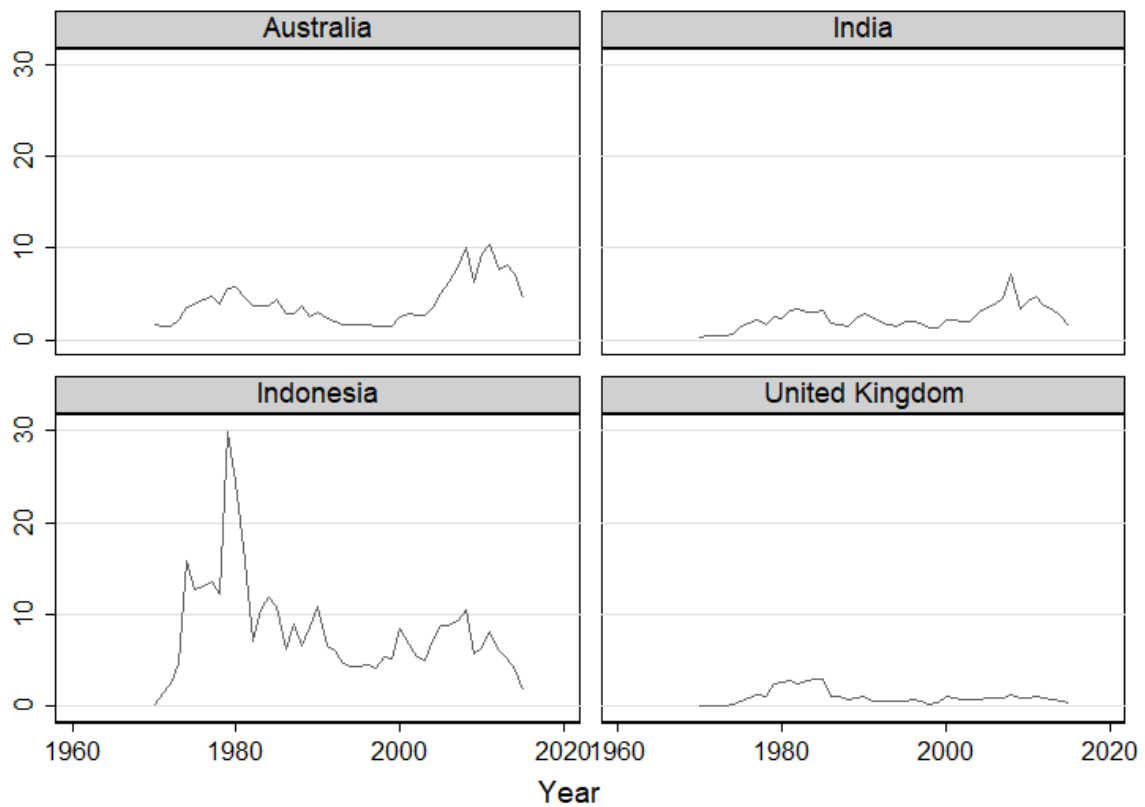


Figure 5.1. Natural resources rent (% of GDP)

Notes: Natural resources rent consist of the sum of oil rent, natural gas rent, coal rent and mineral rent. Source: World Bank (2017)

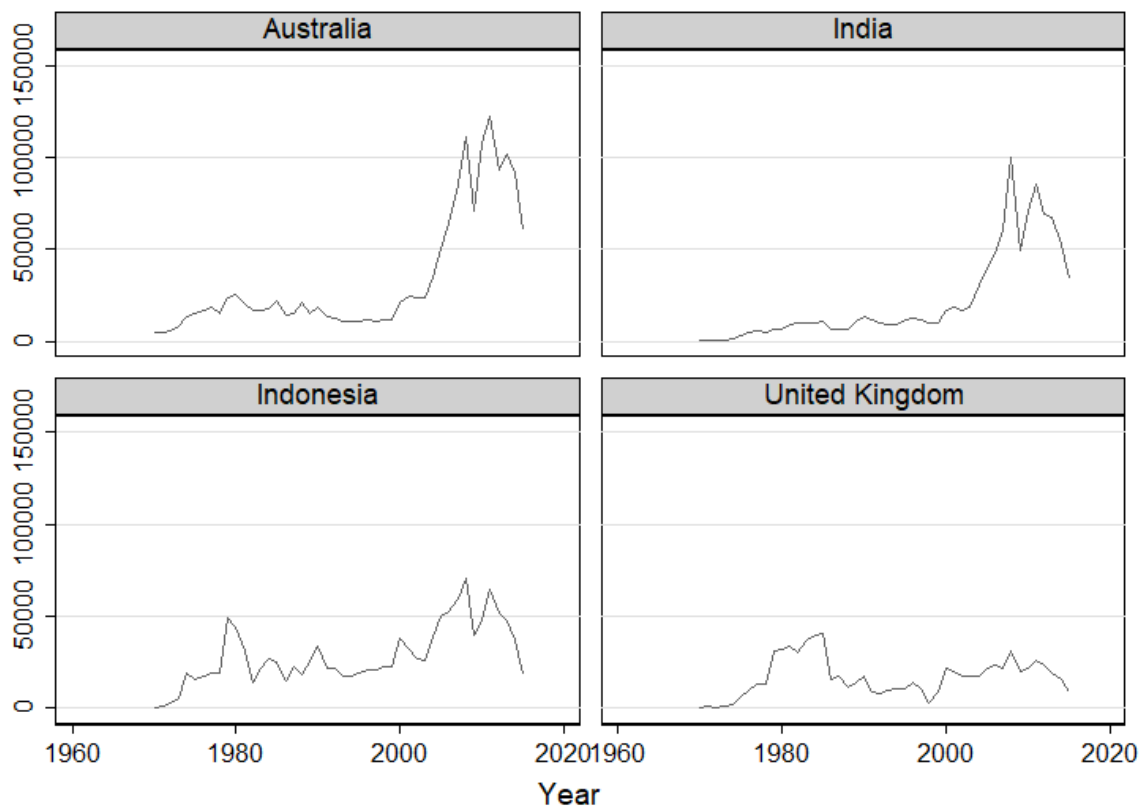


Figure 5.2. Natural resource rents (million USD, constant 2010 USD)

Notes: Based on World Development Indicator (World Bank, 2017). Natural resource rents are transformed from the percentage of GDP to constant 2010 US dollar using real GDP. It consists of the sum of oil rent, natural gas rent, coal rent and mineral rent.

To construct the instruments, I use annual nominal commodity price data from the World Bank Commodity Price Database (World Bank, 2017). Since the estimates use four kinds of resource rents (oil, natural gas, coal, and mineral), I include the price of twelve commodities which are related to these rents in the index construction. They include oil, natural gas, and coal, for the first three resource rents, and aluminium, copper, gold, iron, lead, nickel, precious metals, tin, and zinc for the mineral rents. If there is more than one price for a commodity, I use a simple average of those prices. Those nominal prices are then converted into an index and then deflated using a common deflator of non-fuel export unit value with the year 2010 as the base year (2010=100).

Weighting for the instruments in Equation (2) and (3) uses the average (time-invariant) value of exports of each commodity in the total commodity export of the country. I then interact it with the average (time-invariant) share of commodity exports in the country GDP. To accomplish the first part of the weighting process (average value of each commodity exports to total commodity exports), I use the nominal export value from UN Comtrade Database for the export value of each commodity which is then divided by current GDP and then averaged for the whole period.²⁷ After the reweighting to commodity export to GDP, I get a country-specific index of commodity prices, based on the country's exposure to each commodity.

To give a brief example of the constructed index, Figure 5.3 shows the indexes for the same set of countries as the previous figures. Figure 5.3 shows the constructed index based on Equation (2) and (3). Due to the reweighting to share of commodity exports in GDP process, the size of the index in Figure 5.3 is minuscule, ranging between 2.36×10^{-9} and 8.59×10^{-2} . However, the general pattern remains relatively clear, where resource-rich countries such as Australia and Indonesia experience

²⁷ An alternative way to do the weighting instead of averaging for the whole period, is to choose an arbitrary year and then base the weight on that specific year. I use this approach as a robustness check and get very similar results.

large fluctuations during resource booms and busts while relatively resource-poor countries experience comparatively lower and stable index.

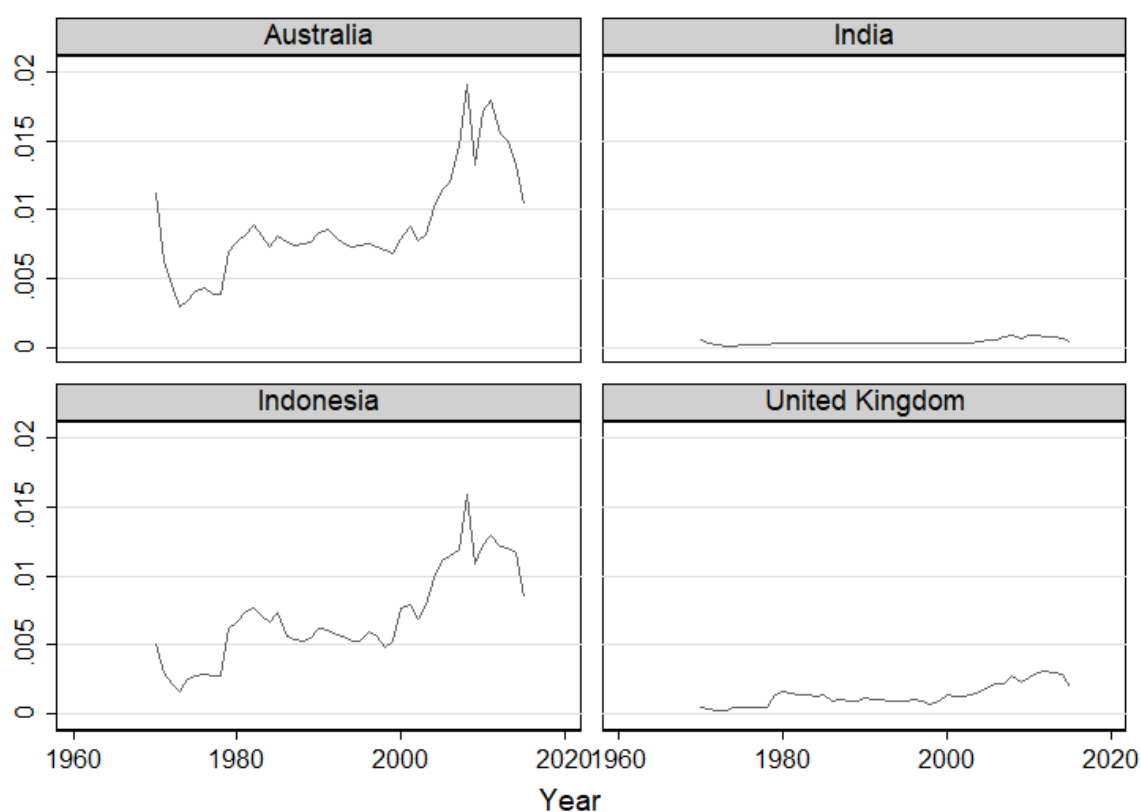


Figure 5.3. Instrument: Comindex

Notes: Constructed by the author based on Equation (2).

5.4. Structural impacts of NRR (results and discussion)

5.4.1. OLS results

Fixed effect panel regression results for the structural impacts of NRR are presented in Table 5.1. Standard errors are robust to heteroscedasticity and clustered at the country level. Columns 1 and 2 are results for (1) regression with resource rents in log US dollar as the dependent variable. While the coefficient for NRR is not significant in column 1, it is negative and significant at the 10 per cent level in column 2. Column 2 indicates that a one per cent increase in natural resource rents on

average reduces manufacturing value-added by 0.006 per cent. This elasticity, although significant, is small and inelastic.

Column 3 and 4 show results for Equation (3), which uses natural resource rents as a percentage of GDP as the dependent variable. They both have a negative and insignificant coefficient for natural resource rents. Although the signs are negative, these results indicate that natural resource rents as a percentage of GDP do not have a significant effect on the growth of manufacturing value-added.

The results on control variables in Table 5.1 indicate that manufacturing value-added increases with GDP per capita with an inverted-U shape. Trade openness, as measured by the share of export plus import in GDP, on average increases manufacturing value added by a small percentage. GDP growth, in contrast, has a negative and significant effect on manufacturing value-added. The population variable is the only variable that is not significant in the results.

The fixed effect panel regression results indicate that all else equal, natural resource rent either does not have any significant effect or has a small negative effect on manufacturing value-added growth. These results are consistent both when natural resource rents are measured in constant US dollar term or as a percentage of GDP. When compared to the Dutch disease model, these results cannot convincingly confirm or reject the theory because the results are either not significant or negative.

Table 5.1. Fixed effects panel regression results

Dependent variable	Log of manufacturing value-added			
	NRR in log USD		NRR as % of GDP	
	(1)	(2)	(3)	(4)
Natural resources rents (NRR)	0.007 (0.005)	-0.006* (0.003)	-0.001 (0.003)	-0.005 (0.003)
Log of population		0.294 (0.704)		0.254 (0.717)
Squared-log of population		0.026 (0.023)		0.027 (0.023)
Log GDP per capita in 2010 USD		2.021*** (0.432)		1.956*** (0.429)
Squared-log GDP per capita in 2010 USD		-0.058** (0.027)		-0.054** (0.027)
Trade (% of GDP)		0.002*** (0.001)		0.002*** (0.001)
GDP growth (%)		-0.005*** (0.002)		-0.005*** (0.001)
Constant	20.467*** (0.100)	-2.047 (6.174)	20.539*** (0.098)	-1.539 (6.315)
Country and year fixed effects	Yes	Yes	Yes	Yes
Observations	4916	4774	4916	4774
R-squared	0.629	0.830	0.628	0.831
Countries	159	155	159	155
Years: 1971-2015				

Notes: The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors clustered by country are in parentheses. Natural resources rent is the sum of oil rent, natural gas rent, coal rent, and mineral rent. NRR in USD is transformed from a percentage of GDP form into constant USD using GDP deflator.

**** Significant at the 1 per cent level*

*** Significant at the 5 per cent level*

** Significant at the 10 per cent level*

5.4.2. Instrumental variable results

The previous results may not represent the causal impact of natural resource rents on the growth of manufacturing value-added and may suffer bias due to possible endogeneity of natural resource rents. In this section, I re-estimate the main equation using IV estimation. Table 5.2 and Table 5.3 show the result of IV estimation using the price index instruments. Table 5.2 shows the results if the NRR is measured in log USD, while Table 5.3 the results with the NRR as a percentage of GDP. The results indicate that an increase in extracted natural resource rents significantly increases the size of

manufacturing value-added. The estimated effect contradicts the OLS results, suggesting that there is a negative bias in the OLS estimation.

The results are consistent both when the resource rents are measured in log US dollar (Table 5.2) and when measured in percentage of GDP (Table 5.3). The estimated impact of NRR in both tables is positive and significant, and they are only different in magnitude. Furthermore, the comparison between the results based on the two instruments confirm each other as the size and level of significance of the coefficients are similar.

Table 5.2 indicates that a one per cent increase of NRR in US dollar will cause an increase in the size of manufacturing value-added by 0.045 per cent. Similarly, Table 5.3 indicates that one percentage point increase in NRR as a share of GDP will increase the size of manufacturing value-added by 0.020 per cent. In both cases, the effect of (instrumented) natural resource rents on the size of manufacturing value-added emerges through the impact of shocks from resource prices. The magnitudes of these results are relatively small and indicate that manufacturing value-added is inelastic to changes in NRR.

The coefficients of the instruments in the first stage regression are of the expected sign. Since the instruments are the weighted average of the relevant commodity price index for each country, they are expected to have a positive correlation with the size of the natural resource rents. In the model with NRR in log US dollar as the dependent variable (Table 5.2), the instruments explain about 2 per cent of the within-country variation in NRR and pass the Stock-Yogo test for weak instruments for 10 per cent maximal Fuller relative bias at the 1 per cent significance level. Both instruments for the NRR are strong instruments. Similarly, in the model with NRR as a percentage of GDP as the dependent variable (Table 5.3), the instruments explain about 6 per cent of the within variation in NRR and pass the Stock-Yogo test for weak instruments for 10 per cent maximal Fuller relative bias at the 1 per cent significance level. Both instruments are also strong instruments in this model.

The IV estimates for the impact NRR on the manufacturing value-added are starkly different from the OLS results in Table 5.1, where they are either negative or not significant. These differences indicate that there might be certain biases in the OLS model that are corrected in the IV regression. One possible explanation for the negative bias in the OLS regression is the reverse causality problem, i.e. the manufacturing sector may have a negative impact on the natural resource sector. It is possible that the manufacturing sector development reallocates factors of production, such as capital and labour, from the resource extraction sectors to the manufacturing sector. The OLS estimates may capture this reallocation process and created a negative bias in the estimates. Another possible explanation is how the NRR is calculated. In the OLS model, NRR data includes extracted resources that are both exported and consumed domestically. The instruments, however, are weighted based on the size of natural resource exports in GDP and therefore adjust the size of the NRR to the importance of natural resource exports in the economy. This means the IV estimates only measure the local average treatment effect, that is, the effect of changes in NRR which are associated with changes in the resource export price index. It is possible that resources extractions for export purposes have positive impacts on the manufacturing sector while those that are consumed domestically have the opposite effects. If this is the case, NRR coefficients in OLS results can be either not significant or have the opposite sign to the IV results.

The positive coefficients of NRR in the IV results also contradict the Dutch disease theory prediction. While it might be too early to dismiss the theory based on these results, the contradicting results highlight the need to reconsider the relationship between resource extracting sector and the manufacturing sectors. Since the Dutch disease theory and its extensions predict that a resource boom will lead to a decline in the traded manufacturing sector, it is helpful to reconsider some of the theoretical assumptions that can explain the contradicting outcome.

Table 5.2. Instrumental variable results, natural resources rents in 2010 US dollar

Dependent Variable	Log of manufacturing value added			
	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
Excluded instruments	None	Comindex	None	Comindex
Log of natural resource rents	0.006 -0.005	0.073*** (0.015)	-0.006* (0.003)	0.045*** (0.011)
Log of population			0.294 (0.704)	-0.104 (0.240)
Squared log of population			0.026 (0.023)	0.031*** (0.007)
Log GDP per capita in 2010 USD			2.021*** (0.432)	1.640*** (0.164)
Squared log of GDP per capita in 2010 USD			-0.058** (0.027)	-0.038*** (0.010)
Trade (% of GDP)			0.002*** (0.001)	0.002*** (0.000)
GDP growth (% change from the previous year)			-0.005*** (0.002)	-0.005*** (0.001)
Country and year fixed effects	Yes	Yes	Yes	Yes
First-stage coefficients	-	2.184*** (0.280)	-	2.131*** (0.262)
F-statistics on excluded instruments	-	60.828	-	66.312
Stock-Yogo critical value (25%/10% maximal IV size)	-	5.53/16.38	-	5.53/16.38
Partial R2 on Excluded instruments	-	0.020	-	0.019
Wooldridge endogeneity test p-value	-	0.000	-	0.000
Sargan-Hansen overidentification test p-value	-	0.000	-	0.000
Observations	4768	4768	4768	4768
Countries	149	149	149	149
Years	1970-2014	1970-2014	1970-2014	1970-2014

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Notes: The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured in constant 2010 US dollar and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. NRR is transformed from a percentage of GDP form into constant USD using the GDP deflator. Reported Stock-Yogo critical values are the 1 per cent significance level critical values for a weak instrument test based on, respectively 25 per cent and 10 per cent maximal Fuller relative bias. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instruments exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 per cent level

** Significant at the 5 per cent level

* Significant at the 10 per cent level

Table 5.3. Instrumental variable results, natural resource rents as percentage of GDP

Dependent Variable	Log of manufacturing value added			
	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
Excluded instruments	None	Comindex	None	Comindex
Natural resource rents (% of GDP)	-0.002 (0.003)	0.031*** (0.007)	-0.005 (0.003)	0.020*** (0.004)
Log of population			0.254 (0.717)	0.236 (0.186)
Squared log of population			0.027 (0.023)	0.024*** (0.006)
Log GDP per capita in 2010 USD			1.956*** (0.429)	2.070*** (0.124)
Squared log of GDP per capita in 2010 USD			-0.054** (0.027)	-0.062*** (0.008)
Trade (% of GDP)			0.002*** (0.001)	0.002*** (0.000)
GDP growth (% change from the previous year)			-0.005*** (0.001)	-0.007*** (0.001)
Country and year fixed effects	Yes	Yes	Yes	Yes
First-stage coefficients	-	5.104*** (0.441)	-	4.873*** (0.419)
F-statistics on excluded instruments	-	133.829	-	135.447
Stock-Yogo critical value (25%/10% maximal IV size)	-	5.53/16.38	-	5.53/16.38
Partial R2 on Excluded instruments	-	0.065	-	0.059
Wooldridge endogeneity test p-value	-	0.000	-	0.000
Sargan-Hansen overidentification test p-value	-	0.000	-	0.000
Observations	4768	4768	4768	4768
Countries	149	149	149	149
Years	1970-2014	1970-2014	1970-2014	1970-2014
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Notes: The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured as a percentage of GDP and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. Reported Stock-Yogo critical values are the 1 per cent significance level critical values for a weak instrument test based on, respectively 25 per cent and 10 per cent maximal Fuller relative bias. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instrument exceeds the Stock-Yogo critical value/s.

**** Significant at the 1 per cent level*

*** Significant at the 5 per cent level*

** Significant at the 10 per cent level*

5.4.3. Extensions and robustness tests

To explain the findings in the previous section, I will attempt several extensions to the primary model, mainly by dividing the sample into sub-samples. These extensions include dividing the sample based on geographical region, GDP per capita, manufacturing share in GDP, and time-period.

I divide the sample into subsamples because I only have one instrument (Comindex) to instrument for the NRR. If the NRR is to be interacted with these variables, I will need a unique instrument for each interaction. I also apply division based on time-period despite already using year fixed effects because this method can show if there is any change in the impact of NRR on the manufacturing sector over the research period. Another extension is to replace the manufacturing value-added as the dependent variable with the services sector. The sector is important because it has theoretical significance in the Dutch disease literature as the non-traded sector.

These extensions can provide some insight into understanding the results from the previous section. However, it is important to note that these extensions are mainly done for explorative purposes. The results of the extension models are not directly comparable to each other and to the primary model since they use different samples and specifications.

The first extension is the sub-sample division based on geographical region. Geographical location can affect how resource rents are spent through multiple channels. Countries in the Middle East might spend the proceeds of their natural resources differently than countries in Latin America or Asia. Regional characteristics such as stability, political setting, investment climate, and openness might also explain some of the differences in how the manufacturing sector responds to increased resource rent. For this extension, I exclude two regions, the Middle East and Sub-Saharan Africa from the sample. These regions are special cases due to both higher reliance on the resource sector and higher instability in general. Furthermore, a large portion of the data for countries in these regions is missing, especially for the earlier period. Table 5.4 shows the results of this modification. Excluding the Middle East and Sub-Saharan Africa, the NRR has a positive (0.016) but not significant impact on the value-added of the manufacturing sector. Furthermore, the magnitude of the impact is also considerably smaller than in the primary model (Table 5.2).

Table 5.4. Subsample: exclude the Middle East and Sub-Sahara Africa

Dependent variable	Log of manufacturing value-added			
	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
Excluded instruments	None	Comindex	None	Comindex
1. Resources rents in USD				
Log of natural resource rents	0.003 (0.006)	0.080*** (0.019)	-0.005 (0.003)	0.016 (0.010)
First-stage coefficients	-	2.039*** (0.253)	-	1.983*** (0.254)
F-statistics on excluded instruments	-	64.78	-	60.895
Partial R2 on Excluded instruments	-	0.0208	-	0.0198
Wooldridge endogeneity test p-value	-	0.000	-	0.040
Sargan-Hansen overidentification test p-value	-	0.000	-	0.000
2. Resources rents as % of GDP				
Natural resource rents (% of GDP)	-0.002 (0.008)	0.063*** (0.017)	-0.008 (0.006)	0.013 (0.009)
First-stage coefficients	-	2.039*** (0.253)	-	2.404*** (0.350)
F-statistics on excluded instruments	-	52.8	-	47.145
Partial R2 on Excluded instruments	-	0.042	-	0.036
Wooldridge endogeneity test p-value	-	0.000	-	0.010
Sargan-Hansen overidentification test p-value	-	0.000	-	0.000
Time-varying country controls	No	No	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes
Observations	3209	3209	3209	3209
Countries	100	100	100	149
Years	1970-2014	1970-2014	1970-2014	1970-2014
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Notes: Samples from all regions except for the Middle East and Sub-Sahara Africa are included. The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is the sum of oil rent, natural gas rent, coal rent, and mineral rent. NRR in USD is transformed from a percentage of GDP form into constant USD using the GDP deflator. Reported Stock-Yogo critical values are the 1 per cent significance level critical values for weak instrument test based on, respectively 25 per cent and 10 per cent maximal Fuller relative bias. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instrument exceeds the Stock-Yogo critical value/s.

**** Significant at the 1 per cent level*

*** Significant at the 5 per cent level*

** Significant at the 10 per cent level*

The next extension is to divide the sample based on the GDP per capita level. I divide the observed countries into three categories of GDP per capita: countries that have GDP per capita less than the 50% percentile, countries that have GDP per capita between 50% and 75% percentile, and countries that have GDP per capita more than the 75% percentile. Using 2010 USD, the 50% percentile of GDP per capita in 1980 is \$3116.6, and the 75% percentile is \$13164.5. Again, 50% and 75% percentiles are arbitrary per capita income thresholds.²⁸ I choose these percentiles to show whether or not the impact of resource rents are different at specific income levels. The results are presented in Table 5.5 and Table 5.6.

Table 5.5 shows that the magnitude of the impact of NRR (in USD) on the manufacturing sector value added differs between income groups. While the estimated impacts are positive in all three income groups, the magnitude is largest at the second group (between 50th and 75th percentile, Column 3) and not significant for the highest income group (higher than 75th percentile, Column 4). However, when the resource rent is measured as a percentage of GDP (Table 5.6), the highest impact is in the first group (less than 50th percentile, Column 2). These results suggest that while the impact of each additional dollar of natural resource rent is largest in countries in the second group (between 50th and 75th percentile, Column 3), the impact of an increased share of natural resource rent in the economy is largest in countries in the first group (less than 50th percentile, Column 2).

²⁸ I also use the same threshold for 1970 GDP per capita data. The results are similar but with a smaller sample size since some countries do not have 1970 GDP per capita data. Another possible classification is the World Bank's analytical classifications based on Atlas methodology. However, the earliest classification is for the 1987 fiscal year.

Table 5.5. Instrumental variable results, natural resource rents in 2010 US dollar, subsample: based on GDP per capita in 1980

Dependent variable	Log of manufacturing value-added			
Sample based on	GDP per capita in 1980 (2010 USD)			
	Whole sample	< \$3116.6	between \$3116.6 & \$13164.5	> \$13164.5
	(1)	(2)	(3)	(4)
Panel A. OLS Estimation	OLS	OLS	OLS	OLS
Log of natural resource rents	-0.006* (0.003)	-0.002 (0.004)	-0.009* (0.005)	-0.010* (0.005)
Panel B. IV Estimation	IV Com index	IV Com index	IV Com index	IV Com index
Excluded instruments				
Log of natural resource rents	0.058*** (0.011)	0.045*** (0.010)	0.060*** (0.022)	0.007 (0.013)
First-stage coefficients	2.335*** (0.284)	3.036*** (0.486)	2.268*** (0.325)	2.578*** (0.517)
F-statistics on excluded instruments	67.482	39.080	48.854	24.862
Wooldridge endogeneity test p-value	0.000	0.000	0.001	0.159
Sargan-Hansen overidentification test p-value	0.000	0.000	0.000	0.000
Observations	4050	2105	1033	912
Countries	115	58	27	30
Country and year fixed effects	Yes	Yes	Yes	Yes
Years	1970-2014	1970-2014	1970-2014	1970-2014

Notes: Samples are divided based on 1980 GDP per capita level. Column (1) includes the whole sample, column (2) includes sample with 1980 GDP per capita less than the 50th percentile (USD 3116.6), column (3) includes sample between the 50th and 75th percentile (between USD 3116.6 and USD 13164.5) and column (4) includes sample above the 75th percentile (above USD 13164.5). The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured in constant 2010 US dollar and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. NRR in USD is transformed from a percentage of GDP form into constant USD using the GDP deflator. Stock-Yogo critical values for 25 per cent maximal Fuller relative bias is 5.53 and the 10 per cent maximal Fuller relative bias is 16.37. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instrument exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 per cent level

** Significant at the 5 per cent level

* Significant at the 10 per cent level

Table 5.6. Instrumental variable results, natural resource rents as a percentage of GDP, subsample: based on GDP per capita in 1980

Dependent variable	Log of manufacturing value-added			
Sample based on	GDP per capita in 1980 (2010 USD)			
	Whole sample	< \$3116.6	between \$3116.6 & \$13164.5	> \$13164.5
	(1)	(2)	(3)	(4)
Panel A. OLS Estimation	OLS	OLS	OLS	OLS
Natural resource rents (% of GDP)	-0.004 (0.003)	-0.006 (0.003)	-0.006 (0.008)	-0.003 (0.002)
Panel B. IV Estimation	IV Com index	IV Com index	IV Com index	IV Com index
Excluded instruments				
Natural resource rents (% of GDP)	0.030*** (0.005)	0.052*** (0.012)	0.026*** (0.010)	0.002 (0.004)
First-stage coefficients	4.580*** (0.448)	2.588*** (0.370)	5.211*** (0.993)	8.039*** (1.062)
F-statistics on excluded instruments	104.553	48.866	27.563	57.332
Wooldridge endogeneity test p-value	0.000	0.000	0.000	0.218
Sargan-Hansen overidentification test p-value	0.000	0.000	0.000	0.000
Observations	4050	2105	1033	912
Countries	115	58	27	30
Country and year fixed effects	Yes	Yes	Yes	Yes
Years	1970-2014	1970-2014	1970-2014	1970-2014

Notes: Samples are divided based on 1980 GDP per capita level. Column (1) includes the whole sample, column (2) includes sample with 1980 GDP per capita less than the 50 per cent percentile (USD 3116.6), column (3) includes sample between the 50 and 75 per cent percentile (between USD 3116.6 and USD 13164.5) and column (4) include sample above the 75 per cent percentile (above USD 13164.5). The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured as a percentage of GDP and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. Stock-Yogo critical values for 25 per cent maximal Fuller relative bias is 5.53 and the 10 per cent maximal Fuller relative bias is 16.37. The null of weak instruments is rejected in the case that the F-statistics on the excluded instruments exceeds the Stock-Yogo critical value/s.

**** Significant at the 1 per cent level*

*** Significant at the 5 per cent level*

** Significant at the 10 per cent level*

Ismail (2010) suggests that one way to explain the missing Dutch disease is that the manufacturing sector was initially too small and that government actively promoted the sector to keep them from adversely affected by the resource sector. To test whether the initial size of the manufacturing sector may have implications on the impact of natural resource rent, I divide the sample based on the share of the manufacturing sector in GDP in 1980. Similar to my previous reasoning, I use 1980 as the benchmark year because it has better data than 1970. I also use the same percentile thresholds as the GDP per capita modification to divide the sample. The 50th percentile is at 13.75%

share of the manufacturing sector in GDP, and the 75th percentile is at 20.95%. Table 5.7 and Table 5.8 show the results of these modifications. The first thing that should be noted from these results is that even with 1980 manufacturing share data, the sample sizes in Table 5.7 and Table 5.8 are considerably smaller than those in the main regressions (Table 5.2 and Table 5.3). However, just like the other modifications, the results can give some insights to explain the missing Dutch disease.

Table 5.7 indicates the NRR only has a positive and significant impact on manufacturing sector value added in regressions with samples that have manufacturing share in GDP in 1980 larger than the 75th percentile (Column 4). In other words, these results suggest that the NRR only has a positive and significant impact on the manufacturing sector value added in countries that already have a sizeable manufacturing sector. These results are also confirmed by Table 5.8, which shows that the impact of NRR as a percentage of GDP on manufacturing sector value added is largest in countries with high manufacturing sector size in GDP. These results reject the idea that the missing Dutch disease is caused by the small initial size of the manufacturing sector. Nevertheless, we need to be careful in interpreting and comparing these results since the sample size is considerably smaller than the main regressions.

Table 5.7. Instrumental variable results, natural resource rents in 2010 US dollar, subsample: based on manufacturing value-added share in GDP in 1980

Dependent variable	Log of manufacturing value-added			
Sample based on	The percentage share of manufacturing value-added in GDP in 1980			
	Whole sample	< 13.75%	between 13.75% & 20.95%	> 20.95%
	(1)	(2)	(3)	(4)
Panel A. OLS Estimation	OLS	OLS	OLS	OLS
Log of natural resource rents	-0.007 (0.005)	-0.009* (0.005)	-0.016 (0.011)	0.022** (0.010)
Panel B. IV Estimation	IV	IV	IV	IV
	Com index	Com index	Com index	Com index
Excluded instruments				
Log of natural resource rents	0.051*** (0.013)	0.223 (0.216)	0.002 (0.011)	0.062** (0.025)
First-stage coefficients	2.086*** (0.325)	0.584 (0.549)	3.135*** (0.446)	1.895*** (0.216)
F-statistics on excluded instruments	41.096	1.132	49.491	77.261
Wooldridge endogeneity test p-value	0.000	0.000	0.058	0.100
Sargan-Hansen overidentification test p-value	0.000	0.000	0.000	0.000
Observations	2981	1354	880	747
Countries	76	37	21	18
Country and year fixed effects	Yes	Yes	Yes	Yes
Years	1970-2014	1970-2014	1970-2014	1970-2014

Notes: Samples are divided based on the share of manufacturing value-added in GDP in 1980. Column (1) includes the whole sample, column (2) includes sample with 1980 manufacturing value-added share in GDP of less than the 50th percentile (13.75%), column (3) includes sample between the 50th and 75th percentile (between 13.75% and 20.95%) and column (4) includes sample above the 75th percentile (above 20.95%). The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured in constant 2010 US dollar and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. NRR in USD is transformed from a percentage of GDP form into constant USD using the GDP deflator. Stock-Yogo critical values for 25 per cent maximal Fuller relative bias is 5.53 and the 10 per cent maximal Fuller relative bias is 16.37. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instrument exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 per cent level

** Significant at the 5 per cent level

* Significant at the 10 per cent level

Table 5.8. Instrumental variable results, natural resource rents as a percentage of GDP, subsample: based on manufacturing value-added share in GDP in 1980

Dependent variable	Log of manufacturing value-added			
Sample based on	The percentage share of manufacturing value-added in GDP in 1980			
	Whole sample	< 13.75%	between 13.75% & 20.95%	> 20.95%
	(1)	(2)	(3)	(4)
Panel A. OLS Estimation	OLS	OLS	OLS	OLS
Natural resource rents (% of GDP)	0.001 (0.003)	0.005 (0.003)	-0.009 (0.007)	-0.018*** (0.005)
Panel B. IV Estimation	IV Com index	IV Com index	IV Com index	IV Com index
Excluded instruments				
Natural resource rents (% of GDP)	0.026*** (0.006)	0.021*** (0.005)	0.003 (0.017)	0.053** (0.026)
First-stage coefficients	4.050*** (0.483)	6.245*** (0.759)	2.010*** (0.754)	2.225*** (0.410)
F-statistics on excluded instruments	70.206	67.747	7.108	29.463
Wooldridge endogeneity test p-value	0.000	0.000	0.445	0.003
Sargan-Hansen overidentification test p-value	0.000	0.000	0.000	0.000
Observations	2981	1354	880	747
Countries	76	37	21	18
Country and year fixed effects	Yes	Yes	Yes	Yes
Years	1970-2014	1970-2014	1970-2014	1970-2015

Notes: Samples are divided based on the share of manufacturing value-added in GDP in 1980. Column (1) includes the whole sample, column (2) includes sample with 1980 manufacturing value-added share in GDP of less than the 50 per cent percentile (13.75%), column (3) includes sample between the 50 and 75 per cent percentile (between 13.75% and 20.95%) and column (4) include sample above the 75 per cent percentile (above 20.95%). The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured as a percentage of GDP and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. Stock-Yogo critical values for 25 per cent maximal Fuller relative bias is 5.53 and the 10 per cent maximal Fuller relative bias is 16.37. The null of weak instruments is rejected in the case that the F-statistics on the excluded instruments exceeds the Stock-Yogo critical value/s.

**** Significant at the 1 per cent level*

*** Significant at the 5 per cent level*

** Significant at the 10 per cent level*

Another modification is to divide the sample based on time-period. I divide the whole sample into three sub-periods: the first resource boom (1970-1984), non-boom period (1985-2002), and the second resource boom (2003-2014). Since there is no formal definition for resource boom in the literature, I define the resource boom as the period between when commodity prices generally start rising and when they generally stop falling. I include the slump period (when prices are falling) as part of the resource boom period because commodity prices in this period are generally still higher than during the non-booming period. The results are shown in Table 5.9 and Table 5.10.

The results indicate that the impacts of NRR on the manufacturing sector value added are different in each period. Not only are they different in magnitude and significance, but they are also different in the direction of the impact. Both Table 5.9 and Table 5.10 indicate that the impact of NRR on manufacturing sector value added is positive and significant during the first boom period (1970-1984), not significant during the non-booming period (1985-2002), and negative and significant during the second boom period (2003-2014). These results are not easy to explain since there are a tremendous amount of factors that changed between these periods. The impact is not significant during the non-booming period.

Table 5.9. Instrumental variable results, natural resource rents in 2010 US dollar, subsample: based on boom period

Dependent variable	Log of manufacturing value-added			
Sample based on	Boom Period			
	Whole Period (1)	First boom (2)	Non-boom (3)	Second boom (4)
Panel A. OLS Estimation	OLS	OLS	OLS	OLS
Log of natural resource rents	-0.006* (0.003)	0.003 (0.003)	-0.001 (0.003)	-0.005 (0.004)
Panel B. IV Estimation	IV	IV	IV	IV
Excluded instruments	Com index	Com index	Com index	Com index
Log of natural resource rents	0.045*** (0.011)	0.048*** (0.013)	0.019 (0.016)	-0.029*** (0.008)
First-stage coefficients	2.131*** (0.262)	2.543*** (0.438)	1.782*** (0.457)	2.671*** (0.331)
F-statistics on excluded instruments	66.312	33.737	15.169	65.220
Wooldridge endogeneity test p-value	0.000	0.000	0.192	0.001
Sargan-Hansen overidentification test p-value	0.000	0.000	0.000	0.000
Observations	4768	947	1952	1867
Countries	149	81	136	149
Country and year fixed effects	Yes	Yes	Yes	Yes
Years	1970-2014	1970-1984	1985-2002	2003-2014

Notes: Samples are divided based on boom periods. Column (1) includes the whole period, column (2) includes the first boom period (1970-1984), column (3) includes the non-boom period (1985-2002), and column (4) includes sample during the second boom period (2003-2014). The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured in constant 2010 US dollar and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. NRR in USD is transformed from a percentage of GDP form into constant USD using the GDP deflator. Stock-Yogo critical values for 25 per cent maximal Fuller relative bias is 5.53 and the 10 per cent maximal Fuller relative bias is 16.37. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instrument exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 per cent level

** Significant at the 5 per cent level

* Significant at the 10 per cent level

Table 5.10. Instrumental variable results, natural resource rents as a percentage of GDP, subsample: based on boom period

Dependent variable	Log of manufacturing value-added			
Sample based on	Boom Period			
	Whole Period (1)	First boom (2)	Non-boom (3)	Second boom (4)
Panel A. OLS Estimation	OLS	OLS	OLS	OLS
Natural resource rents (% of GDP)	-0.005 (0.003)	-0.003 (0.002)	-0.002 (0.003)	-0.004** (0.002)
Panel B. IV Estimation	IV Com index	IV Com index	IV Com index	IV Com index
Excluded instruments				
Natural resource rents (% of GDP)	0.020*** (0.004)	0.037*** (0.010)	0.007 (0.006)	-0.017*** (0.004)
First-stage coefficients	4.873*** (0.419)	3.288*** (0.695)	1.782*** (0.457)	4.703*** (0.607)
F-statistics on excluded instruments	135.447	22.402	45.797	60.100
Wooldridge endogeneity test p-value	0.000	0.000	0.077	0.002
Sargan-Hansen overidentification test p-value	0.000	0.000	0.000	0.000
Observations	4768	947	1952	1867
Countries	149	81	136	149
Country and year fixed effects	Yes	Yes	Yes	Yes
Years	1970-2014	1970-1984	1985-2002	2003-2014

Notes: Samples are divided based on boom periods. Column (1) includes the whole period, column (2) includes sample during the first resource boom (1970-1984), column (3) includes sample during the non-boom period (1985-2002) and column (4) include sample during the second boom period (2003-2014). The dependent variable is manufacturing value-added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is measured as a percentage of GDP and is the sum of oil rent, natural gas rent, coal rent, and mineral rent. Stock-Yogo critical values for 25 per cent maximal Fuller relative bias is 5.53 and the 10 per cent maximal Fuller relative bias is 16.37. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instrument exceeds the Stock-Yogo critical value/s.

**** Significant at the 1 per cent level*

*** Significant at the 5 per cent level*

** Significant at the 10 per cent level*

The last modification is to measure the impact of NRR on the services sector. Theoretically, the Dutch disease literature suggests that resource extraction will lead to an expansion in the (non-traded) services sector and a decline in the (traded) manufacturing sector. While this study finds a small positive impact on the manufacturing sector, this section tests the impact on the services sector. The results for the impact of NRR on the services value-added are shown in Table 5.11. The OLS results indicate that NRR has a negative but not significant impact on the services sector value-added. In the regression with NRR measured in US dollars, the coefficient of NRR is only significant at the 10% significance level. Furthermore, the magnitude of the NRR coefficients in services value-added regression are considerably smaller than those in manufacturing value-added regression. For

the regression with NRR as a percentage of GDP, the magnitude of NRR impact on services value-added is only one-fourth the magnitude of its impact on manufacturing value-added. Overall, these results suggest that there is only weak evidence for an expansion effect of NRR on the services sector.

Table 5.11. Instrumental variable results, services value added as dependent variable

Dependent variable	Log of services value added			
	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
Excluded instruments	None	Comindex	None	Comindex
1. Resources rents in USD				
Log of natural resource rents	0.006*	0.037***	-0.002	0.013*
	(0.004)	(0.010)	(0.002)	(0.007)
First-stage coefficients	-	2.560***	-	2.529***
		(0.330)		(0.306)
F-statistics on excluded instruments	-	60.254	-	2.529***
Partial R2 on Excluded instruments	-	0.030	-	(0.306)
Wooldridge endogeneity test p-value	-	0.000	-	0.040
Sargan-Hansen overidentification test p-value	-	0.000	-	0.000
2. Resources rents as % of GDP				
Natural resource rents (% of GDP)	0.002	0.014***	0.001	0.005*
	(0.002)	(0.004)	(0.002)	(0.003)
First-stage coefficients	-	6.682***	-	6.357***
		(0.522)		(0.495)
F-statistics on excluded instruments	-	163.684	-	164.789
Partial R2 on Excluded instruments	-	0.105	-	0.097
Wooldridge endogeneity test p-value	-	0.000	-	0.010
Sargan-Hansen overidentification test p-value	-	0.000	-	0.000
Time-varying country controls	No	No	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes
Observations	3479	3479	3479	3479
Countries	115	115	115	115
Years	1970-2014	1970-2014	1970-2014	1970-2014

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Notes: The dependent variable is services value added in constant 2010 US dollar prices. Robust standard errors, clustered by country, are in parentheses. Natural resources rent is the sum of oil rent, natural gas rent, coal rent, and mineral rent. NRR in USD is transformed from a percentage of GDP form into constant USD using the GDP deflator. Stock-Yogo critical values for 25 per cent maximal Fuller relative bias is 5.53 and the 10 per cent maximal Fuller relative bias is 16.37. The null of a weak instrument is rejected in the case that the F-statistics on the excluded instrument exceeds the Stock-Yogo critical value/s.

*** Significant at the 1 per cent level

** Significant at the 5 per cent level

* Significant at the 10 per cent level

5.5. Discussion

The results of this paper paint a different picture of the impact of natural resources extraction compared to the theoretical prediction of the Dutch disease theory. Instead of a gloomy, negative impact on the manufacturing sector, natural resource rent appears to have no significant effect (based on the OLS results) or a small positive impact (based on the IV results) on the manufacturing value-added. Reviewing some of the assumptions of the Dutch disease theory is essential to explain these results.

Firstly, the Dutch disease theory does not account for productivity spillovers between the booming resource sector and other sectors in the economy. If resources sectors are technologically more advanced than the rest of the economy, they can introduce innovation to the rest of the economy. This spillover effect can increase the productivity of the whole economy, including the manufacturing sector. Bjørnland and Thorsund (2016) show this effect in Australia and Norway. While this can explain the positive coefficient of NRR in the results, the empirical model applied in this study cannot test this explanation.

The second assumption is the tradability of manufacturing goods. The spending effect of the Dutch disease suggests that a resource boom will result in real exchange rate appreciation. This appreciation then leads to a decline in the traded sector and an expansion to the non-traded sector. While the traded sector can range from agriculture to services, the manufacturing sector is commonly considered as part of the traded sector. However, if the manufacturing sector is, in fact, relatively non-traded, increased wealth can instead stimulate higher manufacturing output. Although this may seem unlikely on the global scale, this possibility cannot be dismissed without a thorough observation. Moreover, the definition and scope of goods tradability are still subject to debate.

Other than these assumptions, policy interventions can also affect the impacts of NRR. Since the Dutch disease theory relies on the real exchange rate appreciation channel, policies that affect the

real exchange rate can alter the impact of NRR. These policies can include monetary policies such as exchange rate interventions or other tools. Moreover, governments have choices on how to use the collected resource rent in terms of taxes or licenses. If they choose to use the proceeds of the resource rents to develop the manufacturing sector, they can avoid the predicted negative impact of NRR on the manufacturing sector.

Evidence on how policies can help countries to avoid the curse of natural resource wealth is well documented. For example, Indonesia during the New Order regime did better in managing the windfall than other resource-rich countries such as Nigeria (Gelb, 1988; Pinto, 1987; Scherr, 1989) or Mexico (Scherr, 1989; Usui, 1997). The most well-known discussion about this period is by Gelb (1988), who attributed this good performance to three distinctive features of Indonesian economic policy at the time: flexible exchange rate policy, prudent macroeconomic management, and broad development strategy that emphasised raising rural incomes. Others attribute it to the importance of recycling mechanism of resource windfall into productivity-enhancing investment in the traded sector, notably agriculture and manufacturing (Coxhead, 2007; Coxhead & Li, 2008; Pinto, 1987).

Although not directly comparable, the extensions to the primary model give a much richer picture of the impact of NRR on the manufacturing sector. Geographical region and period appear to have an essential role in determining how natural resource rent affect the manufacturing sector. While the reason behind their importance is not immediately apparent, they are vital to understanding how resource extractions affect the manufacturing sector. After excluding the Middle East and Sub-Saharan Africa, the estimated impact of NRR remains positive but becomes insignificant. This suggests that the region drives the positive results of the primary model. One possible explanation is because the Middle East is one of the largest hydrocarbon exporters in the world. This means that the region has more petroleum refining industries than other countries, which leads to higher manufacturing value-added.

The second extensions, which divides the sample based on boom periods, indicate that the impact of NRR differs by period. The estimated impact is positive during the first boom, not-significant during the non-boom, and negative during the second boom. Considering the characteristics of each period might be helpful to understand these results. The first boom period (1970-1984) was mainly triggered by a supply shock, caused by the OPEC formation in 1973. The non-boom period (1985-2002) saw relatively stable but declining natural resource prices. The second boom (2003-2014) was mainly a demand shock, triggered by the rapid economic development of China, and to a lesser extent, India. These characterisations are an oversimplification of the three periods, but they suggest that the first boom was mainly due to price increase without a substantial change in demand, while the second boom was mainly due to increased demand. Although there might be a correlation between these characteristics and the estimated impact, I cannot conclude a causal relationship between them. Another possible explanation for the negative results during the second boom is the increased competition in the manufacturing sector due to import competition from China. The other side of China-driven resource boom is a persistent increase in China's manufacturing exports, including to natural resource exporters. While this may explain the difference between the outcome in the first and second boom, it cannot be tested in this study. A simpler explanation for these results is that the periods are significantly different from each other, especially in terms of interconnection between countries, technology and policies. The nature of the manufacturing sector itself has also changed, with the rise of the global production network

Dividing the sample based on initial GDP per capita and the initial percentage share of manufacturing in GDP also provided interesting insights. These extensions show that initial conditions can influence the impact of NRR. Countries with lower initial GDP per capita seem to have a larger positive impact of NRR on the manufacturing sector compared to countries with higher GDP per capita. Furthermore, the impacts appear to be either positive or insignificant in countries with a smaller initial share of manufacturing in GDP. Together, these results suggest that it is possible for countries with low initial GDP per capita and small manufacturing sector to extract their natural

resources and develop their manufacturing sector simultaneously. This optimistic conclusion suggests that countries do not need to choose between manufacturing and resource extraction.

The last extension, which replaces the dependent variable with services value-added, has important theoretical implications. Services, while becoming more traded every day, is considered to be the non-traded sector in the Dutch disease theory. Theoretically, the sector is predicted to benefit from natural resources extraction if the spending effect is larger than the resource movement effect. The results indicate that the impact of NRR on the sector is indeed positive. However, the size is considerably smaller compared to the impact on manufacturing. This suggests that the manufacturing sector benefits more from resource extraction than the services sector. One possible explanation for these results is that the manufacturing sector has more linkages with resource extraction sector and might benefit more from (hypothetical) technological spillover.

The results of this paper, both the primary model and the extensions, show a generally non-negative impact of resource extraction. However, it is important to note that the estimated impact is limited to the manufacturing sector (and services in its extension). I do not measure NRR impact on employment, economic growth, institution, or other social outcomes. The positive impact on manufacturing might also be only concentrated in resource processing manufacturing, which is arguably an enclave sector with small employment. That being said, this paper provides definitive evidence that the impact of natural resources rents on the manufacturing sector is not negative. Therefore, the evidence rejects the Dutch disease prediction of negative impact on manufacturing and its learning-by-doing implication of slower long-term growth.

5.6. Relating results to existing evidence

5.6.1. Existing literature

Since there is already an extensive existing literature on the Dutch disease, it is important to see how the results of this study fit into the existing literature. The earliest cross-country studies of the Dutch

disease by Gelb (1988) does not find any evidence for the Dutch disease in manufacturing in all of the examined countries. This finding is similar to the results of this paper. A possible explanation for the missing Dutch disease was that the sector was initially too small at the beginning of the oil boom in 1971. However, the results of this paper reject this explanation by showing that the impact of NRR on countries with a smaller share of the manufacturing sector in GDP is either positive or not significant. While Gelb's (1988) study and this study are not directly comparable, it is vital to check the consistency of the findings, mainly because this study employs a more extended observation period and includes more countries in its analysis.

Recent cross-country studies have produced contradicting results. A number of studies find evidence for the Dutch disease in manufacturing (Harding & Venables, 2013; Ismail, 2010), some do not (Smith, 2014, 2015), and others find mixed evidence (Bjørnland & Thorsrud, 2016). Ismail (2010), using disaggregated manufacturing sector data, finds that a 10 per cent oil windfall is on average associated with a 3.4 per cent fall in value-added across manufacturing. The results are higher in countries that have a more open capital market and for sectors that are less capital intensive. While providing the opposite results, the study only considers oil as the sole resource, and do not address the endogeneity issue between the manufacturing sector and the oil windfall. However, this contrast in results emphasizes the importance of factors which are not within the scope of this study, such as within sector characteristics and factor mobility. Another way to test for the Dutch disease is by measuring the impact on manufacturing exports. Harding and Venables (2013) find that foreign exchange windfall from natural resource exports crowds out manufacturing exports. While the outcome is different to this study, the results suggest the manufacturing sector is susceptible to the Dutch disease. On the other hand, several studies find more optimistic results, similar to the findings of this paper. Smith (2014) finds that, in contrast to the Dutch disease model, manufacturing value-added and exports are strongly pro-cyclical to oil prices during the boom and bust period. Smith (2015) even argues that countries can push toward industrialisation using oil revenue windfall.

As I discussed earlier, Bjørnland and Thorsrud (2016) propose a modified Dutch disease theory model that allows for direct productivity spillovers from the resource sector to both the traded and non-traded sector. They also find that windfall gains due to resource price booms stimulates the economy, particularly if it is associated with a boom in global demand (Bjørnland & Thorsrud, 2016). However, they find that resource price increases unrelated to global activity are less favourable since it causes substantial real exchange rate appreciation and reduces competitiveness. These findings are compatible with the results of this paper to some extent. Productivity spillovers might explain the estimated positive impact of NRR on manufacturing in this paper. However, their findings regarding the implication of global demand and resource prices cannot help to explain some of the results in this paper. In the previous section, I suggest that the first boom, which is not related to global demand, might have a positive impact while the second boom, which is caused by increased global demand, might have a negative impact on manufacturing value added. Again, these results are not directly comparable due to differences in method, but their conflicting predictions are important to note.

A number of studies test for the Dutch disease using a single country analysis. Compared to the cross-country analysis, these studies have the advantage of less variation in institutional, legal and political explanatory variables (van Der Ploeg & Poelhekke, 2016). However, most of these studies fail to find evidence for the Dutch disease. Sala-i-Martin and Subramanian (2003), in a Nigeria case-study, do not find evidence of the Dutch disease due to oil price movement. Instead, they find evidence of natural resource curse through the negative impact of natural resources on institutional quality. Black et al. (2005), in their study on the impact of 1970s coal boom in the United States, finds no crowding-out effect on manufacturing sector employment. Instead, they find evidence of modest employment spillovers into sectors with locally traded goods. Using a similar method as Black et al. (2005), Allcott and Keniston (Allcott & Keniston, 2014), in their study about how oil and gas boom affect local economies in the United States, find that manufacturing is not crowded out by oil and gas boom. A recent study by Cust et al. (2017) find that manufacturing firms exit rate in

Indonesia is unaffected by oil and gas windfall. They find that oil and gas windfalls cause wage growth, but it was followed by firms productivity increase. This means manufacturing firms can overcome the crowding-out effects from resource windfalls.

5.6.2. Country case study evidence

While this study finds evidence of a mild positive impact of NRR on the manufacturing sector on the global level, each country likely has a different experience with natural resources. This diversity of experience can be attributed to many factors, from history and institutional setting to luck. However, it is still important to reconcile the findings of this study with real-world examples. This section will discuss the experience of Indonesia and Australia with resource windfall and their manufacturing sector development.

Indonesia and Australia are two very different neighbouring countries. While both countries are endowed with natural resources, they are very different in terms of economic development, institutional and political setting, and population (Resosudarmo et al., 2015). They also consistently export their extracted natural resources, although the kind of resources are different and change over time. Figure 5.4 shows the size of manufacturing value-added and natural resource rents in each country over 1970-2015. From Figure 5.4, the high volatility of the NRR as compared to the manufacturing value-added is immediately apparent. The volatility stems from the changes in the three components of NRR: natural resource prices, extracted quantity, and cost of extraction. On the contrary, manufacturing value-added moves in a much smoother pattern, with occasional small spikes, which are related to shocks in the economy.

The impacts of NRR on the manufacturing value-added are not directly visible from Figure 5.4. However, this also means that the size of the impacts (if any) are relatively mild in both countries. Furthermore, the apparent weak relationship between manufacturing value-added and NRR

confirms the results of this paper, which indicates a small positive impact of NRR to manufacturing value-added. For example, while there is a sharp spike in NRR in early 2000, around the beginning of the second boom (2003-2014), there are no extreme changes in manufacturing value-added. In Indonesia, the upward trend in manufacturing continues without interruption, whereas in Australia, manufacturing transitions from an upward trend to a relatively constant trend. Although it is tempting to conclude that Australia might be experiencing a Dutch disease while Indonesia do not, it is important to consider other factors that might also lead to the same outcome. After all, Australia is an advanced economy, where deindustrialisation is not unusual, and Indonesia is a developing economy with a growing manufacturing sector.

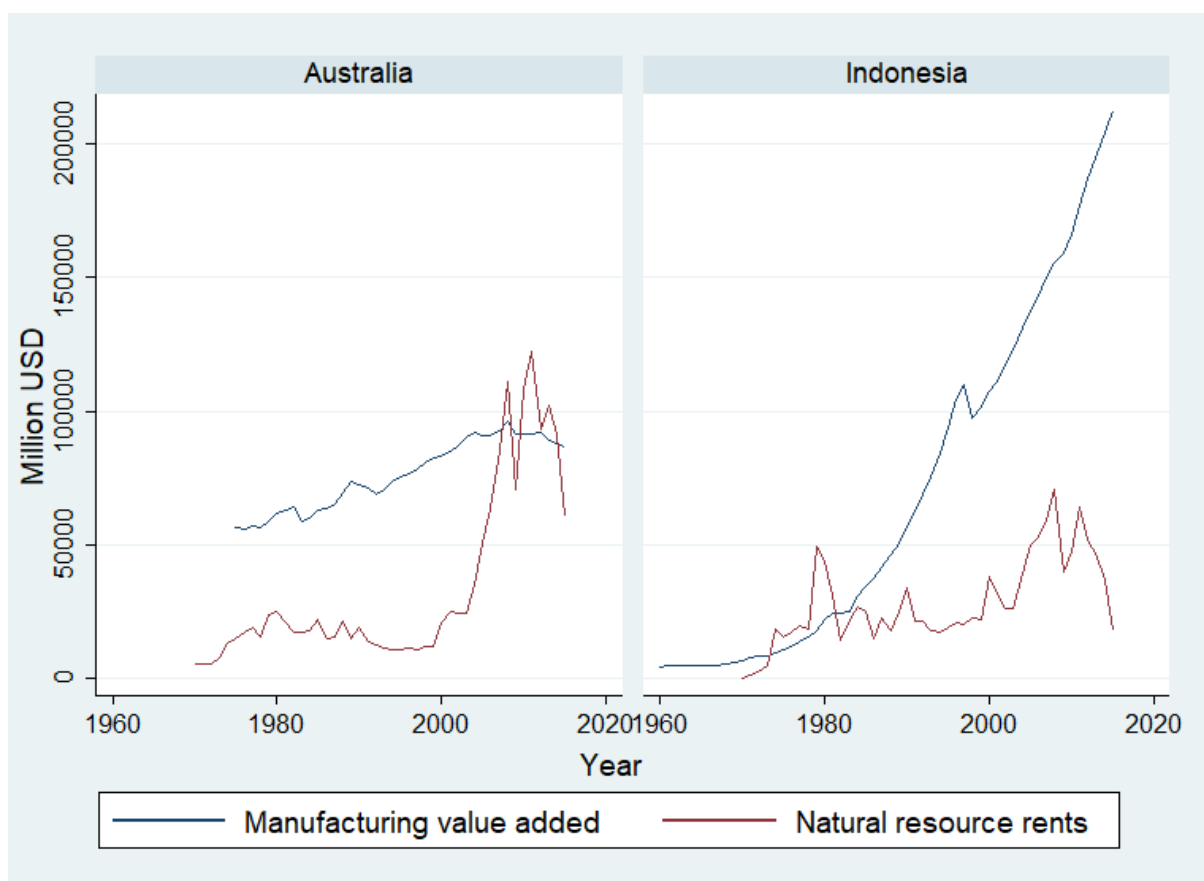


Figure 5.4 Manufacturing value-added and natural resources rent (2010 US dollar)

Notes: Based on World Development Indicator (World Bank, 2017)

Recent studies also find that Australia experienced a mild Dutch disease during the second resource boom, while Indonesia did not. For Australia case, Dungey et al. (2017) confirm Bjørnland and Thorsrud (2016) findings. Dungey et al. (2017) find evidence that although Australia experienced a decrease in production associated with natural resource price shock – or a Dutch disease – during the resource boom of 2003-2012, the economy recovers to its equilibrium relatively quickly. For Indonesia case, Cust et al. (2017) findings are in line with previous studies that highlight that the traded manufacturing sector is not crowded out by resource windfalls (Gelb, 1988; Pinto, 1987; Usui, 1996, 1997). This diversity in experiences shows that despite the theoretical prediction that the natural resources windfall impacts on the traded manufacturing sector should be unambiguously negative, countries can still avoid the negative impacts or even benefit from it. This is reflected in the findings of this paper that an increase in NRR, which are associated with exported resource prices, has a small positive impact on manufacturing value-added.

5.7. Conclusion

This study empirically tests the Dutch disease theory by measuring the impact of natural resource rents on manufacturing sector value-added. I use cross-country panel data and instrumental variable regression to address the endogeneity issues that may arise from reverse causality between the resource and the manufacturing sector. The instrument for the IV model is an index of exported natural resource price index, weighted by the share of resource export in each country GDP. I find that one per cent increase in natural resource rents increases manufacturing value-added by 0.05 per cent while a percentage point increase in the share of natural resource rents in GDP increases manufacturing value-added by 0.02 per cent. The estimated elasticities are small and inelastic, but they give definitive evidence that rejects the Dutch disease theory prediction. This also means that there is no proof of the feared learning-by-doing implications of the Dutch disease that can lead to slower long-term growth. Since the impact is estimated using the instrumental variable method, it is specific to the increase of natural resource rents that are caused by changes in exported natural

resource price. These results contribute to the ongoing debate about the Dutch disease, which has produced mixed results in earlier studies.

The extensions to the primary model also provide important insights. Firstly, resource-processing manufacturing might explain the positive estimated impact of NRR on manufacturing value-added. Secondly, initial GDP per capita and the share of the manufacturing sector in GDP can affect the impact of NRR. The manufacturing sector in countries with lower initial GDP per capita appears to benefit more from NRR than richer countries. Moreover, the impact on countries with a lower initial share of manufacturing in GDP is either positive or not significant. Thirdly, the direction of the impact of NRR changes between period, from positive during the first resource boom, to not significant during the non-boom period, and to negative during the second boom period. These results might be related to the characteristics of the boom, particularly the role of global demand. Lastly, I find that the estimated impact of NRR on services is positive, but smaller compared to the impact on the manufacturing sector.

While the findings of this study do not have direct policy implications, I argue that policies matter in determining the impact of resource rents on manufacturing. These policies may include how countries save or spend their resource windfalls, the kind of spending they engage in, as well as other policies such as exchange rate regime, trade openness, capital mobility and migration. This is supported by the diversity of experiences between countries, as demonstrated by my discussion on the Indonesia and Australia cases. Furthermore, it is worth noting that impacts on manufacturing are just one dimension of the effects of natural resource rents. Policies on natural resources also need to consider other issues such as intergenerational fairness, sustainability, social impacts and welfare. The next chapter will discuss the impacts of natural resources on welfare.

5.8. Appendix

Table 5.12 List of countries

Afghanistan	Georgia	Nigeria
Albania	Ghana	Nicaragua
United Arab Emirates	Guinea	Netherlands
Argentina	Gambia, The	Norway
Armenia	Greece	Nepal
Australia	Grenada	New Zealand
Austria	Guatemala	Pakistan
Azerbaijan	Guyana	Panama
Burundi	Hong Kong SAR, China	Peru
Belgium	Honduras	Philippines
Benin	Croatia	Poland
Burkina Faso	Hungary	Portugal
Bangladesh	Indonesia	Paraguay
Bahrain	India	West Bank and Gaza
Bahamas, The	Ireland	Qatar
Bosnia and Herzegovina	Iran, Islamic Rep.	Russian Federation
Belarus	Iraq	Rwanda
Belize	Iceland	Saudi Arabia
Bolivia	Italy	Sudan
Brazil	Jamaica	Senegal
Brunei Darussalam	Jordan	Singapore
Bhutan	Japan	Sierra Leone
Botswana	Kazakhstan	El Salvador
Central African Republic	Kenya	Suriname
Canada	Kyrgyz Republic	Slovak Republic
Switzerland	Cambodia	Slovenia
Chile	St. Kitts and Nevis	Sweden
Cote d'Ivoire	Korea, Rep.	Swaziland
Cameroon	Kuwait	Seychelles
Congo, Rep.	Lebanon	Togo
Colombia	Liberia	Thailand
Comoros	St. Lucia	Tajikistan
Costa Rica	Sri Lanka	Tonga
Cuba	Lesotho	Trinidad and Tobago
Cyprus	Lithuania	Tunisia
Czech Republic	Luxembourg	Turkey
Germany	Latvia	Tanzania
Dominica	Morocco	Uganda
Denmark	Moldova	Ukraine
Dominican Republic	Mexico	Uruguay
Ecuador	Macedonia, FYR	United States
Egypt, Arab Rep.	Myanmar	St. Vincent and the Grenadines
Spain	Mongolia	Venezuela, RB
Estonia	Mozambique	Vietnam
Ethiopia	Mauritania	Vanuatu
Finland	Mauritius	Samoa
Fiji	Malawi	South Africa
France	Malaysia	Zambia
Gabon	Namibia	Zimbabwe
United Kingdom	Niger	

Table 5.13 Descriptive statistics of the variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Log of manufacturing value added	4,774	21.80	2.58	15.38	28.29
Log of natural resource rents	4,774	15.44	8.62	0.00	26.64
Log of population	4,774	15.72	1.91	10.62	21.01
Squared log of population	4,774	250.82	58.79	112.73	441.60
Log GDP per capita in 2010 USD	4,774	8.28	1.48	5.08	11.62
Squared log of GDP per capita in 2010 USD	4,774	70.73	24.86	25.78	134.98
Trade (% of GDP)	4,774	79.81	50.33	0.17	442.62
GDP growth (% change from the previous year)	4,774	3.83	5.15	-50.25	57.82
Year	4,774	-	12.34	1970	2015
Natural resource rents (%GDP)	4,774	6.17	9.56	0	82.62
Natural resource rents (constant 2010 USD)	4,774	7.71E+09	2.54E+10	0	3.82E+11

Chapter 6

Natural resource prices and welfare: Evidence from Indonesia's coal and palm oil boom

6.1. Introduction

For about a decade, between 2003 and 2014, natural resource-producing countries enjoyed one of the largest and longest commodity demand booms in history. While the boom brought rapid economic growth and increased government revenue in commodity-exporting countries, how the benefits were distributed within these countries is still unclear. This question is important everywhere, but even more so in developing countries such as Indonesia where millions of people are still living under the poverty line, where institutionalized redistributive social transfers are very small, and where the natural resource extraction sector is historically an enclave sector, with little connection with the rest of the economy. In this setting, did the commodity demand boom contribute to poverty alleviation and welfare improvement?

In theory, the extractive industry should be able to contribute to development through positive fiscal impacts, gains in employment, local economic development, and easier access to energy (Weber-Fahr et al., 2001). Yet empirical evidence on the impact of natural resources on poverty is mixed, as summarised by Gamu, Le Billon, and Spiegel (2015). Some resource abundant countries such as Norway, Australia, Botswana and most of the gulf countries manage to achieve relative prosperity, while others, such as Nigeria, Angola, Brazil and Venezuela, fail to do so. This paradox of plenty, where countries with an abundance of natural resources fail to achieve relative prosperity, sparks debate among economists about the role that natural resources play in economic development.

The diversity of experience between countries, where some successfully harness natural resource wealth for economic development while others fail, highlights the need for country-specific case

studies. To this end, this study attempts to test the welfare impact of a commodity boom using Indonesia during the 2000s commodity demand boom as a case study. The demand boom, driven by China's rapid economic growth, increased global commodity prices, which was then followed by production responses from commodity producers. While the boom can be measured in either prices or quantity, I focus on the impact of international prices. International prices are central in understanding the impact of the boom because they are an important channel through which a global demand boom can affect Indonesia's commodity sector, and therefore also affecting welfare at the local level.

Specifically, I look at the impact of international prices for palm oil and coal on the poverty rate, real per capita household expenditure, employment and real wages at the district level. Palm oil and coal are two of Indonesia's main export commodities and have contributed to most of the country's export growth after the Asian Financial Crisis (AFC, 1997-1998). I will discuss the characteristics of the palm oil and coal boom in the third section of the paper. These commodities have distinct characteristics which might lead to different effects on poverty and welfare. Since not all districts can produce palm oil and coal, and each district has different exposure to these commodities, the same level of global commodity prices will have a different effect on each district.

Commodity prices can affect poverty and welfare at the subnational level through two channels: directly through employment and wages, and indirectly through fiscal and institutional effects. This paper focuses on the direct channel but will also briefly discuss the role of the indirect channel. The direct channel works through suppliers' response to the increase in prices. Higher commodity prices will increase suppliers' income and induce them to increase their production (Blake, McKay, & Morrissey, 2002). This then leads to an increase in labour demand, wages and consumer prices. These effects can either positively or negatively affect district poverty and welfare. Positively, higher labour demand and wages from the increased commodity demand will increase workers' welfare and reduce poverty (Winters, McCulloch, & McKay, 2004). Negatively, higher consumer prices

caused by higher spending and wages may lower welfare and increase poverty. This is especially the case if the benefits from higher commodity prices are concentrated among a small section of the population. Migration between districts is another important factor because it can lessen both the positive and negative effects. Since there is no restriction on labour mobility in Indonesia, an increase in labour demand can be met through migration, thus limiting the wage effect. With these multiple possible outcomes, there is no certainty as to which would occur. These channels, time frame and possible outcomes will be discussed in more detail in the following section.

In this study, I use a panel fixed effect model to estimate the welfare impact of the international price of crude palm oil (CPO) and coal at the district level in Indonesia between 2007 and 2013. Examining the impact of commodity price on poverty is a complicated process because each region has a different exposure to commodities, depending on various factors such as soil fertility and sub-soil resource reserve. My identification strategy to address this issue is to use the cross-sectional variation in exposure to each commodity, interacted with global commodity prices. I assign an exposure level to each district based on the size of oil palm plantation in the district and the size of coal reserve using the earliest available data at the district level (2007 for palm oil and 2013 for coal). Although Indonesia's coal and palm oil production soared during the period, this exposure level is held constant (not time-varying). This allows the focus to be on the impact of commodity prices. A supply response, such as plantation expansion, is considered as a mechanism through which these prices can affect the district outcomes, given an exposure level.

I measure the impact on several outcomes, including the poverty rate, the number of employment, average real household expenditure, and average real wage in the district. To check the mechanisms, I test for its impact on the district employment and average real wages in eight job types and nine sectors as defined by Indonesia's Bureau of Statistics. This test will also show if there is any employment and wages spill-over effect on the non-booming sectors in the district. Furthermore, I test the impact on wages at the 25th and 75th percentiles in the district to explore

how the benefit from the commodity boom has been distributed. To check the role of the price mechanism, I also test for its impact on the CPI inflation rate at the closest district in which price data is collected.

I find that an increase in the international price of palm oil and coal both have a poverty alleviation impact in districts that produce these commodities. A price increase in coal also has a positive impact on average per capita household expenditure, while the same effect is not found in palm oil. The reverse is true for total employment impact, where palm oil price has a positive and significant effect, while coal price has no statistically significant effect. This result reflects the relative labour intensity of palm oil production as compared to coal. I also find a positive and significant impact on district average real wage from an increase in coal price, but not palm oil price. However, the results on the impacts of price on district wages at the 25th and 75th percentile are only significant in the case of palm oil. This suggests that palm oil price affects wage distribution in a larger magnitude than coal. Upon closer inspection, palm oil and coal each have positive and significant impact only on jobs that are more relevant to the sector. In the case of palm oil, the price has a positive and significant impact on the average wage of agricultural workers and labourers.

The findings suggest that coal and palm oil prices affect poverty, welfare, employment and wage at the subnational level, but in different ways. While their impacts on poverty are similar, I find evidence that an increase in palm oil price disproportionately benefits people at the lower end of the income distribution. This evidence is supported by the findings on its effect on employment, district wages at the 25th percentile, and the type of jobs that benefit from a palm oil price increase. However, there is no evidence that an increase in palm oil price can increase the average per capita district expenditure or the overall average wage. The opposite is true for coal, where a price increase has a positive and significant effect on per capita household expenditure and average wage but not on the wage distribution.

In the robustness check, I test the model using several different specifications. In the model with lagged values of the coal and palm oil price variables, I find the results to be consistent with the main model, albeit less precise in terms of their significance level. The result is also robust when I use different measures of exposure level (such as using the average or latest data of palm oil plantation size instead of the earliest available data) and when I include time trend and exposure interactions as control variables (to control for the general impact of the boom). Another robustness check is by aggregating the observation at the province level. The coefficient for both palm oil and coal are not significant in this specification. While this can mean that there is no spillover effect of commodity prices from the district to province level, it can also simply mean the number of observations is too low.

This study has multiple contributions. Firstly, it contributes to the already extensive resource curse literature, especially in the within-country evidence for the impact of natural resources. Secondly, the study contributes to the literature about the difference between mining and agricultural commodities in how they affect welfare. Thirdly, the study enriches the poverty literature with evidence on how external commodity prices can affect poverty. Lastly, the study contributes to the measurement of labour market outcomes, particularly wage distribution, in the case of a commodity boom in a developing economy.

This study also has important policy implications in how a country or subnational administrative unit (district) can respond to exogenous changes in commodity prices. The distributional impact of the commodity prices needs to be recognised and responded appropriately both at the national level and at the district level. These responses can include a fiscal policy which can amplify the positive distributional effect of some commodities while reducing the negative distributional impact of other commodities. Another policy implication is on the labour market policy. In the case of palm oil, the average real wage and real household expenditure impacts of prices are not significant. This might be because a large portion of the workers is informal workers. A labour market policy that can

increase the proportion of formal workers in the sector might help to strengthen the wage impact of commodity demand and improve the welfare effect. Lastly, while the impact of an increase in commodity price from a demand boom appears to be desirable, the possible price fall that follows during a bust can be problematic. Policies that prepare for the bad times during the good times are important at both the national and subnational level.

6.2. Mechanisms

Although the research question is straightforward, the answer depends on various factors. Factors such as sectoral labour intensity, policies, and institutional settings can influence the distributional effect of commodity prices, and thus affect its poverty and welfare impact. I divide these factors into two mechanisms, the direct mechanism and the indirect mechanism. This dichotomy is based on whether the effect on poverty and welfare is caused by the intrinsic characteristics and production process of the sector (and therefore direct) or because how it affects external factors such as spillover to other sectors, the fiscal balance and institutional quality (therefore indirect). This dichotomy is not perfect, as there are cases where the two mechanisms are intertwined, but it can help to simplify and understand the mechanism. Furthermore, it is helpful to clarify the time frame and to observe the spending effect and the resource movement effect. This study measures the impact of price on the same year, so it focuses on the short-term effects.²⁹ In the short term, I assume that labour is the only mobile factor because it takes time to expand plantation or mines.

The direct mechanism operates through the production process. It is best understood using a modified version of the Dutch disease model,³⁰ applied to a within-country setting. There have been several attempts to develop a within-country Dutch disease model with various objectives, such as to show the local poverty and employment effect (Weber, 2012), and to show agglomeration versus learning by doing effect in the local economy (Allcott & Keniston, 2014). However, it is important to

²⁹ Nevertheless, I also test the impact of lagged prices as a robustness check to see if there are any lagged effects of prices.

³⁰ For a detailed discussion on the Dutch disease model, refer to Chapter 2 section 2.1. (p. 17)

remember that the research question is not about the Dutch disease effects. This section only uses familiar Dutch disease terminologies to help explain the mechanisms of how international commodity prices can affect welfare in a within-country setting.

Firstly, consider the resource movement effect. The booming sector will demand more factors of production, in this case, labour. This will create employment, but the effects on wages depend on the local labour market. If the labour market is tight, or if the booming sector needs workers with specific qualifications (and it is expensive to train new workers), wages may increase to attract workers from other sectors or from other districts. However, if there are enough people looking for employment and the booming sector does not require workers with specific skills (or if it is affordable to train new workers), wages need not increase. Another possibility is if commuting residents switch jobs to the local booming sector for a wage similar to the level they previously earned in another district. If this is the case, wages and income will not increase, although utility might increase due to less time spent commuting. The local resource movement effect can also have different effects on the traded and non-traded sector, depending on the labour market. If the local labour market is tight, both sectors may need to pay higher wages, which can, in turn, affect their performance.

Secondly, consider the spending effect. As district income rises due to the resource boom induced employment creation and potentially higher wages, spending on traded and non-traded will also increase. Like the original model, non-traded prices are expected to increase while traded prices are not. As the non-traded sector expands, it will demand more labour. Once again, the impact on wages depends on the local labour market. However, in contrast to the original model, the effects on the traded sector are not certain since they also depend on the condition of the local labour market.

The size of both the resource movement effect and the spending effect depend on the propensity of labour migration between districts. Higher internal migration can diminish the size of both effects. If the local labour market is tight, but migration between districts is likely, an increase in labour

demand can be fulfilled by migrating workers from other districts. In that case, the impact on wages may be marginal, although the impact on employment will still be positive.

Commodity characteristics are also an important factor. Commodities are not equal in how they can affect employment and wages. Consider the difference between coal and palm oil sector in Indonesia. The coal sector, for example, is a relatively capital-intensive sector that requires a small amount of high-skilled labour with high wages. The palm oil sector, on the other hand, often requires a large amount of low skilled labour, especially if the estate is not owned by a big company. As an illustration, Indonesia's 2010 Input-Output table indicates that the coal sector spent only ten per cent of its total expenditure on wages, while the palm oil sector spent twenty seven per cent. A boom in the palm oil sector, which requires minimal specific skills, would be more likely to increase employment of local residents and therefore, wages.

The effects of the resource boom on income and poverty are the consequence of its effects on employment, wages, and prices. In any case, the employment effect should be positive and should have poverty eradicating effects. Even if the employment effect is moderated by migration from other districts, the effect on poverty should still be positive. The effect on the average wage is expected to be non-negative. If it is positive, it may have poverty eradicating effects, and if it is not positive, it should not affect the poverty rate. Finally, the impact on poverty also depends on how the boom affects the price level since the poverty line is defined in local prices. An influx of workers, for example, may push non-traded goods prices, such as rental rates, upward. If the cost of living increases more than nominal income, the cost-of-living adjusted poverty rate may increase.

So far, I have not discussed the rents to landowners or capital owners. While these rents are not the focus of this study, it is important to note that they play a key role in how a commodity boom affects the local economy. If land ownership is concentrated in the hands of a few, the gain from rents would also be concentrated. Land ownership is also important because land is an immobile factor. This has two implications: (i) land for plantation or coal mining can only expand (or shrink) in the

long term, but not in the short term; and (ii) the return from land ownership (rents) should fluctuate with the price of the relevant commodities. The rents might have a spillover effect on other sectors, and they can also be spent locally, such as on the property sector, thus increasing housing prices. Tax revenues on these rents, on the other hand, would likely have broader effects through public services and investment. These effects are part of the indirect mechanism.

The indirect mechanism involves everything that is not directly related to the production process in the commodity sector. As I have shown, the line might be blurred in the case of employment and wages spillover effect into other sectors. The fiscal effect, which comes through taxes on the collected resource rents, is as important as, if not more important than, the direct mechanism. Studies have shown how fiscal management can determine whether a country can avoid the Dutch disease or the resource curse. For example, Indonesia's success in avoiding the Dutch disease during the 1970s and 80s oil boom is partly attributed to its government's ability to manage and spend oil revenues on developing infrastructure, agriculture and education throughout the country (Booth, 1992; Gelb, 1988; Hill, 1992; Pinto, 1987; Scherr, 1989). By spending their resource windfalls on public services and investments, the Indonesian government has indirectly used the commodity boom to improve welfare and reduce poverty. This is evident in Indonesia's rapidly declining poverty incidence during the period. Whereas 40.4 per cent of the rural population were below the poverty line in 1976, in 1987, this percentage has fallen to 16.4.³¹ The decline in urban areas is less dramatic; the urban poverty rate declined from 38.8 per cent in 1976 to 20.1 per cent in 1987.

Unfortunately, not many countries shared this experience with Indonesia. Countries have diverging experiences in managing resource booms. While some countries such as Venezuela and Nigeria have been unable to escape this resource curse, other countries such as Norway and Botswana have performed relatively well. These diverging experiences are often attributed to institutional quality differences. The argument is if there is a natural resources windfall in a country with poor

³¹ Official figures based on BPS poverty line.

institutions, it will encourage people to engage in rent-seeking and taking as much as possible of the windfall. But a windfall in a country with strong institutions will lead to more complementary demand and encourage more productive entrepreneurship (Mehlum et al., 2006a). The cross-country evidence suggests that with a good institution, a resource curse can be turned into a blessing with good enough institutional quality (Boschini, Pettersson, & Roine, 2007).

In the local context, empirical evidence suggests the indirect mechanism through fiscal effect also depends on institutions and how the resource rents are taxed. Many countries allow the tax revenues from resource rents to be collected and spent by a local government entity, such as a state or municipality. This means local government have an important role in managing the resource windfall and using it for the benefit of the local resident. Nevertheless, the diversity of experience still exists. In the US, an exogenous increase in a state's resource revenue leads to a lower level of state taxes, and increased spending and saving (James, 2015). In Brazil, however, oil windfall in municipalities only translates into little improvement in the provision of public goods or the local population's living standard (Caselli & Michaels, 2013). This evidence of diversity in experience appears to confirm the findings of cross-country studies. To my knowledge, the fiscal effect of natural resources in Indonesia has not been empirically tested. While this issue is not within the scope of this study, it is important to note that in the last twenty years Indonesia has experienced substantial changes in its central-local fiscal arrangement and how it collects taxes on natural resources. Some of these changes will be discussed in the next section.

While institutions are often viewed as an exogenous variable, evidence suggests that commodity type affects the institutional capacity to respond to shock (Isham, Woolcock, Pritchett, & Busby, 2005). "Point source" resources, which are extracted from a narrow geographic or economic bases, such as mineral and oil, are found to weaken institutional capacity. In contrast, "diffuse source" resources, which tend to be dispersed and rely on livestock and agricultural produce from small farms, do not have any institutional effects. Other studies also suggest that some resources, such as

mining and oil, are more “lootable” than others because they are concentrated and easily taxable, and if combined with a bad institution can lead to slower income growth (Mehlum et al., 2006b). If the kind of commodity can affect institutional capacity, it can then affect the government’s capacity to manage resource windfall and consequently, its capacity to eradicate poverty and improve welfare.

Both the direct and indirect mechanisms are important in explaining the impacts of commodity prices on poverty, welfare, and wages. This study measures the total impact of both mechanism on those variables and tries to explain the results using the two mechanisms. By including coal and palm oil, the results will test if there are any poverty and welfare outcome differences between the prices of these commodities. The spillover effect on other sector and surrounding areas will also be tested in the model. However, variables such as institutional quality and public services, which are part of the indirect mechanism, will not be part of the empirical model but will be discussed as part of the explanations for the results.

6.3. Indonesia: the second boom

Both agricultural and natural resource commodities, have always played a crucial role in the Indonesian economy. While the mix of commodities may change, they always make up a sizeable bulk of the country’s exports (Figure 6.1). This continuous reliance on commodities means Indonesia’s economy is highly influenced by commodity price booms and busts. Over the last fifty years, two major commodity booms have shaped the structure of Indonesia’s economy: the 1970s oil boom and the 2000s commodity boom.

The oil boom delivered an unprecedented windfall for Indonesia. Since the oil sector is a highly capital-intensive sector, it had minimal direct employment impact or wage impact. However, it had a substantial impact on the government’s revenue, which reached 71 per cent of total revenue during the peak of the oil boom in 1981-1982. Although development progress was unequal between regions, overall poverty incident declined rapidly, particularly in rural Java (Booth, 1992; Hill, 1992).

The rapid decline in rural poverty can be mainly attributed to the government's agricultural development program, especially in rice production, through programmes of lavish input subsidies (Booth, 1992; Gelb, 1988). Others attribute it to the importance of recycling mechanism of resource windfall into productivity-enhancing investment in the traded sector, notably agriculture and manufacturing (Coxhead, 2007; Coxhead & Li, 2008; Pinto, 1987).

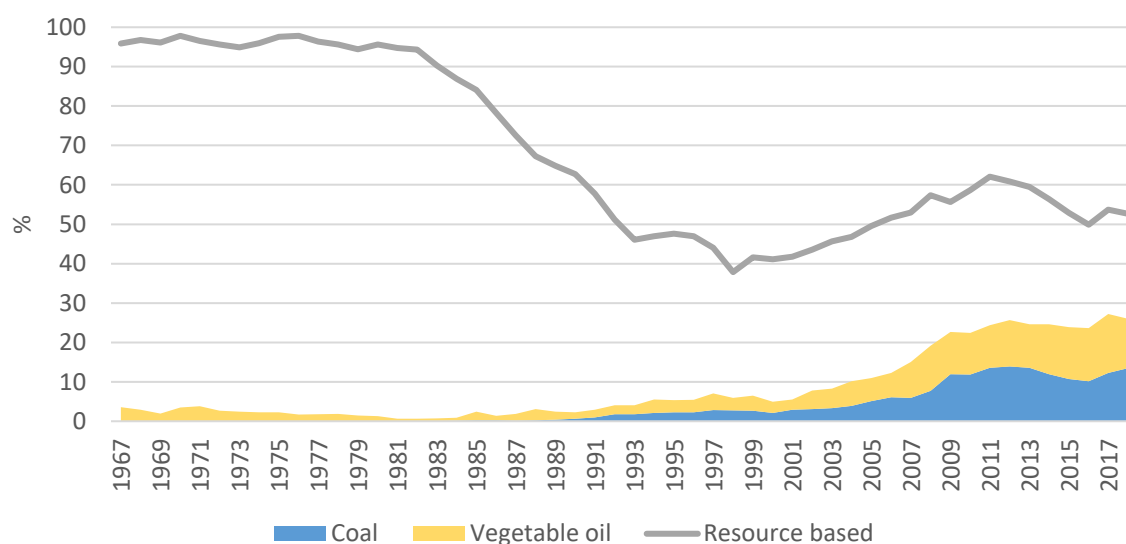


Figure 6.1. The percentage share of coal, vegetable oil and total resource-based goods in Indonesia's merchandise exports

Source: Author's calculation based on UNCOMTRADE data. Notes: resource-based sector includes agriculture, forestry, mining, and oil and gas.

There are at least two important points from Indonesia's oil boom experience that need to be noted. Firstly, the oil boom affected welfare and poverty mainly through how the government spent the oil windfall, and less through employment in the petroleum sector. Secondly, it is fair to say that Indonesia managed to escape the curse of natural resources wealth during the oil boom. The government did better in managing the windfall than other resource-rich countries such as Nigeria (Gelb, 1988; Pinto, 1987; Scherr, 1989) or Mexico (Scherr, 1989; Usui, 1997). The result of this good management is not only apparent in macroeconomic performance, but also in the reduction of the incidence of poverty.

The 2000s commodity boom was driven by strong global economic growth, mainly in China, and to some extent, India. In 2004, the year when commodity prices rose substantially, economic growth in the OECD area was at a historical high of 3.2%, while growth in developing Asia was 8.5%. This rapid growth in developing Asia had enormous impacts on the commodity market because these countries, particularly China (Figure 6.2), were passing through a development stage which is much more commodity-intensive than the dematerialising OECD economies (Radetzki, 2006). Demand acceleration in the early 2000s took commodity suppliers by surprise, leading to supply shortage which drove the increase in prices. The boom was briefly interrupted by the Global Financial Crisis in 2008, which dropped commodity demand in developed countries but not in China and India (Figure 6.2). Supported by the consistently growing commodity demand in China and India, commodity prices recovered quickly, and by 2010 they have climbed back to the pre-crisis level. The price hike continued until 2011 when it reached its peak.

The 2000s commodity boom brought another episode of natural resources windfall to Indonesia, but this time instead of oil, it was driven by coal and palm oil (Figure 6.1). These commodities were not a significant part of the country's export mix prior to the boom. Each of them contributed to less than one per cent of Indonesia's merchandise exports in 1990. By 2011, coal already made up 13.5 per cent of Indonesia merchandise export and palm oil made up 10 per cent, while the total merchandise export value has increased nearly eightfold (in nominal US dollar).

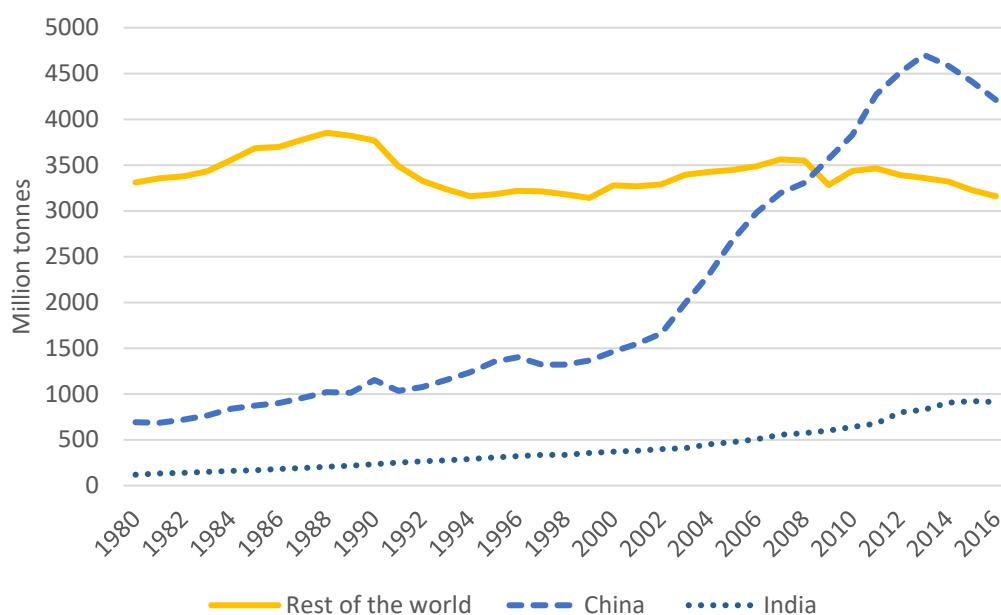


Figure 6.2. Coal consumption of China, India, and the rest of the world (in million tonnes)

Source: International Energy Statistics data, U.S. Energy Information Administration data (2019).

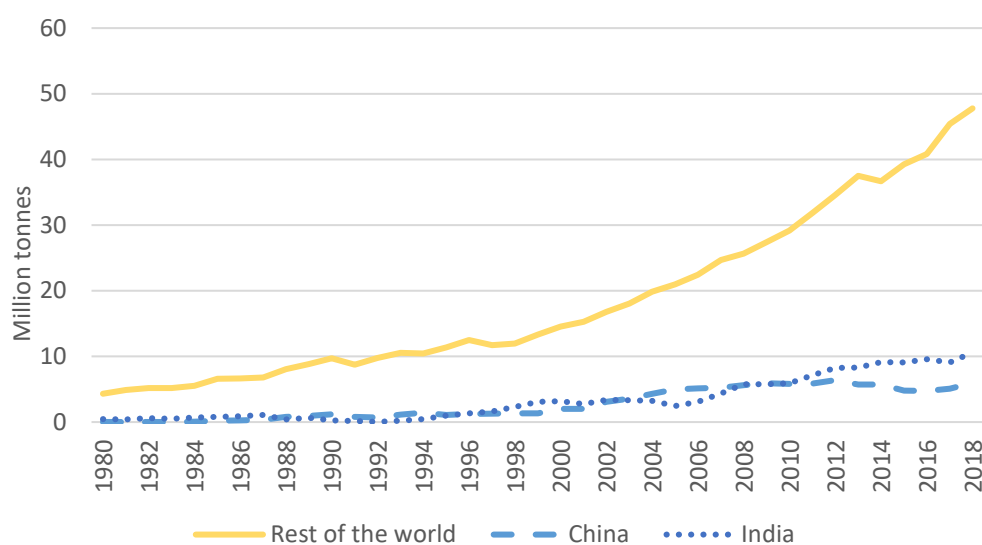


Figure 6.3. Palm oil consumption of China, India, and the rest of the world (in million tonnes)

Source: Global Agriculture Information Network data, U.S. Department of Agriculture (2019).

Although both palm oil plantation and coal mines have existed in Indonesia since the Dutch colonial era, their rapid expansion is relatively recent. This is the result of a combination of the recent increase in global demand for these and the changes in Indonesia's economic and political system. During the 1970s oil boom, coal and palm oil were simply not as profitable as oil. In real (USD) terms, oil price increased by more than tenfold between 1970 and 1982. By comparison, the coal price

barely doubled, and palm oil price dropped by nearly half of its original price in real terms during the same period (Figure 6.4). In contrast, during the 2000s commodity boom, all three commodities experienced a similar level of price increase. The increase in coal price was even higher than in oil price (Figure 6.5). This means coal and palm oil production are comparatively more attractive in the 2000s commodity boom than in the 1970s oil boom.

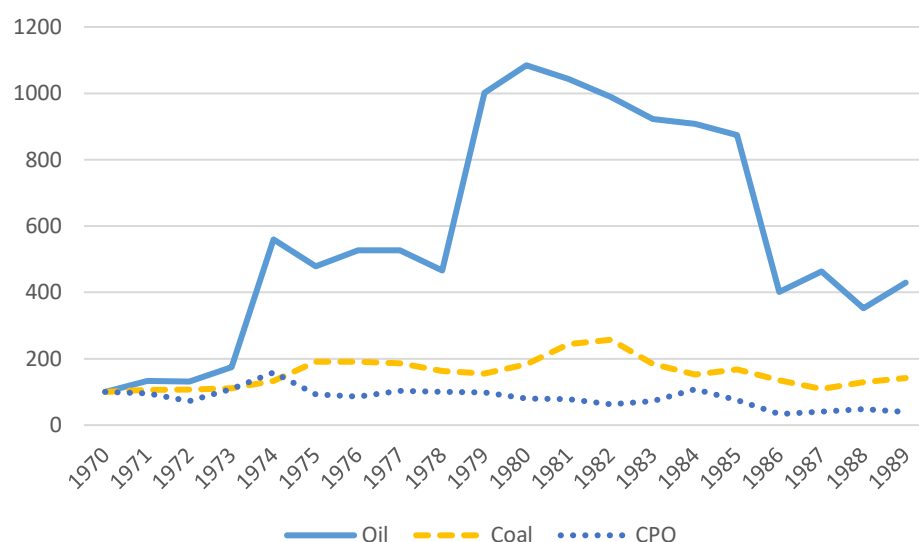


Figure 6.4. Indices of Oil, Coal, and CPO prices in real 2010 USD (1970=100) during the 1970s oil boom

Source: Author's calculation based on World Bank (2019) commodity price data. Notes: 2010 USD value is based on manufacturing unit value index constructed by the World Bank

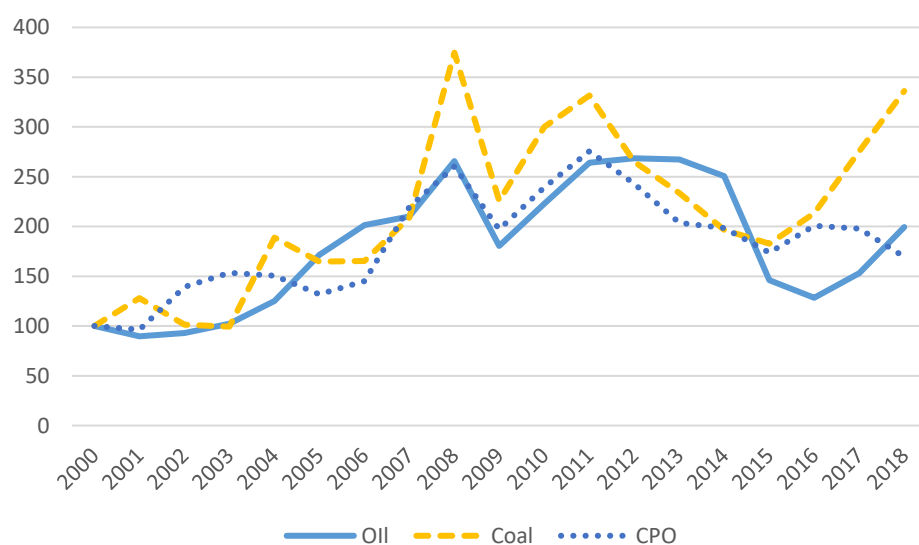


Figure 6.5. Indices of Oil, Coal, and CPO prices in real 2010 USD (2000=100) during the 2000s commodity boom

Source: Author's calculation based on World Bank commodity price data. Notes: 2010 USD value is based on manufacturing unit value index constructed by the World Bank

Domestically, this period marked a transformation in Indonesia's economic and political system. Sharp currency depreciation, as well as commodities and market liberalisation after the 1997-98 Asian Financial Crisis (AFC), provided incentives for Indonesia's commodity producer to assert their comparative advantage in natural resources and cash crops (Rada, Buccola, & Fuglie, 2011; Rada & Regmi, 2010). The incentives are even stronger when combined with the already increasing global commodity prices. In agriculture, the trade liberalising process further steered the growth away from domestic-oriented food crops toward export-oriented crops, such as palm oil (Rada et al., 2011).

Politically, the period marked a sudden transformation from a highly centralised country towards a much more decentralised system of government. This has facilitated rapid growth in oil palm plantations, but not necessarily in coal mines. Firstly, decentralisation brought a new revenue-sharing agreement between the central and regional government. This change means revenues from natural resources were to be shared between levels of government. Revenue sharing laws covered forestry, mining, fisheries, and oil and gas, but not palm oil or other estate crops. This omission supported the palm oil industry as they can get easier access to permit from district heads who were not required to share revenues with the central government (Barr, Resosudarmo, Dermawan, & Setiono, 2006; Naylor, Higgins, Edwards, & Falcon, 2019).

Furthermore, decentralisation also brought a proliferation in the number of districts (district splitting) and ambiguous authority over land titling (Barr et al., 2006). This led to weak institutional capacity in new districts and weaker enforcement of land and environmental law. These factors facilitated deforestation and conversion of forest into oil palm plantations. As a result, oil palm plantations spread across the country, not only in traditional areas such as Sumatra and Kalimantan but also in other areas (Figure 6.6). While both plantation companies and smallholder plantation were involved in the conversion process, smallholder plantations grew more rapidly during the

period (Figure 6.6). This is partly because it is harder to enforce land and environmental law to the numerous and scattered smallholder plantations than to big plantation companies (Naylor et al., 2019).

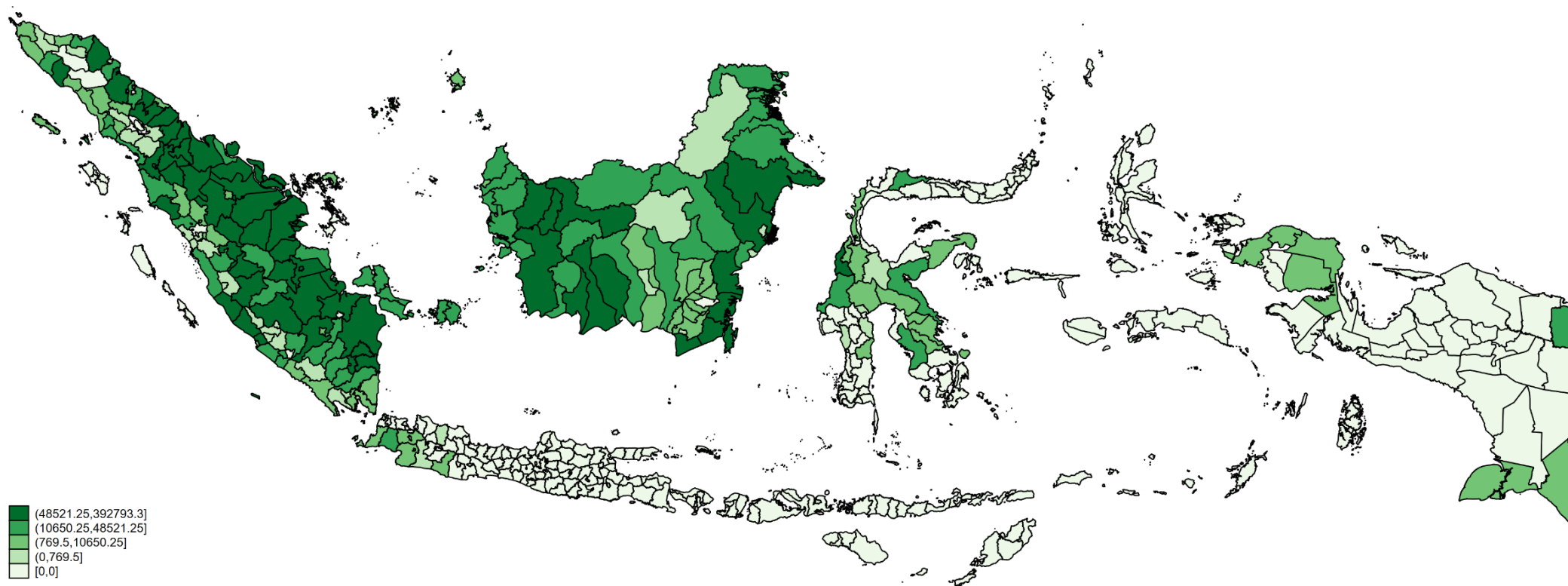


Figure 6.6. District palm oil size averaged for the whole period between 2007 and 2013 (in hectares)

Source: Author's calculation based on Directorate General of Estate Crops (2017) data

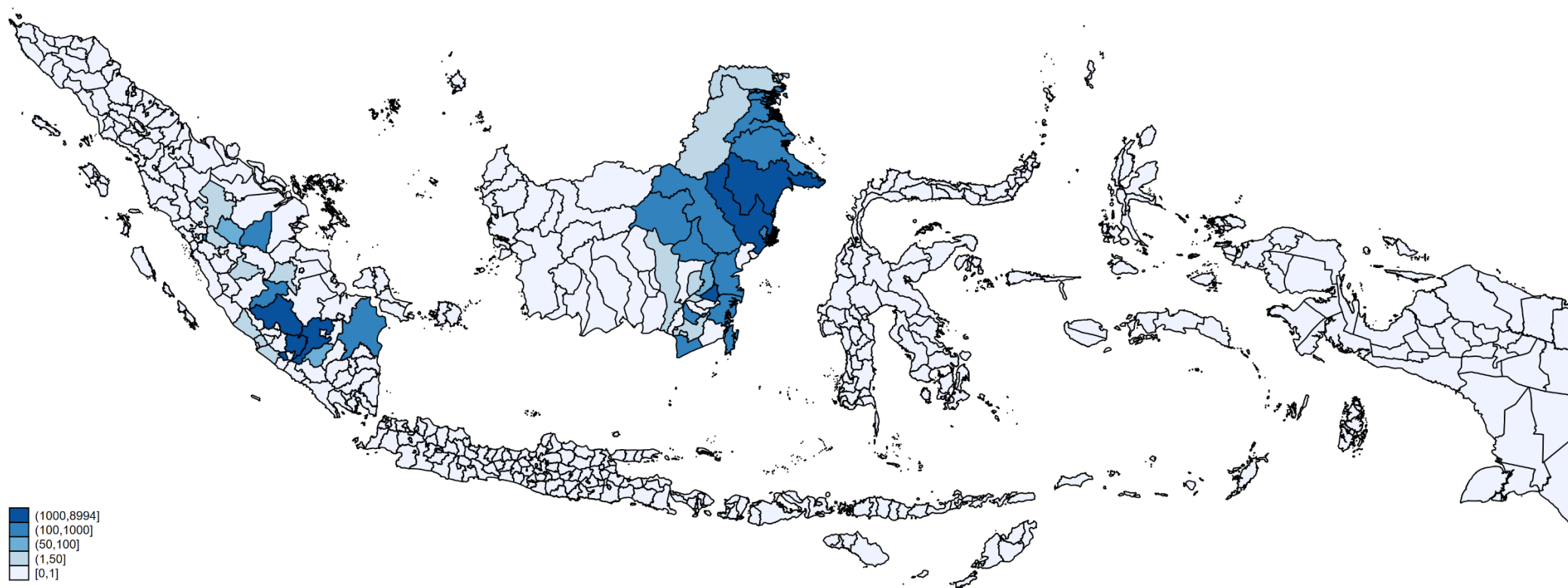


Figure 6.7. District coal reserve in 2013 (in million tonnes)

Source: Author's calculation based on GeorIMA (2019a) data from the Ministry of Energy and Mineral Resources

In contrast, coal mining operations do not receive such special treatment and instead have to face uncertainties due to a lack of clear guidance regarding the distribution of revenue to the local government (B.P. Resosudarmo, 2009). Moreover, the industry was subjected to greater regulatory control by provincial and district government (Lucarelli, 2010). In several regions, the regional government also issued a variety of taxes and levies on mining companies (B.P. Resosudarmo, 2009). As a result, nearly all of the increase in coal production during the early part of the boom came from mining companies which were established during the late 1980s under Coal Contract of Work (CCOW). These contracts involved direct agreements between the government and locally registered foreign companies, which were given special law status (“*lex specialis*”). This status exempts their holder from changes in Indonesian general law, such as revisions to the tax code, investment laws, and land use laws which occur after the CCOW was signed (Lucarelli, 2010).³² This condition lasted at least until 2009 when the New Mining Law came into effect.³³

The new mining law clarifies some of the uncertainties in the mining licenses and grants equal status to foreign and domestic investors. The new law also gave district and municipal governments the authority to issue permits for mid-sized mines. Similar to the problem with oil palm plantation, empowered local districts lack the capacity to enforce environmental law. This, combined with a boom in global commodity prices, resulted in a subsequent explosion of mining permits across Indonesia, many of which have operated in violation of permit laws. According to the International Energy Agency (2014), an estimated 74 million tons of coal were extracted illegally from small mining operations in Indonesia in 2013. Against this background, coal mining operations managed to thrive during the period (Figure 6.7 & Figure 6.9). Indonesia became a major coal exporter since 2004, vying to be the biggest coal exporter in the world with Australia.

³² The contracts have divestment obligation clause which requires the companies to sell a minimum of 51 percent ownership of the companies to domestic entities by the tenth year after they started commercial production. This process happened between 1999 and 2005 for these companies.

³³ UU No.4/2009 about Mineral and coal mining

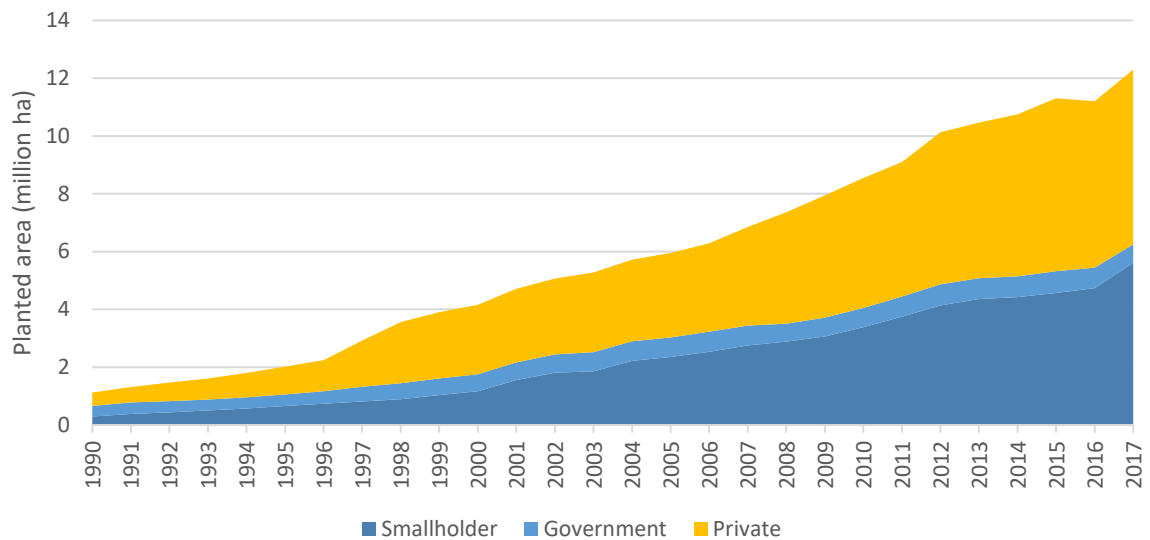


Figure 6.8. Oil palm planted area by producer classification, 1990-2016

Source: Directorate General of Estate Crops (2017). Notes: the classification is based on legal status. Private plantations are registered plantation companies, while smallholders are plantations with no legal status or owned by plantation families.

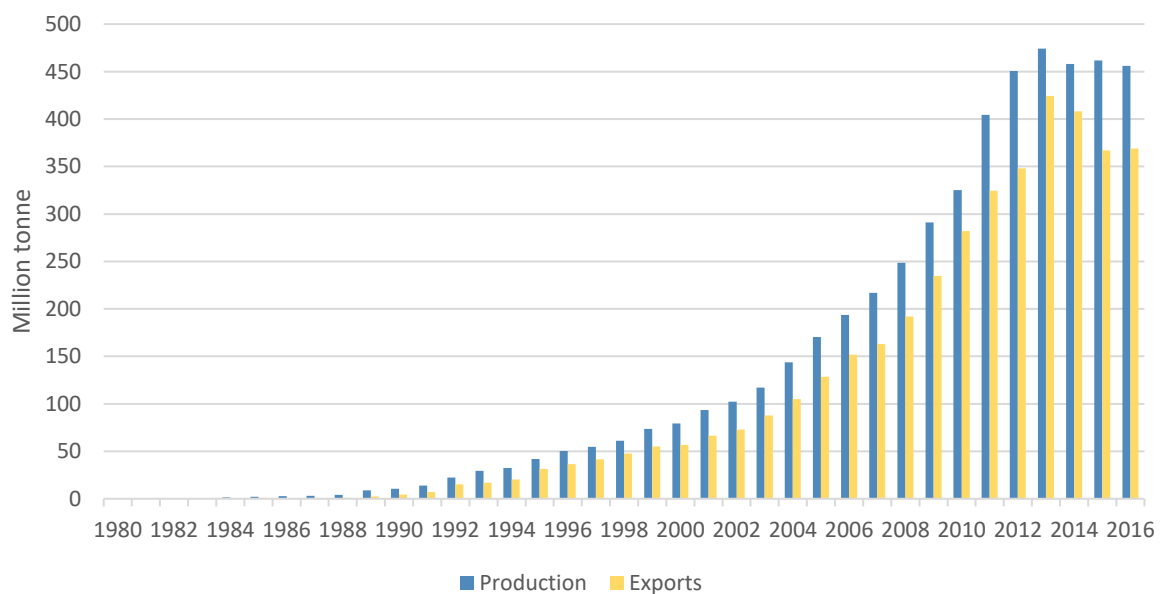


Figure 6.9. Indonesia coal production and export volume (1980-2016)

Source: International Energy Statistics data, U.S. Energy Information Administration data (2019).

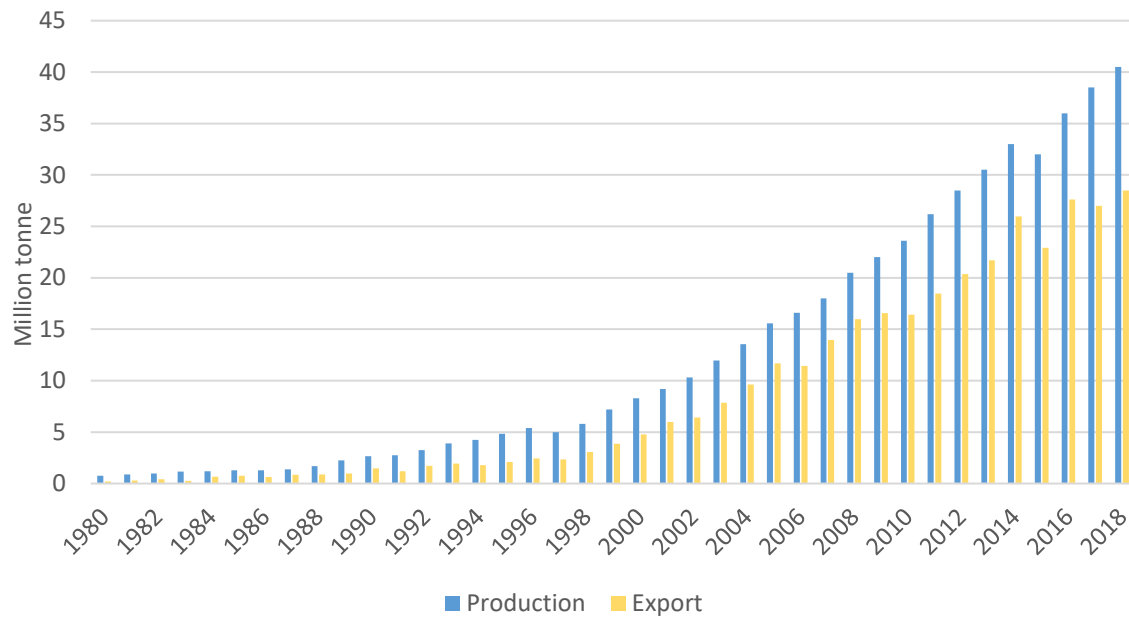


Figure 6.10. Indonesia palm oil production and export volume (1980-2018)

Source: Global Agriculture Information Network data, U.S. Department of Agriculture (2019).

6.4. Method and Data

I test whether the price of two commodities, palm oil and coal, affect poverty and welfare outcomes disproportionately in districts which have the means to produce these commodities (oil palm plantation and reserve of coal). The model is a panel fixed effect model with two variables of interest: the interaction between district coal exposure and international coal price, and the interaction between district palm oil exposure and international palm oil price. I use seven years of data in my analysis, from 2007 to 2013, which covers most of the 2000s global commodity boom.

I use 2007 as the first observation period because some of the required data are available at the district level only start from this year. Consequently, I use the 2007 district configuration for the whole observation period. This decision is important to note because the district administrative boundaries changed a lot during the period. Since the *Reformasi* in 1998, there has been a general trend toward the proliferation of new districts which breaks the initially bigger districts. I merge districts that have split after 2007 back into their original administrative border in 2007. This merging process applies to all relevant data that is used in this study.

My empirical strategy uses cross-sectional variation based on commodity distribution across different districts, similar to Dube and Vargas (2013) for the case of Colombia. This strategy utilises the fact that each district has different exposure to each commodity, based on the capability of the district to produce the commodity. A district with a large coal reserve can benefit more from an increase in international coal price compared to a district with little or no coal reserve. Similarly, districts with large oil palm plantations can also benefit more from an increase in international palm oil price compared to districts that do not.

District exposure to commodities can certainly change, for example with the discovery (or depletion) of coal reserve and expansion of oil palm plantation. However, since the focus of this study is on the effect of international price, I keep the exposure level to be time-invariant and set at the earliest available period. This is done to minimise the feedback effect of production changes caused by price fluctuations. The time-invariant district exposure variables are then interacted with the annual average international price of each commodity. By doing so, annual price fluctuations at the global level affect each district differently based on how exposed the district is to the commodity.

The coal variable is the subsoil reserve of coal in the district in 2013, in log form. Data for district-level coal reserve is drawn from GeoRIMA (Geological Resources of Indonesia Mobile Application), an android-based mobile application developed by the Ministry of Energy and Mineral Resources (Centre for Mineral Coal and Geothermal Resources, 2019b). GeoRIMA is the only publicly available data for coal and mineral reserves at the district level in Indonesia. To my knowledge, this study is the first study to use this application for the purpose of measuring the welfare impacts of natural resources. As a mobile application, GeoRIMA is relatively easy to access, but its data have to be extracted manually. It includes data of potential reserves of minerals, coal and geothermal at the district and provincial level. The application only provides data from 2013 to 2016, so the pre-boom coal reserve data is not available. This can be problematic because it is possible that the search for a new reserve is a response to demand boom and record-high prices in the preceding period. Another

alternative is to use district coal production because coal production is the actual number a district can gain from selling coal. However, coal production data is collected at the firm level, not the district level, and there are cases where a firm has mining sites in multiple districts. While it has its weaknesses, the 2013 district coal reserve is the best available data to capture a district coal exposure.

The palm oil variable is the size of oil palm plantation in the district, also in log form. Data of district oil palm plantation area come from Tree Crop Statistics of Indonesia for Oil Palm, produced by the Directorate General of Estate Crops in the Department of Agriculture and Indonesia's central statistics agency, Badan Pusat Statistik (BPS). This data are available through the World Bank's Indonesia Database for Economic and Policy Research (DAPOER) in their main databank. Unlike coal, palm oil plantation size data is available at the beginning of the observation period (2007). Therefore, the expansion effect of palm oil plantation from the demand boom should be minimal. While data before 2007 are available, the district administration configuration that I use is based on the 2007 configuration, so it is impossible to go earlier than 2007. One possible concern for this variable is the factors that correlate with poverty might also correlate with the decision to open a plantation. These factors might include infrastructure, institutions, history and other unobservable. However, most of those factors should be accounted for by district fixed effects.

Time variations come from annual average prices of each commodity. I obtain price data from World Bank Commodities Price database and use the simple average if there is more than one price for a commodity. The price of coal and palm oil, like the price of any other commodity, is determined by both supply and demand factors. As a major producer,³⁴ changes in Indonesia's output of these commodities can affect international prices, which raise the concern that prices might be endogenous. However, in the case of the 2000s commodity boom, the most important driver for the record high international prices was China's rapid economic growth. Indonesia exports 80% of its

³⁴ In 2018, Indonesia was the second biggest coal exporter and the biggest palm oil exporter. The country had 17 per cent share of global coal exports, and 54 per cent share of global palm oil exports.

coal³⁵ and 85% of its palm oil, which shows that the demand factor is mainly exogenous to the country. Reverse causality is also not a major concern since there is no reason to believe that poverty reduction in a district can affect the international price of coal and palm oil. While the factors that correlate poverty can also affect production expansion in both commodities, it is unlikely that those factors can affect the international price. Moreover, the unit of observation in this study is the district level, and it is unlikely for a district to be able to affect international prices.

For both commodities, I use nominal international prices converted to nominal rupiah value, in log form. While the actual prices that farmers and miners face differ from international prices, local prices do move in parallel with international prices. In the case of palm oil, the fresh fruit bunch (FFB) benchmark prices received by farmers are determined using a formula at the provincial level at least once a month by a committee set by the governor. The formula is based on the actual export price of palm oil received by a local CPO manufacturer, multiplied by a constant “K” index. The index is a proportion of how much the farmer should get from the company export price. Like the FFB price, the K index is also determined at least once a month by the governor’s committee.³⁶ This mechanism is regulated through the Minister of Agriculture regulation, which is updated every few years. During the study period, there were two ministerial regulations³⁷, and they use the same formula to determine the FFB price. This formula means while there can be variations between provinces in the price that farmers receive, the price is always proportional to the international price.

Likewise, the coal benchmark price is also regulated and determined using a formula at least once a month. The benchmark price is determined by the director-general of mineral and coal at the national level. The formula is not as transparent as for CPO, but according to ministerial regulation,³⁸

³⁵ Ministry of Energy and Mineral Resources (ESDM).

³⁶ Price also varies based on the age of the oil palm tree to reflect the oil content of the fruit. This means FFB price per kg will increase as the oil palm tree gets older, up to the age of ten to twenty-year-old when the oil yield peaked, and then decline gradually.

³⁷ Permentan No.395/Kpts/OT.140/11/2005 and Permentan No.17/Permentan/OT.140/2/2010

³⁸ Permen ESDM No.17/2010 and Perdirjen Minerba No.515.K/32/DJB/2011

it is based on market mechanism and international prices. Therefore, it is reasonable to use the international coal price in the model.

The panel fixed effect model is as follows:

$$Y_{kpt} = \alpha_k + \beta_t + \delta_p \beta_t + (Coal_{kp} \times CP_t)\theta + (Palm_{kp} \times PP_t)\rho + X_{kpt}\varphi + \varepsilon_{kpt} \quad (1)$$

Where $Coal_{kp}$ is the size of coal reserve of district k, island p (log form, time-invariant). CP_t is the average global price of coal in year t (converted to Rupiah, in log). Similarly, $Palm_{kp}$ is the size of palm oil plantation in district k, island p (log of hectares, time-invariant) and PP_t is the average global price of crude palm oil in year t (converted to Rupiah, in log). α_k are district-level fixed effects; β_t are year fixed effects; $X_{kpt}\varphi$ are time-varying controls, which includes literacy rate, employment share in agriculture and manufacturing, and access to electricity, sanitation, and clean water.

$\delta_p \beta_t$ are island-year fixed effects in Indonesia's six major islands (Sumatra, Java, Kalimantan, Sulawesi, Eastern Indonesia and Papua). These account for some potential omitted variables since commodities may be concentrated in particular regions, and other regional factors such as history and remoteness of the region. For example, Sumatra and Kalimantan soil characteristics are more suitable for palm oil than other regions and are historically the first region where oil palm was cultivated in Indonesia. Reflecting these characteristics, Sumatra and Kalimantan produced 97 per cent of Indonesia's palm oil³⁹ in 2007.

Y_{kpt} is the outcome of interest in district k, island p, in year t. My primary outcomes are district poverty rate, average monthly per capita household expenditure, and average monthly wage in the district. I also include several other output variables as extensions to the model to help explain the main results. The district poverty rate is the share of district population living below an expenditure-based poverty line, roughly equal to \$25 US dollar per person per month. District poverty rates and average household expenditures are estimated from the consumption module of BPS' National

³⁹ Secretariat of Directorate General of Estates (Ditjen Perkebunan) Indonesia, 2007

Socioeconomic Survey (SUSENAS), both taken from DAPOER. SUSENAS is representative at the district level since 1993. One limitation with the household expenditure data, is that the 2008 data in DAPOER are missing, so this year is excluded from the regression for the model which has it as the outcome variable.⁴⁰ Average monthly wage is the average wage of paid employed workers in the district in the last month of the survey. This calculation excludes self-employed workers, non-paid workers and employers. It is calculated from BPS' national labour market survey (SAKERNAS), which is representative at the district level since 2007. The average wage can be disaggregated based on professions and sectors. In this study, I use the profession-based disaggregated average wage as outcome variables as an extension to the main model. Wage level at the 25th and 75th percentile in the district is also added as an outcome in the extension to show the estimated impact on wage inequality.

The last outcome in the model is the district inflation rate. However, BPS does not collect inflation data at the district level. They calculate the consumer price index in 71 cities and districts all over Indonesia and construct the inflation rate based on these cities and districts. For districts that are not part of the 71 cities and districts where consumer price data are collected, I use the data from the closest district based on physical distance (in Km). This method has some weaknesses, particularly because closer physical distance does not always equate to better connectivity. If two neighbouring districts are separated by mountain or river, and not connected directly by road, consumer price in these districts can be substantially different from each other. This factor cannot be accounted for using the physical distance method used in this study. Nevertheless, without better data quality, this is the best approximation for price level changes that can be used in this study.

Based on the model specification, coefficient θ captures the differential effect of coal price on the district level outcome in districts producing more coal and ρ measures the differential effect of palm oil price on the district level outcome in districts cultivating more palm oil. However, it is important

⁴⁰ The results with 2008 data included (Appendix 2.4., p.38) are consistent with the main results. I extract the data directly from SUSENAS and construct the per capita household expenditure with the same method as DAPOER. The.

to remember that the interpretation of both of these coefficients depends on the size of the commodity exposure (i.e. the size of coal reserve or oil palm plantation) in the district.

6.5. Results

The fixed-effect panel regression results are presented in Table 6.1 and Table 6.2, where Table 6.1 presents results without any control variable, and Table 6.2 includes several time-varying controls. The addition of control variables only causes small changes in the magnitude of the coefficients and does not change the significance level or the signs of the results.

Table 6.1. The effect of coal and palm oil prices on welfare (Panel Fixed-effect OLS, no control variable)

Dependent variables	(1) Poverty rate (%)	(2) Log real Household expenditure ¹	(3) Inflation (%) ²	(4) Log total employment	(5) Log average real wage	(6) Log of 25th percentile real wage	(7) Log of 75th percentile real wage
Exposure to CPO x log CPO price	-0.518*** (0.114)	0.004 (0.006)	0.094 (0.130)	0.014* (0.008)	0.007 (0.007)	0.016* (0.009)	0.011* (0.007)
Exposure to coal x log coal price	-0.243*** (0.084)	0.019** (0.009)	0.235* (0.121)	0.001 (0.007)	0.012* (0.006)	0.014 (0.009)	0.010 (0.006)
Observations	3130	2658	2673	3130	3105	3100	3105
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample period	2007-2013	2007-2013	2008-2013	2007-2013	2007-2013	2007-2013	2007-2013

¹Excludes 2008 data; ²Excludes 2007 data

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

Table 6.2. The effect of coal and palm oil prices on welfare (Panel Fixed-effect OLS, with control variables)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile wage	Log of 75th percentile wage
Exposure to CPO x log CPO price	-0.424*** (0.112)	0.001 (0.006)	0.099 (0.132)	0.016** (0.008)	0.009 (0.007)	0.018** (0.009)	0.015** (0.007)
Exposure to coal x log coal price	-0.264*** (0.083)	0.020** (0.010)	0.245** (0.120)	0.002 (0.007)	0.012* (0.006)	0.013 (0.010)	0.010 (0.007)
Observations	3119	2652	2666	3119	3094	3089	3094
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	450	449	446	450	449	449	449
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2008-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing (except for total employment), household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

Column (1) of Table 6.1 and Table 6.2 show that the price of coal and palm oil both have a significant district poverty alleviation effect. The effects of both commodities are significant at the one per cent level. However, interpreting the coefficient is not a straightforward process because the interpretation depends on the exposure level, (i.e. the size of palm oil plantation or coal reserve in the district). To gauge the magnitude of the coefficients in Table 6.2, consider the increase in CPO price from 2007 to 2008 when the international CPO price increase by 0.25 log points (from USD780 per metric ton to USD948 per metric ton). For the average palm oil district, in which the palm oil plantation size is 36 thousand hectares, the coefficient (-0.424) implies that the price increase reduced the poverty rate by 1.11 percentage point relative to districts with no palm oil plantation. Similarly, consider the coal price increase from 2007 to 2008 by 0.71 log points (from USD64 per ton to USD123 per ton). In the average coal-producing district, with an average reserve of 826 million metric ton, this price increase translates into 1.26 percentage point decrease in poverty rate compared to a district without coal. Since the national poverty rate only declined by 0.87 percentage point (from 12.52 to 11.65 per cent) between 2007 and 2008, the estimated additional poverty rate decline in districts which have coal mine or oil palm plantation is relatively large.

The results for household expenditure, inflation rate and average district wage are only statistically significant for coal. To understand the magnitude of the effect, again consider the coal price increase from 2007 to 2008 and the average coal district with coal reserve of 826 million metric ton. The price increase will increase household expenditure by 9.5%, increase inflation by 1.17 percentage points, and increase the average district wage by 5.7% compared to non-coal districts. Considering the coal price approximately doubled from 2007 to 2008, the elasticities of these outcome variables are inelastic. In contrast, the estimated impact on total employment is only significant for palm oil. In an average palm oil district, the palm oil price district increases total employment by 4.2% compared to non-palm oil districts.

These results highlight the difference between coal and palm oil in how the gain from the commodity demand boom is distributed. While the poverty impacts are significant in both commodities, the impact on per capita household expenditure is only significant in coal. It implies the expenditure impact of palm oil price is concentrated in the lower end of the income distribution. In other words, an increase in palm oil price benefits the poor disproportionately as compared to coal. Furthermore, the positive and significant employment impact in palm oil shows its relatively labour-intensive production process. If the newly created jobs pay relatively lower wage than the prevailing average wage, the average wage need not increase and can even decline. This is not necessarily a bad outcome, especially if the oil palm sector employs previously unemployed people. This reasoning is also supported by the wage distribution impact results. Conversely, coal does not generate much employment but increases the district average household expenditure.

Inflation is another indicator through which commodity prices may affect welfare. The results indicate that it is positively affected by coal price, but not by palm oil price. It is important to note that these results are in terms of comparison with non-resource-producing districts; that is, there is no significant difference in inflation between coal or palm oil districts with other districts. Taken together with the poverty impact, the results provide no evidence for the initial concern that

poverty might increase if real income falls as consumer price rise faster than income.⁴¹ What the results show instead is that, in the case of coal, real household expenditure is still positively affected by coal price despite it also causing higher inflation rate. In the case of palm oil, price does not significantly affect either real household expenditure nor consumer prices, which also disprove the earlier concerns.

As expected, the estimated impacts on wage distribution are only significant in the case of palm oil. The fact that palm oil price only significantly affects wage at the lower (25th percentile) and upper (75th percentile) end of the distributions but not the overall average wage might be related with the kind of jobs and sectors that are directly affected by the sector. In contrast, coal price significantly affects average wage, but not its distribution.

To explore the detailed impact on employment and wages, Figure 6.3, Table 6.4, and Table 6.5 present the results of regressions where the outcomes are employment and the average real wage of each sector and profession in the district. Table 6.3 and Table 6.4 suggest that the employment and average real wage of most sectors are not significantly affected by either coal or palm oil price, with a few exceptions. Unsurprisingly, palm oil price appears to positively affect employment in agriculture and the social sector (Table 6.3). The sector also significantly increases the wage in finance and decreases the wage in the social sector⁴² (Table 6.4), both in real terms. Results on profession-based wage (Table 6.5) show that palm oil price has a positive and significant impact on the average real wage in agriculture, animal husbandry, and forestry, and production and related worker, transport equipment operators, and labourers. Again, these results are expected since palm oil plantations directly employ workers in these types of jobs.

The palm oil sector is a relatively labour-intensive sector and directly employs agricultural workers and labourers. Therefore, it is reasonable to conclude that the significant impact of a palm oil price

⁴¹ Results for the estimated effect on nominal wages are in Appendix B (p.146)

⁴² The finance sector includes financial institutions, real estates, rental businesses and corporate services, while the social sector includes the government, education, healthcare, and entertainment.

on wages at the 25th percentile is related with the direct employment effect on agricultural workers and labourers in the palm oil sector. Taken together with the employment results, the positive and significant effect on wages of directly related jobs suggests that palm oil price affect wages through increased labour demand. Furthermore, the spillover effect on the wage of other job types is minimal.

In comparison, coal price positively affects employment in the mining sector and the transportation sector, while negatively affects manufacturing employment (Table 6.3). The impact on manufacturing employment can be viewed as an indication of a possible local Dutch disease, but it must be interpreted carefully since manufacturing jobs are not generally located in the same districts as mining. In terms of wage, coal price does not significantly affect the real wage in any sector, but positively affects clerical profession wages.

Table 6.3. The effect of coal and palm oil prices on district employment, by sectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variables	Agriculture	Mining	Manufacturing	Utility	Construction	Trade, Hotel & Restaurant	Transport and Communication	Finance	Social
Exposure to CPO x log CPO price	0.050** (0.020)	-0.045 (0.087)	0.033 (0.037)	-0.139 (0.103)	0.029 (0.030)	0.030 (0.023)	-0.010 (0.027)	0.006 (0.075)	0.047** (0.023)
Exposure to coal x log coal price	0.031 (0.020)	0.215** (0.087)	-0.190* (0.109)	0.076 (0.118)	0.081 (0.070)	0.055 (0.037)	0.087* (0.046)	0.049 (0.140)	0.024 (0.038)
Observations	3119	3119	3119	3119	3119	3119	3119	3119	3119
District & island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	450	450	450	450	450	450	450	450	450
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013
Controls: Literacy rate, household access to electricity, sanitation, and clean water									

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

Table 6.4. The effect of coal and palm oil prices on district real wage by sectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variables	Agriculture	Mining	Manufacturing	Utility	Construction	Trade, Hotel & Restaurant	Transport and Communication	Finance	Social
Exposure to CPO x log CPO price	0.018* (0.011)	-0.004 (0.023)	0.017 (0.016)	0.006 (0.030)	0.012 (0.010)	-0.006 (0.010)	0.001 (0.011)	0.039* (0.021)	-0.011 (0.007)
Exposure to coal x log coal price	0.006 (0.010)	-0.015 (0.015)	0.006 (0.016)	0.068 (0.044)	-0.006 (0.017)	0.011 (0.012)	0.013 (0.012)	0.041 (0.030)	0.001 (0.007)
Observations	3090	2699	3050	2164	3074	3078	3073	2940	3094
District & island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	449	445	446	444	448	449	448	447	449
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing, household access to electricity, sanitation, and clean water									

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. Regression excludes districts which have no worker in the specified sector.

Table 6.5. The effect of coal and palm oil prices on district average wages, by type of profession

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variables	Professional, technical, and related	Administrative and managerial	Clerical and related	Sales	Services	Agriculture, animal husbandry, and forestry	Production worker, transport operators and labourers	Others
Exposure to CPO x log CPO price	-0.003 (0.012)	0.011 (0.030)	-0.003 (0.010)	-0.013 (0.011)	0.024 (0.016)	0.020* (0.011)	0.016* (0.008)	-0.027* (0.015)
Exposure to coal x log coal price	-0.008 (0.025)	-0.027 (0.025)	0.029*** (0.010)	-0.005 (0.016)	0.001 (0.017)	0.012 (0.012)	0.002 (0.007)	-0.000 (0.022)
Observations	2986	2871	2986	2980	2966	2991	2988	2738
District & island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	433	433	433	433	433	433	433	430
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing, household access to electricity, sanitation, and clean water								

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. Regression excludes districts which have no worker in the specified profession. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level.

6.6. Robustness checks and Extensions

There are several robustness checks and extensions that I apply to the model. The first one is to include the lag of the coal and palm oil interaction variable to the model. This check is to test if there is any lagged effect of prices on the welfare outcomes. It would be expected that there is a lagged response in the outcome variables, such as poverty, household expenditure, and wages because they need time to adjust after the exogenous commodity prices change. The model specification is similar to the main model, with the only difference is it includes three years lag value of the coal and palm oil variable in the model. Equation 2 is the model specification, and the results are presented in Table 6.6.

$$Y_{kpt} = \alpha_k + \beta_t + \delta_p t + (Palm_{kp} \times PP_t)\rho_0 + (Palm_{kp} \times PP_{t-1})\rho_1 + \dots + (Palm_{kp} \times PP_{t-3})\rho_3 + (Coal_{kp} \times CP_t)\theta_0 + (Coal_{kp} \times CP_{t-1})\theta_1 + \dots + (Coal_{kp} \times CP_{t-3})\theta_3 + X_{kpt}\varphi + \varepsilon_{kpt} \quad (2)$$

Where PP_{t-1} to PP_{t-3} are the lag value of palm oil price from one year to three years, and CP_{t-1} to CP_{t-3} are the lag value of coal price CP_t .

Results in Table 6.6 are generally consistent with the main results in Table 6.2. For poverty, palm oil price appears to affect poverty for three years before the effect subsides. The cumulative effect is, therefore, larger than suggested in the main model. Coal price, on the other hand, only significantly affect poverty in the same year, with no significant coefficient for the lagged variables. The employment effect results are only significant for palm oil, and only in its second and third-year lag, suggesting the need for an adjustment period before palm oil price can affect total employment. The other results, including household expenditure and inflation, are less precise, with no significant effect in the same year. The results for the average wage are consistent with the main results, where palm oil price does not significantly affect average district wage while coal price has a positive and significant impact. Interestingly, although the cumulative effect is still positive, coal seems to have a negative lag effect. The impacts on wage distributions also confirm the main results, where palm oil

has positive and significant impacts on wage at the 25th and 75th percentile. Coal, on the contrary, have a negative cumulative effect on wage both at the 25th and 75th percentile.

Table 6.6. Robustness check (1): lag of palm oil and coal interaction variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile real wage	Log of 75th percentile real wage
Exposure to CPO x log CPO price	-0.305** (0.143)	0.007 (0.018)	0.465 (0.289)	-0.006 (0.007)	0.003 (0.009)	0.027** (0.014)	0.019* (0.010)
L1. Exposure to CPO x log CPO price	-0.093 (0.058)	0.006 (0.005)	-0.206* (0.109)	0.001 (0.003)	0.004 (0.005)	-0.002 (0.007)	0.003 (0.005)
L2. Exposure to CPO x log CPO price	-0.170*** (0.059)	-0.005 (0.006)	0.232 (0.193)	-0.008* (0.005)	-0.009 (0.007)	-0.002 (0.009)	-0.002 (0.006)
L3. Exposure to CPO x log CPO price	0.057 (0.066)	-0.003 (0.008)	-0.216 (0.216)	0.011*** (0.004)	0.005 (0.006)	-0.003 (0.009)	-0.003 (0.006)
Exposure to coal x log coal price	-0.291*** (0.084)	0.027 (0.018)	-0.094 (0.237)	0.003 (0.007)	0.013** (0.006)	0.012 (0.009)	0.009 (0.007)
L1. Exposure to coal x log coal price	-0.067 (0.055)	-0.005 (0.004)	-0.115 (0.102)	-0.000 (0.003)	-0.009** (0.004)	-0.002 (0.005)	-0.012*** (0.004)
L2. Exposure to coal x log coal price	-0.028 (0.051)	0.003 (0.004)	-0.166** (0.075)	0.003 (0.004)	-0.001 (0.003)	-0.012** (0.005)	-0.003 (0.003)
L3. Exposure to coal x log coal price	0.023 (0.039)	-0.004 (0.006)	0.134 (0.144)	0.002 (0.003)	-0.002 (0.005)	0.002 (0.006)	-0.000 (0.005)
Observations	3119	2652	2666	3119	3094	3089	3094
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	450	449	449	450	449	449	449
Sample period	2007-2013	2007-2013	2008-2013	2007-2013	2007-2013	2007-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing, household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

Two other specifications are also applied to address time-series related issues, and they are put in the chapter appendix. The first one is with all variables in first-differenced form (Appendix 6.10.6), and the second one is with autoregressive structure (Appendix 6.10.7). These results are also consistent with the main results.

The second robustness check is to include exposure and time-trend interaction as a control variable. By including this variable, the model controls for the effect of a general commodity boom, which occurred throughout the observation period. This check is to address concerns that the estimated effects are the result of a general production expansion period, which may have happened regardless of the international commodity price. The modified model with exposure and time-trend interaction variables is specified in Equation 3.

$$Y_{kpt} = \alpha_k + \beta_t + \delta_p t + (Palm_{kp} \times PP_t)\rho + (Coal_{kp} \times CP_t)\theta + (Palm_{kp} \times TT_t)\gamma_2 + (Coal_{kp} \times TT_t)\gamma_1 + X_{kpt}\varphi + \varepsilon_{kpt} \quad (3)$$

Where TT is the time trend variable, which ranges from 0 to 6 (from 2007 to 2013). The coefficient γ_1 and γ_2 estimate the general boom period effect to districts with exposure to coal or palm oil. The results are presented in Table 6.7.

Results in Table 6.7 are generally consistent with the main results, with the new variables only significant in a few cases. The CPO-time-trend interaction is significant in the results for district poverty rate, while coal-time-trend interaction is significant for the average real wage, as well as the 25th and 75th percentile real wage. Despite the modification, the commodity price effects are still consistent with the main results. Interestingly, the magnitude of the palm oil price effect on poverty is comparatively smaller in this model than the main results.

Table 6.7. Robustness check (2): Exposure and time-trend interaction

Dependent variables	(1) Poverty rate (%)	(2) Log real Household expenditure ¹	(3) Inflation (%) ²	(4) Log total employment	(5) Log average real wage	(6) Log of 25th percentile real wage	(7) Log of 75th percentile real wage
Exposure to CPO x log CPO price	-0.149* (0.086)	0.001 (0.007)	0.140 (0.117)	0.008** (0.003)	0.016** (0.006)	0.032*** (0.008)	0.020*** (0.006)
Exposure to coal x log coal price	-0.286*** (0.072)	0.024* (0.013)	0.238* (0.138)	0.002 (0.006)	0.015** (0.006)	0.017* (0.009)	0.014** (0.007)
Exposure to CPO x time-trend	-0.027*** (0.010)	0.000 (0.000)	-0.003 (0.008)	0.000 (0.000)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)
Exposure to coal x time-trend	-0.004 (0.013)	0.001 (0.001)	-0.001 (0.012)	0.001 (0.001)	-0.002** (0.001)	-0.002* (0.001)	-0.002** (0.001)
Observations	3119	2652	2666	3119	3094	3089	3094
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	450	449	449	450	449	449	449
Sample period	2007-2013	2007-2013	2008-2013	2007-2013	2007-2013	2007-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing, household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

The last robustness check is to aggregate the observation to the province level. This model checks if the commodity price effect is also present at the province level. Since not all districts within a province have coal or palm oil, the province-wide effect might be limited. For this check, I only run regressions for poverty, total employment and average real wages. These estimated outcomes should be able to show if there is any spillover commodity prices impact from districts that have coal or palm oil to the province level.

The aggregation process depends on how the variable is constructed. In the case of poverty, the number of people living under the poverty line in the district is summed with other districts in the same province and then divide it by the province population. The process is similar in the case of total employment, where the total number of people employed in each district is summed with other districts within each province. For province average real wage, the variable is constructed from weighted individual-level labour force data. For the province level palm oil and coal exposure, I use

the total size of palm oil plantation and total coal reserve in the province. The model is specified in Equation 4, and the results are presented in Table 6.8.

$$Y_{ipt} = \alpha_i + \beta_t + \delta_p t + (Coal_{ip} \times CP_t)\theta + (Palm_{ip} \times PP_t)\rho + X_{ipt}\varphi + \varepsilon_{kpt} \quad (4)$$

The specification is exactly the same as the main model, with the only exception being that instead of using subscript k that represents the district, Equation 4 uses subscript i which represents the province. The results in Table 6.8 are different from the other results in that both palm oil and coal prices have no significant effect on poverty, employment or average wage. The results show no evidence for spillover effects for all outcomes from districts with coal or palm oil to the rest of the province. It is possible that these districts are too small compared to the whole province to have province-wide effects. However, the results have to be interpreted carefully since the aggregation process also substantially reduce the observation number to only 224.

Table 6.8. Robustness check (3): panel regression with data aggregated to province level

	(1)	(2)	(3)
Dependent variables	Poverty rate (%)	Log total employment	Log average real wage
Exposure to CPO x log CPO price	-0.243 (0.242)	0.010 (0.009)	-0.001 (0.008)
Exposure to coal x log coal price	0.116 (0.179)	0.006 (0.007)	-0.003 (0.006)
Observations	224	224	224
Province and island fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Provinces	32	32	32
Sample period	2007-2013	2007-2013	2007-2013

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

Based on these three robustness checks, I find that the main results in Table 6.2 are robust to modifications in the specifications. The main results are consistent with the model which include the lags of the coal and palm oil variables. Moreover, the results reveal that palm oil price affects poverty for three years before the effect subsides thus having larger cumulative effect than suggested in the main results. The regression results with time-trend interaction are also consistent

with the main results in terms of the sign of the estimated impacts. This suggests that the price effect is more important than the general boom effect. Lastly, the province-level estimates do not have any statistically significant coefficient. While the estimation is problematic because it uses a substantially smaller sample, it also suggests that the effects of commodity prices are only concentrated in the districts that have those resources.

6.7. Discussion

This section relates the results to the theory and explores several possible explanations for the main findings. In the case of palm oil, the price has a statistically significant negative impact on district poverty rate and a positive impact on employment, but no statistically significant impact on household expenditure, inflation rate, and average wages in districts that produce palm oil. Furthermore, it significantly increases wages in the 25th and 75th percentiles, while also significantly increases the wage of professions that are directly related to the sector, including agricultural workers and labourers. These findings confirm some of the predictions of the theory.

Firstly, a price increase can benefit the poor through the direct mechanism by creating employment and increasing wages. This mechanism is supported by the findings that total employment effect is positive and significant in districts that produce palm oil. This is also confirmed by the positive impact on agricultural workers and labourer wages. However, the average real wage and average real household expenditure are not significantly affected. The first possible explanation is there might be enough people who are looking for jobs in palm oil districts, similar to 'labour surplus' in Lewis (1954) model, that the overall average wage does not need to increase to attract workers from other districts. If this is the case, it is still a good outcome, because commodity price increase creates employment opportunity for people who are otherwise unemployed. Another possible explanation is these newly created jobs employ local residents that used to commute to other districts to work. Since the new jobs are mainly in the low-paying professions (Figure 6.11), the average real wage and average household expenditure do not need to increase significantly. Still, the price boom appears to

disproportionately benefit people in the lower end of the income distribution, as shown by the wage distribution impacts.

Another possible explanation for the limited impact on average household expenditure is the quality of jobs that are created in the palm oil sector. A study by Coxhead and Shrestha (2016) finds that a higher intensity of palm oil productions predicts diminished formal employment, which in turn predicts lower earnings. While I do not find evidence for lower earnings, the informal employment created by the palm oil sectors might partly explain the limited estimated impact on average per capita expenditure and average wage.

Secondly, the indirect mechanism through spillover effect into other sectors appears to be weak. Wages in other sectors are not significantly affected by the palm oil price. The inflation effect of palm oil price also appears to be neutral. Again, this suggests that the number of people looking for jobs in the district is sufficient to fulfil the increased labour demand in the palm oil sector so that other sectors do not need to increase wages to retain or attract workers. This is not surprising considering Indonesia is a lower-middle-income country which has not passed the Lewis turning point during the period. While it is interesting to speculate whether the indirect mechanism, through fiscal or institutional impacts, plays a role in alleviating poverty, there is not enough information to do so.

For coal, an increase in its price has a negative and significant impact on the district poverty rate and positive impacts on local average per capita expenditure, inflation, and the average real wage in districts that have coal reserve. Coal has a positive effect on all other outcomes except for employment and wage distribution. Unlike palm oil, the direct mechanism in the coal sector leads to an increase in overall district average wage without significantly affecting total employment. Employment impact is only positive and significant in the mining sector itself, which does not generate large employment in the first place, and the transportation sector. This significant impact on real wage might be because the kinds of jobs that are created are likely to have wages that are

above the average district wage. The results in Table 6.5 confirm this hypothesis as it shows that coal price only significantly affects the wage of the clerical and related profession. This profession already has an average wage that is higher than the overall average wage nationally, both in 2007 and 2013 (Figure 6.11).

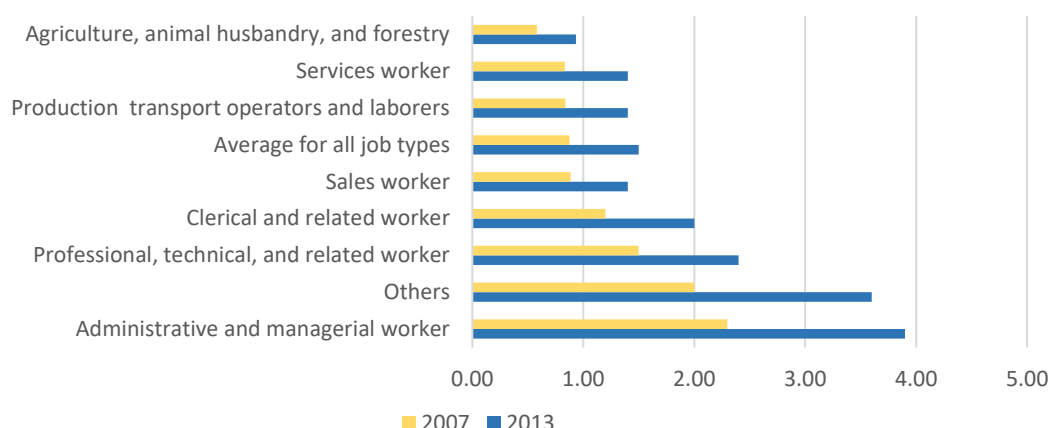


Figure 6.11. The average wage in each job type, all districts between 2007 and 2013 (in million Rupiah)

Source: author's calculation based on SAKERNAS data. Notes: Data is calculated as the average of all district average wage, not at the individual level.

Another possible explanation is the local Dutch disease effect, which suggests that the mining sector increases the district real wage (across all sectors) to attract workers from other tradable sectors in the district, such as manufacturing. This explanation is supported by the evidence that coal price has a negative impact on manufacturing employment. However, there is no evidence that coal price increases the mining sector real wage more than any other sector.

Migration can also partly explain these results. As mentioned, this study only measures the wage and employment impacts, not migration impact. It is possible that an increase in the demand for workers in other professions can be fulfilled by local residents, but not in the clerical and related profession. This leads to an increase in wage in this profession to attract workers from outside the district. Moreover, since the wage in this profession is higher than the overall average wage, this profession probably requires a certain level of education or training, which might not be available

among the local residents. If that is the case, the increase in average per capita household expenditure and average wage may be partly the result of higher than average paid migrants into the district.

It also is important to note that the inflation impact of coal price is positive and significant. This impact, however, does not neutralise or reverse the poverty alleviation impact of the price. This suggests that the poor still benefit from the positive price shock even though the average wage of low paying professions are not significantly affected. This can be the result of new employment opportunities to previously unemployed residents or can also be the results of an indirect mechanism. Coal is a natural resource that is regulated under Indonesia's revenue-sharing arrangement. This means that the local governments of districts that produce coal receive sizeable extra revenue when compared with districts that do not. If they use the extra natural resource revenue from the price increase to improve public service, local residents can benefit indirectly from the sector and help the district in reducing the poverty rate.

There are two caveats to these results. The first caveat is that this study does not attempt to measure the impact on capital owners. Just like any other natural resources, coal and palm oil create a rent on the immobile factors. In the case of coal, the immobile factor is the mine and the area surrounding it, and in the case of palm oil, it is the land that is used as oil palm plantation. In both cases, the owners of the immobile factor should collect the rent from commodity production. This means the owners of these immobile factors should disproportionately be affected by commodity prices. While these impacts are undeniably important, they are not the focus of this study. Data that can measure the outcome for this impact, such as land prices, are also not available at the district level. Instead, this study offers an observation on the impact of commodity prices on labour, the mobile factor.

The second caveat is the possibility of a demand bust following the demand boom. The discussion so far has been focusing on the scenario of a demand boom, a period of record-high prices for coal and

palm oil. The model assumes that the impact of a commodity price decrease is symmetrical to a price increase. Whether this is true or not is an empirical question. Nevertheless, the results suggest that a fall in commodity price by the same size as the increase can reverse the poverty alleviation impact of the boom.

How do the findings of this study compare with other similar studies? As discussed, the findings of previous studies on the sub-national poverty impact of commodity production have been mixed. A review of fifteen sub-national panel studies on the impact of the extractive sector on poverty by Gamu et al. (2015) discovers that eight studies find positive impacts, four studies find negative impacts, and three studies find mixed impacts. These studies use various methods and country cases and are not directly comparable to this study. However, the findings in this study are unique because it focuses on the impact of international prices. This study is also different because it provides evidence that while mining and agricultural commodity both have poverty alleviation impact, they work through different mechanisms.

6.8. Conclusion and policy implications

This study estimates the welfare impact of coal and palm oil prices on districts that produce them in Indonesia. To do so, I exploit the within-country cross-sectional variation in exposure to each commodity, interacted with exogenous changes in global commodity prices. Each district is affected by coal and palm oil prices at a different level depending on how much it produces (i.e. exposed to) them. Firstly, I establish the mechanisms through which global commodity prices can affect poverty, per capita household expenditure and wages. I identify two possible mechanisms, the first one is through direct employment effect, and the second one is through spillover effect into other sectors. Secondly, I estimate the impacts using panel fixed-effect regression on district-level data in Indonesia.

I find that a price increase of coal and palm oil both have significant poverty alleviation impact. As mentioned, the impact depends on the exposure level of the district to each commodity. For

example, from 2007 to 2008, a 0.25 log point of palm oil price increase (from USD780 per metric ton to USD948 per metric ton) is estimated to reduce the poverty rate by 1.11 percentage points in an average palm oil district with plantation size of 36 thousand hectares. Similarly, coal price increase during the same period by 0.71 log points (from USD64 per ton to USD123 per ton) is estimated to decrease poverty rate by 1.26 percentage points in a coal district with coal reserve of 826 million metric ton.

A significant effect on total district employment is only found in the case of palm oil, but sectoral employment effects are significant in sectors and professions that are directly related to both commodities (e.g. mining employment in the case of coal). I also find that average household expenditure, inflation and average wage are only significantly affected by coal price, but not palm oil price, in districts that produce them. Moreover, palm oil price affects the wage distributions at district 25th and 75th percentile wage, while coal price does not. These findings are robust in various specifications. Similar to the employment impact, the palm oil price has a positive impact on wage in professions that are closely related to the sector, including agricultural workers and labourers. In comparison, coal price only significantly affects the wage of the clerical and related profession.

These findings suggest that in the case of palm oil, direct employment effect is more important with minimal spillover effect into other sectors. A possible explanation for the not significant average wage impact is the sector may have employed local residents previously looking for work. Thus the average wage does not need to change. One of the consequences is palm oil price increase disproportionately benefits the poor by creating employment, albeit in a lower-paying profession such as agricultural worker. In the case of coal, the significant average wage and household expenditure impact of coal price suggests that the sector create jobs that pay relatively higher wages. The findings also suggest that the sector may have attracted migrants from outside the district to fulfil increased demand for highly skilled workers. Furthermore, coal district enjoys natural

resource revenues that are shared between the central government and the local government. Coal districts can use natural resource windfall to improve welfare by increasing public service.

These findings also highlight the differences between coal and palm oil, two important export commodities for Indonesia. Coal is a point source resource, and palm oil is a diffuse resource. Although caution must be taken in making broad generalisations in regard to these two kinds of resources, the findings show that they are different. Not only are they different in terms of welfare, employment, and wage impacts, they also use different mechanisms to affect poverty and welfare in their local areas.

The results also show the need for further study to directly measure the employment, migration, capital return, and fiscal impacts of commodity prices. These topics are not within the scope of this study, but they are an integral part of understanding the mechanism of commodity booms. Understanding them will help commodity producers, many of which are developing countries, to formulate the appropriate policy response to commodity booms.

The findings of this study have several policy implications. Firstly, the district governments have an important role in optimizing the benefit of commodity booms. Much of the policy discussion today still focuses on national policy for natural resources. My results show that the welfare impacts of commodity prices are significant at the local level, which means local government need to have the willingness and capability to maximise the welfare benefit of the boom.

Secondly, while the palm oil sector is not an extractive sector, a scheme of revenue sharing similar to other extractive natural resources might be beneficial. So far, the closest scheme that has been in effect for palm oil is the automatic export tax based on the international price. However, the export tax is a national scheme and is geared to make sure a sufficient level of domestic supply for palm oil. A revenue-sharing scheme with the local governments is needed so that they can improve public service and enhance the indirect mechanism of the palm oil sector through the fiscal effect.

Thirdly, the national and local government need to respond properly to the global trend towards better environmental protection. I have not touched on the issue of environment in this paper, but both coal and palm oil are in the centre of environmental debates around the world. This trend is a good thing and should not be fought, but the government must carefully assess the welfare impact of any policy to respond to this trend since both coal and palm oil are central to people's livelihood in many parts of the country. Lastly, while this study focuses on the booming part of the commodity price cycle, policies to prepare for the bust must start before the boom ends. If the local and national government are not prepared, the welfare gain from the boom can disappear in a painful adjustment period.

6.9. Appendix A: Data

6.9.1. Main explanatory variables

- **Palm oil and coal international price**
Data for the international price of both commodities are from the World Bank pink sheet, available from the World Bank website. Data are available from 1960 both at monthly average and annual average, and in nominal and real 2010 United States dollar. For palm oil, the World Bank uses CIF Rotterdam price. For coal, the price is the simple average of Australia and South Africa coal price, because they have the longest time-series data. The study uses the nominal price of both commodities so that they can be converted into Rupiah.
- **Oil palm plantation size**
Plantation size data are collected by the Directorate General of Estate Crops in the Department of Agriculture and Indonesia statistical agency, *Badan Pusat Statistik* (BPS). For 2007 to 2013, the data is available through the World Bank's Indonesia Database for Economic and Policy Research (Indo-DAPOER) in their main databank.
- **Coal reserve**
Data for district-level coal reserve come from GeoRIMA (Geological Resources of Indonesia Mobile Application), an android based mobile application developed by the Ministry of Energy and Mineral Resources. GeoRIMA is the only publicly available data for coal and mineral reserve at the district level in Indonesia. As a mobile application, GeoRIMA is relatively easy to access, but its data must be extracted manually. It includes data of potential reserve of mineral, coal and geothermal at the district and provincial level. The downside is, the application only provides data from 2013 to 2016, so the pre-boom coal reserve data is not available.

6.9.2. Outcomes

- **District poverty rate**
The poverty rate is measured as the share of district population living below an expenditure-based poverty line, roughly equal to \$25 US dollar per person per month. The rate is estimated using BPS' National Socioeconomic Survey (SUSENAS), implemented at least annually and is representative at the district level. All poverty rate data are taken from Indo-DAPOER. In cases where there were district splitting during the period, I recalculate the poverty data into the 2007 district configuration by summing the number of people under the poverty line of the split districts and divide it by the total population of the split districts.
- **Real household expenditure per capita**
It is calculated from SUSENAS as the sum expenditure from the consumption module divided by the household members. All data are also taken from Indo-DAPOER. In the case of district splitting, I use the simple average of the split districts. It is deflated into real value using the CPI of the closest district where data are available (see inflation rate data description).
- **Inflation rate**
The inflation rate is calculated using CPI data, collected by BPS for 71 cities and districts. BPS periodically increase the number of cities and districts where they collect the CPI data, but the number was 71 throughout the study period. If CPI data are not collected for the district, I assign the inflation rate of the closest district (by the physical distance of district central point) where inflation data are collected.
- **District total employment**

Total employment is the number of people employed within a district. Employment includes both the formal and informal sectors, as well as both paid and unpaid. It is calculated from the National Labour Force Survey (SAKERNAS) data, collected by BPS at least annually and is representative at the district level since 2007. The survey is conducted at the individual level and asks questions about employment and wages. Data are available from Indo-DAPOER.

- District average real wage
The average real wage is calculated using the monthly wage paid to people employed in a paid job, both formal and informal. It only includes wages received and excludes other sources of income, such as profit or rent. The average value is weighted using the individual weight provided by BPS. It is calculated from SAKERNAS data and converted into real value using CPI.
- 25th and 75th percentile real wage
Like average real wage, it is calculated using monthly wage paid to people employed in a paid job. To get each percentile value, I use the individual weight provided by BPS. The data are also from SAKERNAS.
- Employment by sector
It is the district total number of people employed in each of the nine sectors. Data are from SAKERNAS, available from Indo-DAPOER.
- Average real wage by sector
It is also calculated using monthly wage paid to people employed in a paid job. A weighted average value in each sector is calculated using the provided individual weight. Data are from SAKERNAS.
- Average real wage by profession
It is similar to average real wage by sector, but individuals are grouped based on professions instead of sectors. Data are from SAKERNAS.

6.9.3. Control variables

- Over-15 literacy rate
Calculated from SUSENAS, via Indo-DAPOER.
- Agricultural and manufacturing employment share
Calculated from SAKERNAS, using standard classification, via Indo-DAPOER
- Household to electricity, sanitation, and clean water
Each one is calculated from SUSENAS, as a share of household in the district, via Indo-DAPOER.

6.10. Appendix B: Other robustness checks

6.10.1. Sectoral nominal wage as outcomes

Table 6.9 The effect of coal and palm oil price on nominal wage by sectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variables	Agriculture	Mining	Manufacturing	Utility	Construction	Trade, Hotel & Restaurant	Transport and Communication	Finance	Social
Exposure to CPO x log CPO price	0.018* (0.011)	-0.003 (0.023)	0.017 (0.016)	0.005 (0.030)	0.012 (0.009)	-0.005 (0.010)	0.001 (0.011)	0.039* (0.021)	-0.011 (0.007)
Exposure to coal x log coal price	0.008 (0.010)	-0.014 (0.015)	0.006 (0.015)	0.071 (0.044)	-0.005 (0.017)	0.011 (0.011)	0.014 (0.012)	0.042 (0.030)	0.003 (0.007)
Observations	3090	2699	3050	2164	3074	3078	3073	2940	3094
District & island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	449	445	446	444	448	449	448	447	449
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013
Controls: Literacy rate, agricultural employment share, manufacturing employment share, household access to electricity, sanitation, and clean water									

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

6.10.2. Using real commodity price, but deflated using district CPI

Table 6.10 The effect of coal and palm oil price (real, deflated using district-level CPI) on welfare (Panel Fixed-effect OLS, with control variables)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile wage	Log of 75th percentile wage
Exposure to CPO x log CPO price	0.217** (0.098)	0.013** (0.006)	-0.358*** (0.084)	0.005 (0.003)	0.018*** (0.006)	0.034*** (0.008)	0.018*** (0.006)
Exposure to coal x log coal price	-0.251*** (0.057)	0.019 (0.013)	0.205*** (0.077)	-0.006 (0.003)	0.023*** (0.006)	0.017** (0.008)	0.022*** (0.007)
Observations	3095	2652	2666	3095	3094	3089	3094
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	449	449	446	449	449	449	449
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2008-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing (except for total employment), household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data; Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

6.10.3. Exposure level adjusted by population

6.10.3.1. *Main outcome*

Table 6.11 The effect of coal and palm oil price (real, deflated using district-level CPI) on welfare (Panel Fixed-effect OLS, with control variables)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile wage	Log of 75th percentile wage
Exposure to CPO x log CPO price	-4.579* (2.587)	-0.032 (0.148)	-1.184 (3.443)	0.537*** (0.170)	0.451** (0.204)	0.491* (0.258)	0.593*** (0.180)
Exposure to coal x log coal price	-97.378** (46.036)	2.820 (7.957)	122.499*** (26.831)	3.159 (2.865)	0.126 (3.471)	0.364 (4.651)	0.242 (3.442)
Observations	3083	2627	2636	3083	3064	3059	3083
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	444	444	444	444	444	444	444
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2008-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing (except for total employment), household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data; Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

Note: Exposure to CPO = Size of oil palm plantation in the district in 2007 divided by population in 2007

Exposure to coal = Size of district coal reserve in 2013 divided by population in 2007

6.10.3.2. *Sectoral employment as outcomes*

Table 6.12 The effect of coal and palm oil price on sectoral employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variables	Agriculture	Mining	Manufacturing	Utility	Construction	Trade, Hotel & Restaurant	Transport and Communication	Finance	Social
Exposure to CPO x log CPO price	1.214*** (0.381)	0.013 (1.625)	0.954 (0.971)	-0.281 (2.452)	0.045 (0.697)	-0.031 (0.735)	-1.110 (0.927)	0.591 (1.379)	1.454*** (0.508)
Exposure to coal x log coal price	13.963*** (4.211)	63.686*** (20.933)	-31.711 (44.358)	-48.254 (59.629)	19.203 (13.361)	24.291* (12.582)	20.588 (13.519)	64.412 (45.296)	20.861* (10.955)
Observations	3090	2699	3050	2164	3074	3078	3073	2940	3094
District & island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	449	445	446	444	448	449	448	447	449
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013
Controls: Literacy rate, agricultural employment share, manufacturing employment share, household access to electricity, sanitation, and clean water									

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

6.10.4. Other measures of CPO exposure, based on average for the whole period and the final year

Table 6.13 The effect of coal and palm oil price on welfare (Panel Fixed-effect OLS, with control variables), CPO exposure based on average 2007-2013 plantation size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile wage	Log of 75th percentile wage
Exposure to CPO x log CPO price	-0.433*** (0.116)	0.002 (0.006)	0.148 (0.135)	0.005 (0.006)	0.009 (0.007)	0.019** (0.009)	0.014* (0.007)
Exposure to coal x log coal price	-0.265*** (0.083)	0.020* (0.010)	0.237* (0.121)	0.004 (0.007)	0.012* (0.006)	0.013 (0.010)	0.010 (0.007)
Observations	3095	2652	2666	3095	3094	3089	3094
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	449	449	446	449	449	449	449
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2008-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing (except for total employment), household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data; Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

Table 6.14 The effect of coal and palm oil price on welfare (Panel Fixed-effect OLS, with control variables), CPO exposure based on 2013 plantation size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile wage	Log of 75th percentile wage
Exposure to CPO x log CPO price	-0.440*** (0.114)	0.003 (0.006)	0.115 (0.131)	0.004 (0.006)	0.009 (0.007)	0.020** (0.010)	0.013* (0.007)
Exposure to coal x log coal price	-0.267*** (0.082)	0.019* (0.010)	0.244** (0.121)	0.004 (0.007)	0.012* (0.006)	0.014 (0.010)	0.011 (0.007)
Observations	3119	2652	2666	3119	3094	3089	3094
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	450	449	446	450	449	449	449
Sample period	2007-2013	2007-2013	2007-2013	2007-2013	2007-2013	2008-2013	2007-2013
Controls: Literacy rate, employment share in agriculture and manufacturing (except for total employment), household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data; Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

6.10.5. Include 2008 for household expenditure regression

In the main model, 2008 data for household expenditure are excluded because there are irregularities in the data. Indo-DAPOER also excludes the 2008 data.

Table 6.15 The effect of coal and palm oil price on welfare (Panel Fixed-effect OLS, with control variables), CPO exposure based on 2013 plantation size

	(1)	(2)
Dependent variables	Log real Household expenditure (exclude 2008)	Log real Household expenditure (include 2008)
Exposure to CPO x log CPO price	0.001 (0.006)	0.001 (0.005)
Exposure to coal x log coal price	0.020** (0.010)	0.011** (0.005)
Observations	2652	3119
District and Island fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Districts	449	450
Sample period	2007-2013	2007-2013

Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

6.10.6. All variables in first-difference form

The model exploits the time-series variation in the data (in a panel setting). First-differenced estimates make sure that time-series issues are under control.

Table 6.16 The effect of coal and palm oil price on welfare, all variables first-differenced (Panel Fixed-effect OLS, with control variables)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile wage	Log of 75th percentile wage
Exposure to CPO x log CPO price	-0.054 (0.043)	0.039*** (0.004)	1.167*** (0.082)	0.005** (0.003)	0.013*** (0.004)	0.021*** (0.005)	0.020*** (0.004)
Exposure to coal x log coal price	-0.245*** (0.050)	0.015 (0.014)	0.448** (0.185)	-0.001 (0.005)	0.008 (0.006)	0.001 (0.009)	0.005 (0.006)
Observations	2662	1772	2214	2666	2637	2632	2637
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Districts	450	446	446	450	446	446	446
Sample period	2008-2013	2009-2013	2008-2013	2008-2013	2008-2013	2008-2013	2008-2013

Controls: Literacy rate, employment share in agriculture and manufacturing (except for total employment), household access to electricity, sanitation, and clean water

¹Excludes 2008 data; ²Excludes 2007 data; Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

6.10.7. Autoregressive model

This specification includes the lag of the dependent variable as a predictor. To avoid the Nickell bias, the regression was done without including the fixed effects.

Table 6.17 The effect of coal and palm oil price on welfare, autoregressive model, without fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	Poverty rate (%)	Log real Household expenditure ¹	Inflation (%) ²	Log total employment	Log average real wage	Log of 25th percentile wage	Log of 75th percentile wage
L1 of Dependent variable	0.63828*** (0.131)	0.76237*** (0.017)	0.10061*** (0.014)	0.53241*** (0.152)	0.81610*** (0.017)	0.80778*** (0.019)	0.81529*** (0.020)
Exposure to CPO x log CPO price	-0.00858* (0.005)	0.00028*** (0.000)	0.00027 (0.001)	0.00042 (0.000)	0.00016*** (0.000)	0.00046*** (0.000)	0.00019*** (0.000)
Exposure to coal x log coal price	-0.01164* (0.006)	0.00055*** (0.000)	0.00101 (0.002)	-0.00080 (0.001)	0.00027** (0.000)	0.00032** (0.000)	0.00027** (0.000)
Observations	2671	1776	2223	2671	2646	2640	2646
District and Island fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No	No	No	No
Districts	450	446	446	450	446	446	446
Sample period	2008-2013	2009-2013	2008-2013	2008-2013	2008-2013	2008-2013	2008-2013
Controls: Literacy rate, employment share in agriculture and manufacturing, household access to electricity, sanitation, and clean water							

¹Excludes 2008 data; ²Excludes 2007 data; Notes: robust standard errors clustered by districts are in parentheses. Exposure to CPO is the size of oil palm plantation in the district in log form. Exposure to coal is the size of coal reserve in the district in log form. *** is significant at the 1 per cent level; ** is significant at the 5 per cent level; * is significant at the 10 per cent level

6.11. Appendix C: Maps

6.11.1. District poverty rate in 2007 (% of population)

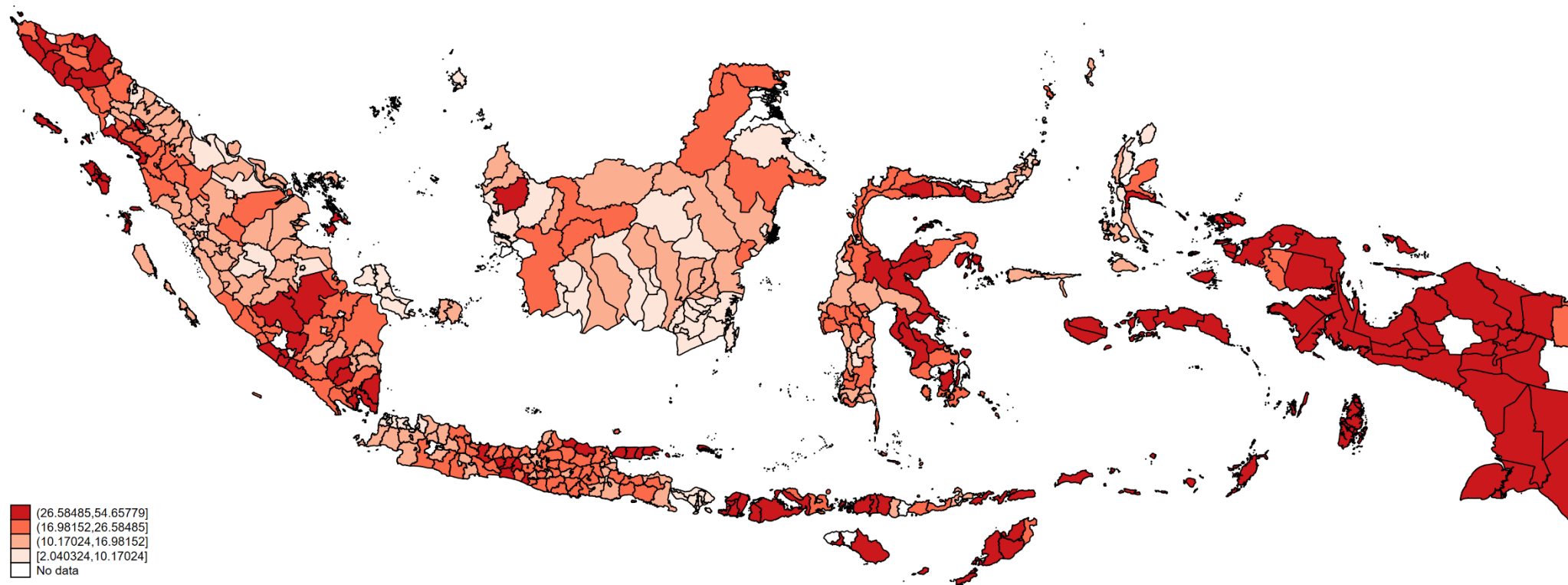


Figure 6.12. District poverty rate in 2007 (% of population)

Notes: The poverty rate is based on the national poverty line, calculated using SUSENAS data from Indo DAPOER (World Bank, 2019)

6.11.2. District poverty rate in 2013 (% of population)

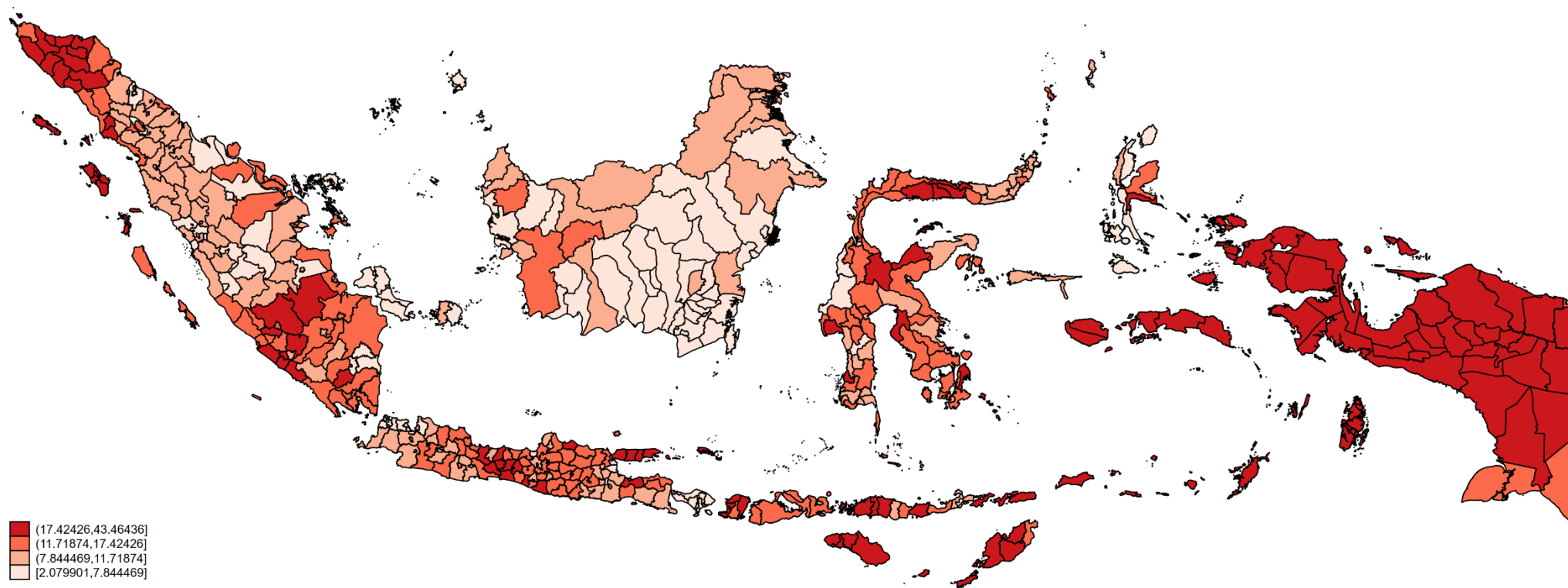


Figure 6.13. District poverty rate in 2013 (% of population)

Notes: The poverty rate is based on the national poverty line, calculated using SUSENAS data from Indo DAPOER (World Bank, 2019)

Chapter 7

Conclusion

Questions about the role of natural resources in economic development have occupied the thinking of economists for a long time. On the one hand, natural resources can represent an opportunity for a country to accelerate its development. On the other hand, many countries have failed to do so and appear to have suffered from a natural resources curse, or the Dutch disease. These questions are important not only for their theoretical implications but also for their effects on the life of millions of people across the globe, especially in resource-abundant developing countries.

Over the last forty years, the discipline of economics has made tremendous progress in answering some of these questions. However, our understanding is still limited and many questions remain unanswered. Firstly, measuring the effects of natural resource boom, especially through the Dutch disease mechanism, is a difficult task. Various indicators that have been used to measure the Dutch disease do not fit within the theoretical foundation of the Dutch disease theory. Secondly, the effects of natural resource rents on the manufacturing sector via the Dutch disease are still a subject of an ongoing debate and various measurement and endogeneity issues may be present in previous studies. Thirdly, the effects of natural resources on the sub-national level, especially on the welfare of the communities which are directly affected by their production process are still poorly understood. This thesis has attempted to answer these questions by examining the impacts of natural resource booms in the case of Indonesia.

As a country that has a long history of natural resource dependence and has experienced two radically different natural resource booms during the last fifty years, Indonesia offers us many valuable lessons. The role of natural resources in Indonesia's economic, social and political development is so central that it is impossible to understand the country's history without mentioning natural resources. Indonesia is also a country that in the last fifty years has managed to

achieve relatively rapid and stable economic growth, a sizeable manufacturing sector, and a continuous decline in its poverty rate, albeit with significant setbacks due to the Asian Financial Crisis in 1997-98. These traits, combined with the fact that it has successfully transitioned from three decades of an authoritarian, centralised, growth-oriented regime under Suharto (1966-1998) into a stable electoral democracy for the past twenty years, make Indonesia unique among resource-abundant developing countries.

While Indonesia's uniqueness has been a subject of previous studies, much of the mechanism of how natural resource booms affect its economic development is not well understood. Natural resource booms and busts have been a crucial aspect of modern Indonesia's economic development. Various factors, including the characteristics and scale of the boom, type of resources involved, institutional settings, and a myriad of other factors contribute to determining the effects of natural resources booms. Against this background, this thesis has explored Indonesia's experience during the last two natural resource booms and has examined the effect of natural resources on the Dutch disease measurements, the manufacturing sector, and welfare measurements. The results show that natural resource booms have a complicated relationship with economic development and that they affect the economy through distinct mechanisms at each level of analysis, whether it is cross-country, national, or sub-national.

7.1. Summary

This dissertation consists of three closely related empirical chapters, which each discussing a specific segment of how natural resource booms affect the economy. Additionally, it also has one chapter on the relationship between Indonesia's economic development since the 1960s in relation to natural resource booms, and one chapter on the development of the Dutch disease and natural resource curse literature.

Chapter 2 discussed the Dutch disease and the natural resource curse theory, which forms the analytical foundations of this dissertation. The chapter discussed the original model developed by

Corden and Neary (1982) along with its extension and application in the Indonesia case. Chapter 3 discussed Indonesia's two natural resource booms and showed how natural resource booms have, to a large extent, shaped the country's economic development.

The first empirical chapter (Chapter 4) compared various methods to measure the effects of natural resource booms from a Dutch disease perspective and discussed the most appropriate method for using Indonesia as a case study. This is an important issue as the trade-weighted real exchange rate, a widely used method to measure the Dutch disease, is not compatible with the Dutch disease theory. The chapter proposed other methods, including CPI based and GDP deflator based price ratio, as alternatives to the trade weighted real exchange rate. A comparison between the three methods showed that the GDP deflator based price ratio has advantages over other methods. These advantages originate from the GDP deflator price ratio's closeness to the Dutch disease theoretical specification (non-traded to traded price ratio) and its detailed sectoral breakdown. The GDP deflator based price ratio also introduced a more transparent and justifiable sectoral tradability classifications based on trade intensity as compared to the other methods. In contrast, the CPI based price ratio is less suitable for the purpose of Dutch disease measurement even though it has longer available continuous data. This is because the CPI based price ratio cannot sufficiently capture sectoral tradability, due to its aggregation and weighting process. The study then showed that during the 2000s commodity boom Indonesia's GDP deflator price ratio had a modest appreciation, confirming the Dutch disease theory prediction.

The second empirical chapter (Chapter 5) examined the impact of natural resource rents on the manufacturing sector. Unlike other parts of this thesis, this chapter used cross-country data instead of only employing Indonesia data. The chapter tried to address possible reverse causality biases, which are present in earlier studies, using an instrumental variables (IV) method. This method utilised the fluctuation of world resource prices, arguably exogenous to individual country, weighted by each country's exposure to the resource. Using data from 149 countries from 1970 to 2014, I

found that natural resource rents had a positive, but small, effect on manufacturing value-added. The IV results were different to the OLS results, which found that natural resource rents had no significant effect on manufacturing value-added. While the results differed, both methods contradicted the prediction of the Dutch disease theory, that natural resource rents should negatively affect the manufacturing sector.

The chapter then introduced several extensions to the model by dividing the sample based on geographical region, initial GDP per capita, initial share of manufacturing in GDP, and time-period. While these extension results were not directly comparable to the main results, they provided a much richer picture of the impact natural resource rents have on manufacturing. The study found that the effects of natural resource rents were not uniform across regions, with certain regions experienced stronger effects than others. It also found that the impacts were stronger in countries with lower initial GDP per capita and in countries with higher initial manufacturing share of GDP. The measured effects also appeared to vary between time periods. When the model only included samples from the first resource boom period (1970-1984), natural resource rents had a positive and significant effect on manufacturing value added. However, when the model only used samples from the non-boom period (1985-2002), the results were not significant, but when it only used samples from the second boom period (2003-2014), the results were negative and significant. Lastly, the chapter also found weak evidence of a positive effect of natural resource rents on services. Although there were many possible explanations for these findings, they were not within the scope of the chapter.

The third empirical chapter (Chapter 6) tested the impact of coal and palm oil prices on welfare measurements in Indonesia at the district level. The empirical strategy was to use cross-sectional variation based on commodity distribution across districts. This was based on the fact that districts are affected by global resource prices at different levels depending on their exposure to each commodity. Exposure to palm oil was measured using the size of oil palm plantation in the district,

while exposure to coal was measured using the size of subsoil coal reserve in the district. The welfare effects are then measured in terms of district poverty rate, average household expenditure, average district wage, and district employment.

The chapter found that palm oil price had a negative and significant impact on district poverty rate and a positive impact on employment, but no statistically significant impact on household expenditure, inflation rate, and average wages in districts that produce palm oil. Furthermore, it positively affected wages at the 25th and 75th percentiles, and the wages of professions that were directly related to the sector, including agricultural workers and labourers. Like palm oil, coal price also had a negative and significant impact on the district poverty rate, but it had no significant impact on total employment. Instead, coal price had positive and significant impacts on local average per capita expenditure, inflation, and the average real wage in districts that have coal reserve. These findings indicate that both coal and palm oil prices have poverty eradicating effects, but that they occur through different channels. While coal price mainly affected average district wage, palm oil price mainly affected district employment.

7.2. Contribution

The dissertation contributes to the Dutch disease and economic development literature by providing empirical evidence for the impacts of natural resources on the real exchange rate, the manufacturing sector, and welfare indicators in the case of Indonesia at three levels of analysis: sub-national, national, and international. Chapter 3 provided a long-term view of Indonesian economic development through the lens of natural resource booms and busts. While similar works had been done before, discussion about the 2000s commodity boom and a direct comparison with the 1970s oil boom is still limited. Moreover, comparing the two booms also allowed us to see how commodity booms in different settings operate differently.

Chapter 4 scrutinised previous studies that rely on the widely used trade-weighted real exchange rate to analyse the Dutch disease and proposed two alternative methods which have stronger

theoretical foundation than the trade-weighted real exchange rate. The main contribution of the study, especially in relation to literature on the Dutch disease, consists of developing new methods that are more accurate from a theoretical perspective to measure the effects of the Dutch disease than earlier studies on the topic. Based on this, the study then concludes that the GDP-deflator based price-ratio has advantages over other methods, not only because it is theoretically more accurate, but also because it represents a consistent and transparent way of addressing the issue of sector tradability. This is an important contribution which can change the way the discipline views the effects of natural resource booms on an economy. The second contribution of the study is the proposed technique to classify sectoral tradability. The technique combined World Input-Output Database table with GDP data to objectively classify sector tradability. This is an innovation which can resolve the measurement issue of sector tradability, a concept which have various theoretical importance, especially in the Dutch disease literature.

Chapter 5 provided evidence on the impact of natural resource rents on manufacturing value-added using an instrumental variable method, thus reducing the possible endogeneity effects in the cross-country analysis. This is an important contribution considering earlier studies on this topic did not address the possible endogeneity problem, especially reverse causality, which may be present in a panel cross-country setting. It is also the first study that used natural resource rents, the value of extracted resources subtracted by the cost of extraction, as a measure of resource dependence in the resource curse literature. This allowed the study to have a longer timeframe than other similar studies, and to include more countries in the dataset. The study also extended the model by dividing the samples based on various categories, including geographical regions, boom-periods, initial GDP per capita, and initial manufacturing share of GDP. These extensions revealed the complexity of the topic in much more detail than other studies on this topic and opened the possibilities of further studies.

Chapter 6 compared the welfare impacts of two different commodity prices, palm oil and coal, at the district level using the case of Indonesia. This study provided evidence that global prices can affect welfare at the subnational level. More generally, the study found that people at the lower end of the income distribution also enjoyed gains from commodity price booms, with both commodities having poverty eradicating effects. Furthermore, the study found that commodity characteristics, broadly generalised as point source and diffuse resources, were important in determining their welfare impacts. Palm oil, classified as a diffuse resource, has a significant employment effect, while coal, classified as a point source resource, has a significant wage effect. The welfare impacts were measured in a level of detail that is unique from other studies on this topic. To explain the mechanisms of these impacts and to test the presence of spillover effects to other sectors, the chapter also measured the district wage and employment impacts at the sectoral and professional levels. This study is also the first study to have used the GeoRIMA database to measure coal exposure at a district level.

While each chapter has its specific contributions to the literature, when taken together, they provide a comprehensive analysis of various effects of natural resources, especially in a developing country case study. The thesis has showed that natural resources affect the economy through different channels at each level of analysis. Consequently, policy responses to natural resource booms and busts have to be considered at multiple levels: sub-national, national, and international.

7.3. Policy Implications

The findings of this thesis are complex, and so are the policy responses. While the Dutch disease and natural resources curse are valid concerns in a resource-abundant developing country, they are not a certainty. Instead, the empirical chapters of this thesis found that natural resource rents had either no significant effect or a small positive effect on manufacturing value added, and commodity price boom had a generally positive effects on the welfare of commodity producing districts in the case of Indonesia.

Chapter 4 found evidence for a modest appreciation of non-traded to traded prices in Indonesia during the 2000s commodity boom. However, this depends on the definition of tradability. For example, both the construction sector and the trade, hotel and restaurant (THR) sector are non-traded, but construction price increased much more than THR price during the boom (based on GDP deflator). This suggested that sector-specific story was important to explain these changes, and the commodity boom was just one part of the explanations. In terms of policy implications, the findings suggested that natural resources boom may affect sectors that were not directly related to the natural resources sector. Therefore, policies that were designed to respond to the boom need to consider how it may affect other sectors as well.

Furthermore, I did not find evidence for natural resource rents causing a decline in manufacturing value added (Chapter 5). While these findings are good news for resource-abundant countries, they do not mean that countries do not need to take any action when faced with natural resource booms. Policies may be tailored to amplify the positive effects of natural resource rents, such as by supporting the potential productivity spillover from the highly sophisticated resource sector to the non-booming traded and non-traded sectors. The study also showed that country characteristics, such as region, GDP per capita, and the initial share of manufacturing sectors may influence the impacts of natural resource rents. Each period of natural resource boom also had distinct effects on the manufacturing sector. These findings mean policymakers also need to pay attention to their country characteristics and the global circumstances during each natural resource boom. As discussed in Chapter 5, where I briefly compared the experience of Indonesia and Australia, the experience of each country is different. Various factors, including policies, may be able to explain these differences, but the empirical model could not capture this complexity. Studying which policies matter on a country-by-country basis is important, but it is beyond the scope of this study.

Similar to Chapter 5, in Chapter 6 I also did not find any evidence for the negative welfare effects of commodity prices at the districts that produced them. The findings in Chapter 6 implied that

producing coal and palm oil is good for a district since an increase in their prices can reduce the district poverty rate, create employment, and increase average wages. However, since the model assumed linearity, the results also suggest that a decline in coal and palm oil prices will have the opposite effects: increased district poverty rates, reduced employment, and lower average wages. Therefore, districts need to manage the boom well and prepare for the possibility of a bust. Another implication of this study is that each resource has its characteristics (point source resource and diffuse resource) and the impacts of their prices were specific to each district depending on its exposure to each kind of resources. Consequently, natural resources policies should consider resource characteristics and involve stakeholders in the districts in policy formulation. Local district governments also need to be both willing and capable of maximising the welfare benefit of natural resource booms. Lastly, the study suggests that any policies designed to limit or reverse the development of these sectors, including for valid environmental concerns, will have welfare implications in the district. This does not mean the government cannot intervene in the coal and palm oil sector, but the employment, wage, and poverty implication of the policies have to be part of the policy considerations.

7.4. Limitations and future research

While each of the empirical chapters has its own limitations, there were also limitations that apply throughout the thesis. Firstly, the empirical chapters did not directly test the impact of policies that may be relevant to each case. At each level of analysis, there were existing policies that can affect the relationship between natural resources and the economy. Due to technical and data limitations, the models that were used in the empirical chapters did not include policy variables. This means these models could not directly evaluate the effects of these policies. This limitation considerably restricts the policy implications of this thesis. Future research needs to find ways to include policy variables into the model so that the findings have more meaningful policy implications.

The thesis used the Dutch disease theory and its modifications as its theoretical framework. While this in itself was not a limitation, it means that other potential frameworks in the resource curse literature were not considered. This includes the role of institutions, which arguably played a key role in explaining the impact of natural resource booms. Incorporating institutional quality variations to the model may help to identify the reasons behind the diversity of experience in the impact of natural resources, either between countries (Chapter 5) or within a single country (Chapter 6). Another possible improvement would be to identify specific policies that may affect the impacts of natural resource booms and incorporate them into the model. The Dutch disease and the resource curse are not a destiny and policies can alleviate or exacerbate their negative impacts. A policy impact evaluation study on these policies, such as sovereign wealth fund, subsidies, or exchange rate policies, may provide definite policy recommendations to national or subnational government on how to respond to or prepare for a natural resource boom.

Important variables, such as migration, return to capital, education, land price, price volatility, environment, and others were also not included in the empirical model, mainly because of data limitation. For example, local-level land price data may help to explain the impact of natural resource booms on non-traded sectors (Chapter 4) and the returns of the immobile factors (Chapter 5). Another example is migration data, which will allow the model to test the role of labour movement in determining the impact of natural resources on welfare, employment, and wages (Chapter 6) and their implications on manufacturing or the non-booming traded sector in general (Chapter 5). The environmental effects of natural resource booms were also largely untouched in this dissertation. While these issues were not within the scope of this dissertation, they can enrich the discussion of the welfare effects of resources and its sustainability.

While the empirical models are based on the Dutch disease framework, they have important differences. For example, the role of real exchange rate, which is central to the theory as discussed in Chapter 4, were barely mentioned in Chapter 5 and 6. Incorporating the methods to measure

relative prices, as identified in Chapter 4, can help to connect the empirical findings in Chapter 5 and 6 to the theory. Furthermore, there were differences between the time frame of the empirical model and the theoretical model. The empirical model in Chapter 5 measured the impact of natural resources rents on manufacturing value-added in the same year. The Dutch disease model, in contrast, focused on the longer-term structural effects of natural resource booms. Similarly, Chapter 6 used the modified version of the Dutch disease for the sub-national level, which had important differences with the country level main model. In this dissertation, I used narrative arguments to justify these differences and modifications. This can be improved in future research by building new theoretical frameworks that consider these differences and modifications. New theories may also help to explain some of the results that cannot be explained in this research.

There is still much room for future research on the impact of natural resources on the economy. New theoretical frameworks and empirical evidence are necessary because there are so many different ways natural resources can affect the economy at various level of analysis. Furthermore, policy recommendations on how to manage natural resources are important for governments and people living in resource abundant countries, especially in the developing world. I hope the research presented in this thesis can encourage other researchers to investigate these issues further, extend my analysis with other relevant variables and better datasets as well as develop new theories to explain my findings.

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