Essays on Growth, Productivity and the Oil Industry in Indonesia

by

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Dedication

To my family, my parents, and my relatives

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ABSTRACT

This study examines the sources of growth in Indonesia. To do this, a standard growth model is developed. First, the model is decomposed into two sectors, oil and non-oil, which are then estimated by applying OLS and 2SLS procedures. This decomposition is intended to capture the externality impact of the oil sector on the economy. Second, the model is extended to incorporate how foreign trade affects productivity and output growth in Indonesia. The second model is estimated by using OLS, OLS with Fixed Effects, 2SLS, and 2SLS with Fixed Effects procedures. To overcome the weakness of our econometric estimation results, the study finally offers a different method to account for Indonesia's Total Factor Productivity. This last method is to directly measure labour share.

The data sets used in this study are from the World Bank, the Central Board of Statistics of Indonesia, the Bank of Indonesia, Pertamina, and other sources.

The results show that both growth in factor inputs and in productivity contributed to output growth in Indonesia. This study shows that foreign trade affects productivity in the short-run. However, oil and non-oil exports alone cannot secure long-run growth in Indonesia. The contribution of the oil sector is smaller than the non-oil sector. It is argued that the positive effect of the oil sector might have been reduced as a result of monopoly in the oil industry.

The results also show that the relative contribution of productivity growth to output growth is higher than the contribution of factor inputs. The contribution of productivity growth is around 3.6 per cent, while factor inputs are always less than 1 per cent regardless of the method and data used.

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CHAPTER 1

INTRODUCTION

1.1. Objectives of the Study

The purpose of this thesis is to analyze the growth of the Indonesian economy over the last 30 years and related questions on productivity and factor shares. More specifically, the thesis examines these questions in the context of the role of the oil sector versus the non-oil sector in the Indonesian economy. Three principal questions will be examined, each of which will be the subject of an independent essay. These questions are (1) what is/has been the contribution of the oil and the non-oil sectors to economic growth in Indonesia? (2) what is/has been the relationship between oil and non-oil exports and growth and productivity? (3) what are the relative factor shares of labour and capital in the output of Indonesia? The first two questions will be examined by using an econometric approach which draws heavily on a framework developed by Feder (1983), Caballero and Lyons (1992) and İşcan (1998a and 1998b). The last question will be explored by employing a framework developed by Gollin (2002).

The principal hypothesis to be tested is whether the oil sector, the non-oil sector or both are a main cause of growth in Indonesia. To do this, the study will employ a standard growth model initially broken into the two sectors. The study is motivated by Indonesia's experience since the late 1960s, during which the country has experienced sustained and substantial economic growth.

After disastrous policies in the mid-1960s, the Indonesian economy grew rapidly. There is little disagreement that Indonesia's high economic growth in the period 1970 - 1980 (when real per capita income grew, on average, 5.6 per cent per year) was accelerated by growth of the oil industry, and more specifically, by the world oil price increases in 1973 and 1979 (World Bank, 2001). In particular, from the mid-1970s until the 1980s, the oil industry was Indonesia's single largest economic sector, accounting for no less than 49 per cent of Indonesian GDP per year (CBS, 1992). It was also the largest single earner of foreign exchange. For example, the real value of oil exports quadrupled from 5 per cent of GDP in 1970 to 21 per cent of Indonesian GDP in 1980 (Woo *et al.*, 1994).

Due to the fluctuation of world oil prices post-1981 and the growing depletion of oil resources, by the mid-80s the contribution of the oil sector began to change again. Whereas, in the early 1980s, the oil industry accounted for almost half of total GDP, by the early 1990s this figure had fallen to less than 25 per cent (CBS, 1994).

In the mid-1980s, because of the fluctuation of oil earnings, the Government of Indonesia tried to diversify its revenues by launching a series of trade reform programs. These trade reforms targeted non-oil exports and investment through financial liberalization, import liberalization and tax reform. In fact, over the period 1985 – 1995, per capita income growth reached as much as 5 per cent annually, not too far from the high-growth oil boom period.

Recognizing that both the oil and the non-oil sectors have each played some part in Indonesia's growth record over time, it becomes an interesting question for us to explore in greater detail the relative contribution of each, while also asking what, if any, other factors have affected growth. In addition, because the "true" size of productivity remains controversial, the study also attempts to present a different angle in computing productivity by introducing a new accounting of labour shares in the Indonesian economy.

The main discussion of the first essay investigates the sources of growth in Indonesia using a production function approach. Despite the fact that the sources of growth have been discussed in the economic literature, the "true" determinants of growth remain questionable. Until recently, economists have been relatively unsuccessful at fully characterizing factors other than capital and human inputs which affect the level and growth rate of an economy (Todaro, 2000). Across countries, there also appear to be differences between cross-section observations and time-series observations (Gollin, 2002). Recent papers by, for example, Young (1995), Harberger (1998), and Prescott (1998) have again focused attention on the need (for improved theories) to more fully characterize residual growth influences. Most studies, however, are not concerned with a new theory, but rather with providing an analysis of the historical patterns of output and growth or presenting the accounting results of productivity growth. This present study is also not designed to propose a new theory but to provide new empirical evidence on the sources of growth in Indonesia.

Up to now, studies of total factor productivity (TFP) in Indonesia have been done only in a very limited fashion. These studies have usually used either a descriptive statistics approach (see, for example, Abimanyu, 1995) or an econometric estimation technique, but have focused only on the manufacturing sector (see, for example, Tuwo, 1998). This was mostly due to data availability problems, especially for the capital stock. This current study attempts to fill the gap by analyzing the impact of the oil sector and the non-oil sector on economic growth and productivity in the Indonesian economy in a more comprehensive fashion. In this study, because data on capital stock do not exist in Indonesia, data on the capital stock series are constructed as suggested by Nehru and Dhareshwar (1993). The data construction used in the model is discussed in Chapter 2.

The other important methodological issue in Chapter 2 is the selection of the econometric estimation technique. This is an issue because of endogeneity problems in our model. Two estimation techniques are used: Ordinary Least Squares (OLS) and the Instrumental Variables (IV) estimation procedure.

The model in Chapter 2 will consist of one dependent variable and seven input variables, i.e., capital in the oil sector and the non-oil sector, labour in the oil sector and the non-oil sector and prices in the oil sector and the non-oil sector plus technical change. The regression results of the model can then be interpreted in terms of how much of total growth can be explained by input growth and the residual growth in output (i.e., productivity growth).[1] If the model turns out to have little explanatory power, this means a growth accounting model is likely not appropriate to explain growth in Indonesia. In other words, economic growth in Indonesia is unlikely to be traced from input growth and productivity growth.

Chapter 3 provides an analysis of the causal relationship between foreign trade variables (e.g. sectoral exports) and productivity growth, as well as overall economic growth.

In general, there are two ways to measure productivity growth.[2] First, it can be measured by employing an econometric estimation method which requires an explicit specification of a production function or cost function (for example, Caballero and Lyons, 1992; and İşcan, 1998b). Second, it can be calculated by taking the growth in output minus the weighted growth in inputs (for example, Young, 1995).

The idea of innovation was introduced by Joseph Schumpeter in the first

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[1]Of course, residual could contain other factors.

[2]Regardless of the differences in measurement, because in the literature the terms technical change and productivity (TFP) growth are considered as two sides of the same coin, this study uses the terms technical change and productivity (TFP) interchangeably.

decade of the 20th century.[3] He argued that innovation was the main source of modern industrial growth. This view, in turn, inspired underlying theories of monopoly, development and the business cycle. After World War II, a vast literature on the measurement of technical change and its relationship with economic growth evolved. The Harrod-Domar growth model (1940s) and the Solow neoclassical growth model (1957 and 1962), among others, were pioneers in attempting to measure technical change and its relationship to economic growth. Since then, studies on technical change have evolved from single factor measures to multi-factor measures to find reliable and robust estimates of productivity and economic growth.[4]

Until the early 1970s, most empirical studies of productivity growth were heavily based on the index approach that did not need a model specification (except Solow (1957), who explicitly specified a production function model). One limitation of the index approach is that it ignores the probability of substitution among inputs. This limitation has led to many attempts to improve the methods to explain productivity growth. These include: the use of flexible cost function forms by Diewert (1971) and Christensen *et al.* (1973); and the use of a translog cost

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[3]Karl Marx, a long time ago, argued that technical change was the driving force of capitalist development. Yet, his argument had little immediate impact on the economic literature of that time.

[4]See, for example, Lee (1991) who provides an excellent review of productivity growth studies.

function model by Binswanger (1974), and Berndt and Wood (1975). The study on productivity has also morphed from a static approach towards a dynamic approach. Examples of this are Berndt and Christensen (1973), Berndt and Fuss (1982), Denny *et al.* (1981), Morrison and Berndt (1981), Berndt and Hesse (1986), and Easterly and Levine (2001), among others.

Although the model specification for examining productivity growth has conceptually improved, the "true" measure of productivity growth has remained elusive. In this context, Easterly and Levine (2001) argued that although TFP rather than factor accumulation accounts for most of the income and growth differences across countries, more efforts toward modeling and quantifying TFP is still required. See also Bernanke and Gürkaynak (2001), Romer (2001), and Lagos (2001). Regardless of the debate about measuring productivity growth, however, many studies have attempted to extend the model by incorporating other exogenous variables such as human capital (for example, Benhabib and Spiegel, 1994), foreign trade (for example, İşcan, 1998a and 1998b), and finance (for example, Beck *et al.*, 1999).

Following İşcan (1998a and 1998b), the second essay of this thesis will utilize foreign trade as an exogenous variable for further investigation of the sources of growth of output. Stated differently, the study tries to estimate both the main determinants of growth in the Indonesian economy and to extend the use of the growth accounting model by incorporating foreign trade, along with economic growth and productivity, into the model.

The primary hypothesis of the second essay (Chapter 3) is that export levels or growth in exports, or both, affect output and productivity growth. The sign of the export variable is expected to be significantly positive because exports are thought to foster economic growth and stimulate productivity via foreign competition. This implies that both oil and non-oil exports are likely to support growth and technical change. If the hypothesis is rejected, this means that export led growth theory cannot be applied in the case of the Indonesian economy, i.e. foreign trade is not a policy variable to be used to boost the economy.

Finally, the third essay (Chapter 4) attempts to measure labour income shares by calculating the employee compensation shares for Indonesia. This type of study has not previously been done for Indonesia. This calculation does not use an econometric estimation but employs an accounting technique based on existing statistics. This accounting technique is used to overcome the weaknesses of the previous model (Chapter 3), including the discrepancies between cross-section observations and time-series observations. A framework developed by Gollin (2002) is used in Chapter 4.

The third essay does not test any hypothesis. The main outcome of this essay is to measure labour shares which may be approximately constant across time and space. This labour share will ultimately be an important vehicle to compute a "true" measure of productivity in Indonesia, which may be useful for policy makers to take into account in defining appropriate industrial policies. Razzak (2003) states that it is important to measure "true" productivity growth when there is a structural change (e.g., trade reform), because factor shares, which are coefficients in the production function, can be unstable in this case. We will compute factor shares here by initially computing labour shares which will also include the income of the self-employed. Thus, this computation is likely a correction of the usual calculation of labour share which only uses employee compensation as a fraction of GDP.

1.2. An Overview of The Indonesian Economy

Since its independence on 17 th August 1945, Indonesia has experienced four distinct phases in the role of government in the economy. These are: gradual attenuation of government control (1945-1965); stabilization and oil boom under the New Order Period (1966-1981); New Liberalism and the decline of oil prices under the New Order Period (1982-1997); and the Reformation and economic crisis in the post-Soeharto era (1998 - present) (Booth, 1998, Robison and Rosser, 1998, Wee, 2002, and Rosser, 2002). Each of these will be briefly examined in turn.

1.2.1. General Settings

Indonesia proclaimed its independence on August 17, 1945. Before this proclamation, Indonesia was colonized by the Dutch for more than 350 years (from the mid-17th century until 1942) and occupied by Japan for three and a half years (from 1942 until mid-1945). Thus, it is not surprising that the Dutch life-style and language have affected Indonesia. For example, the Indonesian language, known as *Bahasa Indonesia,* has adopted some Dutch pronunciation.[5]

Indonesia, straddling the area from 6° North to 11° South Latitude and 95° to 146° Longitude, is the largest archipelagic nation in the world and the third-largest country in Asia. It consists of five large and 17,500 smaller islands, and has a total land area of 1,919,317 square kilometers. The principal islands are Java, Sumatra, Kalimantan (comprising more than two thirds of the island of Borneo), Celebes, Papua, the Moluccas and Bali.[6] In 2000, the Indonesian population was around 210 million, making it the fifth most populous nation in the world. Almost 60 per cent of the total population live on the island of Java (which has only 7 per cent of Indonesia's arable land), while abundant resources such as oil, gold, and wood are found on the other islands, including, in particular, Sumatra, Kalimantan and Papua.

The period 1967-1996 was a time of great optimism in Indonesia. The real Gross Domestic Product (GDP) jumped over eight times from Rp 318 billion in

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[5]The government in 1972 changed the pronunciation rules considerably.

[6]See Appendix 1.1 for a map of Indonesia.

1967 to Rp 2.6 trillion in 1996, with a 7.5 per cent average annual growth for three decades. The 1967-1996 period, known as the New Order Era, started in 1966 when Soeharto took over the leadership of the country from Soekarno, the first president. The significance of the Soeharto government was that he established a program emphasizing stability and improvement of the political structure, in part by oppressing his opponents but also, more essentially, by promoting economic development. The latter was expressed principally in a series of Five-Year Development Plans (*Rencana Pembangunan Lima Tahun* or *Repelita*) issued by the People's Consultative Assembly during the New Order Era.[7]

The driving force behind the brisk economic activity of the Soeharto period was the persistence of high oil prices in the world market. Stimulated by a series of deregulation measures in the real sector in the 1970s, 1980s and 1990s, total oil exports rose rapidly. This high oil price was also due to international politics. For example, Iraq's invasion of Kuwait in 1990 added to the boom in the Indonesian economy due to the extra oil windfall that resulted.

However, oil's contribution to the fiscal revenue of the government fluctuated considerably overtime. Oil prices are set in international markets and are subject to variation. This price variation in world markets translates to

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[7]In this period, the People's Consultative Assembly (Majelis Permusyawaratan Rakyat or MPR), a higher parliament of Indonesia, selected and appointed the Indonesian President as well as designed a broad state guideline for the government.

considerable variation in oil's contribution to fiscal revenue in Indonesia.

In general, Table 1.1 shows that oil's contribution to the fiscal revenues in Indonesia increased in the 1970s. The second oil boom in 1979-1980 also yielded a significant increase in oil's contribution to fiscal revenues. However, since 1982, the share of oil revenues in fiscal revenues has decreased, because world oil prices post-1982 have tended to be lower than pre-1982. This decrease posed a threat to planned government spending and prompted a search for alternatives.

The depletion of oil reserves has also reduced Indonesia's oil production and in turn, caused oil revenues to decline. It has been estimated that if new oil resources are not immediately discovered and explored, Indonesia will become a net oil importer in the near future (Prawiraatmadja, 1997).[8] The existing resources are sufficient to last no more than 20 years at the present rate of exploitation.[9]

The fluctuation of international oil prices along with the depletion of Indonesia's oil reserves persuaded the Government to reform its export programmes by promoting non-oil exports and investment through macro and micro economic policies. These policies have evidently reduced the relative price of goods for the domestic and export markets by over thirty percent of the original price, and have increased cumulative foreign investment from US$ 5,145 million

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[8]See also Appendix 1.2 for an overview of Indonesian oil production.

[9]Indonesia's oil resources were around 10 million barrels in 1999, or around 1 per cent of world oil resources.

Table 1.1: The World Oil Prices and The Share of Oil Revenues in Fiscal Revenues, 1969 - 1999

Year	WOP (US$/BRL)	SORFIR (%)	Year	WOP (US$/BRL)	SORFIR (%)
1969	2.11	26.15	1985	27.31	57.88
1970	2.11	27.97	1986	14.23	45.52
1971	2.57	31.98	1987	18.15	48.30
1972	2.80	39.03	1988	14.72	41.41
1973	3.14	39.50	1989	17.84	39.15
1974	11.22	54.58	1990	22.97	34.14
1975	10.60	55.67	1991	19.33	37.35
1976	11.83	56.27	1992	19.03	29.99
1977	12.84	55.14	1993	16.82	28.67
1978	12.95	54.12	1994	15.90	20.38
1979	29.22	63.61	1995	17.20	21.99
1980	35.48	68.61	1996	20.37	22.98
1981	34.12	70.65	1997	19.27	27.22
1982	31.12	65.79	1998	13.07	25.96
1983	29.66	65.96	1999	17.298	27.92
1984	28.56	65.57			

Source: The CBS and International Financial Statistics Yearbook (various years).
Notes: 1. WOP is the World Petroleum Price in US$ per barrel.
2. SORFIR is the Share of Oil Revenues in Fiscal Revenues in %.

in 1980 to US$ 12,690 million in 1985 and then to US$ 160,679 million in 1996 (Abimanyu, 1995, and Rachbini, 1999). Nevertheless, until recently, oil exports have still been the single largest commodity contributor to Indonesia's fiscal revenues.

Since the early 1990s, Indonesia has confronted a series of crises in the form of high real interest rates, currency devaluation, and a growing foreign debt problem. This foreign debt was, in fact, fundamentally tied to the economic crisis in Indonesia in 1997. The existence of expiring foreign debts in the late 1990s caused the Indonesian currency, the Rupiah, to drop.[10] The value of the Rupiah fell by almost 300% in 1997, i.e., in early 1997 one US$ equaled to Rp 2,909.40, while in 1998 1 US$ equaled Rp 10,013. 60 (World Bank, 2001). Production declined drastically and many companies faced imminent bankruptcy; inflation rose into double digits (Baker *et al.*, 1999 and Wee, 2002). This devaluation also caused income per capita of Indonesians to fall from approximately Rp 2,079,260 in 1996 to nearly Rp 1,803,271 in 1998 in real terms (CBS, 2002 and World Bank, 2001). Thus the economy of Indonesia experienced a 30 year setback.

While this setback was a result of a specific crisis and can be explained, it nonetheless underlines why it is important to improve our understanding of the sources of growth in Indonesia over time. Thus, this is a major goal of this study, with particular emphasis on the New Order Era.

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[10]The expiring of foreign debts raised the demand for US dollars.

1.2.2. Sectoral Analysis

The sectoral analysis in this study uses Input-Output (IO) data. These data provide a statistical framework which shows the interdependence between the economic sectors of Indonesia.

Although in the early-1980s, manufacturing sector growth was relatively slow, the government spurred on the manufacturing industry as a leading sector for its multiplier effects. Throughout the 1980s, manufacturing was the fastest growing sector for much of the oil boom period. In fact, the manufacturing industry was one of the important non-oil sectors for the recovery in the late 1980s. It contributed directly to about one third of non-oil GDP growth, and around 75% of non-oil export growth during 1985-1995 (Abimanyu, 1995). But, until this recent period (post-1985) of broad-based, export-oriented industrial growth, the manufacturing sector tended to swing between periods of boom and bust.

Table 1.2 presents the sectoral shares in gross output for the Indonesian economy. Agriculture has historically been the principal economic activity in Indonesia, although its relative importance has been in decline. The share of agriculture output stemming from farming, livestock, forestry and fisheries declined from about 45% of GDP in 1971 to just over 16% of GDP in 1995. Meanwhile, the manufacturing contribution to GDP has increased dramatically. It was only 8.4% in the early 1970s, while in 1995, it had grown to almost 25% of

Table 1.2: The sectoral share of output (%)

Sector	1971	1975	1980	1985	1990	1995
Agriculture	44.8	31.7	24.9	22.8	19.8	16.4
Mining etc.	8.0	19.7	25.7	14.8	12.2	7.6
Manufacturing	8.4	8.9	11.7	15.5	20.3	24.1
Electricity etc.	0.5	0.6	0.5	0.4	0.7	1.1
Construction	3.5	4.7	5.6	6.3	5.6	6.6
Trade etc.	16.1	16.6	14.1	15.4	17.6	16.7
Transport etc.	4.4	4.1	4.3	5.8	6.3	6.8
Financial	-	-	-	6.5	7.8	11.5
Services	14.3*	13.8*	13.4*	12.5	10.3	9.1

Source: CBS (various years) and author's analysis.
Note: * denotes that data on financial sector prior 1980 were included services sector.

GDP. Hence, both agricultural and manufacturing are very significant sectors, although one is declining in importance while the other is rising.

As Table 1.2 shows, the highest contribution to GDP in both 1990 and 1995 came from the manufacturing sector. This followed a 1985 decision by the Government of Indonesia to boost the non-oil export sector in an effort to reduce the relatively high dependence on oil exports, while stimulating export earnings as well as increasing employment opportunities and Indonesia's GDP.

The mining sector in Table 1.2 consists of coal, oil and non-metal industries. The contribution of the oil industry in the mining sector varies but is consistently over 60 per cent per year. Figure 1.1 exhibits the share of the oil industry in the mining sector in Indonesia. As in Figure 1.1, oil has been the most important commodity in the mining sector of Indonesia. Its contribution ranged from 62 % in 1995 to 95 % in 1980. In fact, from the mid-1970s to the mid-1980s, oil's contribution reached its peak value, i.e. around 95 percent of total mining output. This happened because the Government of Indonesia significantly pumped oil within this period to boost its economy.

In 1995, the export of goods and services by Indonesia increased by more than 156% as compared to 1990. The composition of exports in 1995 was dominated by the manufacturing sector (67.5%) and the mining sector (15.5%). The exports of agricultural products, on the other hand, declined from 3.3% in 1990 to 1.9% in 1995. This was partly due to a crop failure and partly to an increase in domestic demand in the 1990s. (See Table 1.3). Thus, it appears that Indonesia is making the transition towards a more advanced industrial economy. Its export focus has switched from agriculture and mining to manufacturing and while manufacturing imports remain very high and are growing, the export share for manufacturing far outstrips the import growth shift for the sector. Thus, it seems the trade liberalization programs introduced in the mid-1980s have begun to

Figure 1.1: The Share of The Oil Industry in The Mining Sector, 1971-1995

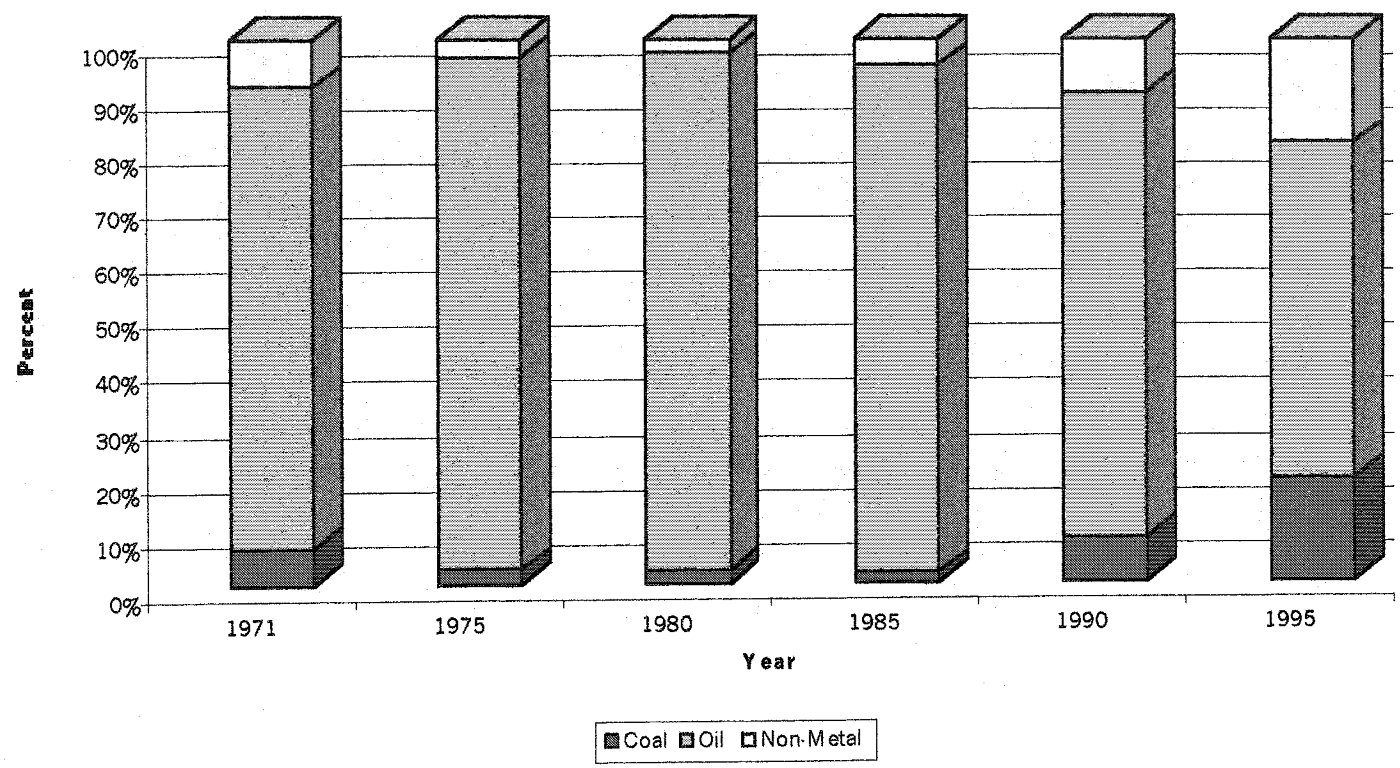

Table 1.3: Exports and Imports By Sector (%)

Sector	Export			Import		
	1985	**1990**	**1995**	**1985**	**1990**	**1995**
Agriculture	9.1	3.3	1.9	5.1	1.6	2.8
Mining etc.	43.5	25.1	15.5	7.2	4.8	3.0
Manufacturing	41.5	63.3	67.5	69.4	80.3	75.5
Electricity etc.	0	0	0	0	0	0
Construction	0	0	0	0	0	0
Trade etc.	0.9	2.1	4.6	2.7	1.8	2.3
Transport etc.	2.5	2.1	4.7	4.0	2.6	6.7
Financial	2.3	3.5	4.5	5.6	4.1	6.4
Services	0.2	0.6	1.2	6.0	4.8	3.3

Sources: CBS (various years) and author's analysis.

take effect.[11]

In spite of the increase of Indonesian exports, from Rp 53 trillion in 1990 to Rp 122 trillion in 1995, Indonesia experienced a deficit in its trade balance in 1995. The deficit was around Rp 4 trillion. This deficit was likely due to an

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[11]In 1985, due to the declining trend of oil prices, the Government of Indonesia launched a series of economic reform policies. The policies were composed of financial liberalization, export promotion, import liberalization, tax reform and so on. Major changes in foreign trade policies especially were started in 1985. A trade deregulation package was introduced. For example, some items were exempted from the import license requirement, restrictions on certain exports were lifted. The mid-1980s were indeed a beginning of trade liberalization in Indonesia which was marked by a growing non-oil sector.

increase in imports in service sectors such as transportation and communication services in the mid-1990s. The import of services jumped around 150% in 1995. This happened because of a tremendous increase in demand for transportation and communication equipment such as cellular phones, for which both the spare parts and the final products (including accessories) are imported.

Other than oil products, the principal exports of Indonesia are textiles, plywood, processed foods, electronic equipment, cement, fertilizer and metals. The contribution of these commodities has increased significantly from 21 percent of total exports in the mid-1980s to 39 percent in 1990, and around 60 per cent in the mid-1990s. This indicates the rising importance of the non-oil sector, in general, and the manufacturing sector, in particular.

Japan, Singapore and the United States of America are Indonesia's principal export markets. In 1995, however, although exports to these countries increased in absolute value, their relative shares declined in percentage terms. For example, Indonesian exports to Japan were 30.34% (Rp 11.2 billion) of total exports in 1993 and 27.06% (Rp 12.3 billion) in 1995. Meanwhile, the United States and Singapore accounted for 14.2% (Rp 5.2 billion) and 9.16% (Rp 3.4 billion) of Indonesian exports in 1993, and 13.92% (Rp 6.3 billion) and 8.2% (Rp 3.8 billion) in 1995, respectively.

Further, using a linkage approach, we can analyze the inter-industry relationships among sectors. In doing so, Tables 1.4 and 1.5 present the backward

Table 1.4: The Backward Linkage Indices of The 19 Sector Classification

Code	Sector	1971	1975	1980	1985	1990	1995
1	Paddy	0.6977	0.7678	0.7954	0.7756	0.7881	0.7994
2	Other Food Crops	0.9969	0.9791	0.9793	0.7810	0.7549	0.7509
3	Other Agriculture	1.0399	1.0631	1.0087	0.9154	0.8683	0.8807
4	Livestock and Its Products	0.9257	1.0424	1.1331	1.2414	0.9999	1.1597
5	Forestry	0.8775	0.9214	0.8357	0.7973	0.8248	0.8501
6	Fishery	0.8980	1.0021	0.9124	0.8889	0.9105	0.8517
7	Mining and Quarrying	0.7332	0.7469	0.8021	0.7828	0.7671	0.7801
8	Manufacture of Food, Beverages and Tobacco	1.2825	1.3495	1.3417	1.328	1.2785	1.2420
9	Other Manufacturing	1.0848	1.1713	1.0526	1.0826	1.1208	1.1283
10	Oil Refinery	1.1451	1.2448	1.1771	1.0820	1.0784	1.0088
11	Electricity, Gas and Water Supply	1.1590	1.0711	1.2354	1.5164	1.3186	1.1264
12	Construction	1.1234	1.1910	1.2330	1.2248	1.2532	1.2309
13	Trade	0.7683	0.8368	0.8099	0.7945	0.8263	0.8555
14	Restaurant and Hotel	1.3614	1.3989	1.3135	1.3016	1.2427	1.2635
15	Transportation and Communication	0.9516	0.9941	1.0261	1.0862	1.0471	0.9737
16	Financial and other Services	0.8797	0.8852	0.8804	0.8610	0.8830	0.9336
17	General Government and Defense	0.6488	0.7126	0.7198	0.6742	0.6726	0.9406
18	Other Services	0.8454	0.9093	1.0239	0.9940	1.0304	1.0727
19	Unspecified Sector	1.5812	0.7126	0.7198	0.8736	1.3348	1.1513

Sources: CBS (various years) and author's analysis.

Table 1.5: The Forward Linkage Indices of The 19 Sector Classification

Code	Sector	1971	1975	1980	1985	1990	1995
1	Paddy	1.2919	1.3419	1.2724	1.0974	1.0496	0.8862
2	Other Food Crops	0.8480	0.9092	0.8355	0.7694	0.7601	0.7465
3	Other Agriculture	1.2580	1.1292	1.0689	0.9531	0.8445	0.9189
4	Livestock and Its Products	0.9812	1.0351	1.1272	1.0772	0.7917	0.9847
5	Forestry	0.8711	0.8725	0.8470	0.7653	0.7719	0.7609
6	Fishery	0.9428	0.8954	0.8143	0.7440	0.7583	0.7213
7	Mining and Quarrying	1.3067	1.3088	1.2998	1.4652	1.3772	1.2636
8	Manufacture of Food, Beverages and Tobacco	0.9669	0.9661	0.9439	0.9475	1.0649	1.0663
9	Other Manufacturing	1.4277	1.5682	1.6300	1.6463	2.1018	2.3208
10	Oil Refinery	1.1309	0.8951	0.9510	1.3732	1.1796	0.9608
11	Electricity, Gas and Water Supply	0.8259	0.8282	0.9288	0.9278	0.9158	0.8510
12	Construction	0.7973	0.9170	0.8865	0.8473	0.8131	0.8310
13	Trade	1.3818	1.2618	1.1933	1.2748	1.1943	1.0886
14	Restaurant and Hotel	0.7882	0.7847	0.7870	0.7499	0.7617	0.7775
15	Transportation and Communication	1.1105	1.0659	1.0294	1.0508	1.0827	1.1992
16	Financial and other Services	0.8907	1.0188	0.9848	1.0142	1.0726	1.3778
17	General Government and Defense	0.6488	0.7126	0.7198	0.6742	0.6726	0.6580
18	Other Services	0.7535	0.7771	0.9607	0.9425	0.8902	0.8849
19	Unspecified Sector	0.7783	0.7126	0.7198	0.6801	0.8975	0.7021

Sources: CBS (various years) and author's analysis.

and forward linkages for 19 sectors. The calculation of these linkage indices is not only a descriptive tool to help keep overall macroeconomic balances but also an aid to formulating investment/ production decisions. A high linkage usually indicates that the expansion of an industry will most likely stimulate production in other sectors in the domestic economy.

The formula to measure the backward linkage index at time t (L_{bit}) is:

$$L_{bit} = \frac{\frac{1}{n} \sum_i a_{ij}}{\frac{1}{n^2} \sum_i \sum_j a_{ij}} \qquad (1.1)$$

where the numerator is the average stimulus created by sector j while the denominator is the average stimulus to the economy (the overall average)[12], n is the number of sectors, and a_{ij} is the elements in each row of the production inverse matrix in the Input-Output Table of Indonesia. Meanwhile, the forward linkage index at time t (L_{fjt}) is:

[12]The average stimulus to the economy is the total stimulus created by sector i and j divided by the number of sector i and j.

$$L_{fit} = \frac{\frac{1}{n} \sum_i b_{ij}}{\frac{1}{n^2} \sum_i \sum_j b_{ij}} \tag{1.2}$$

where the numerator represents the average stimulus from sector *i*, while the denominator is the average stimulus to the economy (the overall average), *n* is the number of sectors, and b_{ij} is the elements in each column of the production inverse matrix in the Input-Output Table of Indonesia. The use of the average stimulus to the economy as a denominator is to capture the sectoral shares of all productive activities in an economy so that all sectors are comparable.

As shown in Tables 1.4 and 1.5, manufacturing, other than the manufacture of food, beverages and tobacco, is an important sector in the Indonesian economy in terms of linkages. The forward linkage index in the "other manufacturing" sector (which includes the textile industry) is greater than its backward linkage index. This indicates that this sector is very sensitive to the rest of the economy (Poot *et al.*, 1992).

The backward linkage index for the oil refinery sector is greater than its forward linkage index. This implies that the expansion of the oil refinery sector raises demand in other sectors. In addition, the backward linkage index of the oil refinery sector has been greater than unity since 1971, while the forward linkage index of this sector ranged from 0.8951 to 1.3731. This shows that the power of dispersion of the oil refinery sector is greater than the degree of sensitivity of the oil refinery sector to the economy.

However, the forward linkage index of the mining sector which is dominated by the (crude) oil industry is higher than its backward linkage. The forward linkage of the mining sector has been greater than one since 1971. This indicates that this sector is sensitive to the rest of economy. This means that oil has two important factors, i.e., 1) the degree of sensitivity of crude oil to the rest of economy, and 2) the power of dispersion of its refined oil products to other domestic industries.

Agriculture does not seem an important unit for the Indonesian economy in terms of linkages. In 1995, the backward and forward linkage indices of this sector were just below one. This simply means that the agricultural sector is likely to be a weak stimulus for other industry. In fact, crop failure and long droughts in some areas have caused a significant decline in output in the agricultural sector.

Labour productivity is also a main factor affecting sectoral production. Different labour productivity results indicate that 1) different sectors operate different technology and employ different skills of labour, 2) economic policies yield different effects on sectoral activities, and 3) there are differences in sectoral composition. These ultimately cause sectoral employee compensation to differ. Thus, the sectoral labour share in Indonesia needs to be re-estimated, in order to offer another measure of Indonesia's TFP.

Tables 1.6 and 1.7 provide sectoral estimates of labour productivity levels and growth. These sectoral estimates present an additional perspective to the dimensions of technical change, despite being at an aggregate level. They indicate that labour productivity in the manufacturing sector has always been the highest among all sectors. This labour productivity (LP) is calculated as sectoral value added per worker divided by national value added per worker (Susanti *et al.*, 1995, p. 81). The formula is

$$LP_i = \frac{VA_i / H_i}{GDP / H} \times 100 \qquad (1.3)$$

where LP_i is labour productivity in sector i, VA_i is gross value added in sector i and H_i is number of workers in sector i, GDP is gross domestic product and H is total number of workers for all sectors. Equation (1.3) means that labour productivity in sector i is lower than national labour productivity if LP_i is less than one hundred. If LP_i is higher than one hundred, sectoral labour is more productive than national labour.

Table 1.6: Real Indices of Labour Productivity, 1971-1990

Sector	1971	1980	1990
Agriculture	65	43	39
Industry	206	314	243
I. Industry Excl. Mining	130	149	174
II. Manufacturing only	117	141	183
Services	152	112	120

Sources: CBS(various years) and Abimanyu (1995).
Notes: As in Equation (1.3), the labour productivity is expressed as an index, equaled 100.

For decades, agricultural labour productivity has shown the smallest index. Stated differently, the agricultural sector is the least productive sector in the Indonesian economy. Meanwhile, the manufacturing sector's productivity has increased significantly. This is at least partly due to the trade policy changes of the mid-1980s, which forced Indonesian firms to become more competitive and efficient.

Agriculture has steadily become less attractive as compared to other sectors. Its decrease in output share was particularly evident in the country's capital-intensive growth phase of the 1970s. Also, low returns in the agricultural sector and a fast increasing rate of agricultural land use for non - agricultural activities, in turn, caused the agricultural sector to be unattractive for (young) rural people so that agricultural output has declined sharply (Mubyarto, 1985 and CBS, 2003).[13] This decline has become a key factor in directing labour flows into non-agricultural activities.

The labour productivity in manufacturing industry, on the other hand, has risen, mainly because its production has increased sharply.[14] Most of this increase occurred in the 1980s when reforms increased the profitability of exports and foreign capital inflows. By contrast, the labour productivity in the service sector has varied, which implies a fluctuation of capital accumulation and technical change in this sector. The change of labour productivity in this sector was presumably because of the advances in finance, telecommunications and tourism (Abimanyu, 1995).

On average, labour productivity in manufacturing industry grew faster than in non-manufacturing and even the overall economy. The fast productivity growth in the 1970s reflected both the cast of extremely labour intensive, traditional technologies, and the push towards oil-financed heavy industry. In the 1980s, manufacturing was dominated by the adoption of a labour intensive, export-oriented industrialization strategy. Therefore, the share of the manufacturing sector rose. Nevertheless, the growth of labour productivity in this sector was still

[13]Around 3 per cent per year, the agriculture land has become a settlement or industrial complex (CBS, 2003).

[14]Also, rural people tend to offer low wages for manufacturing industry.

significant, averaging 5.7 % per year during the 1980s.

Labour productivity growth in the agricultural sector was three times as high in the 1970s as in the 1980s. This was because the oil boom of the 1970s made the non-agricultural sectors look more promising. As a result, labour moved into non-agricultural activities out of agriculture. Since there was a net surplus of workers in agriculture, their departure had little or no effect on output, meaning that labour productivity (measured as output per worker) went up.

Table 1.7: The Growth of Labour Productivity (%), 1971- 1990

Sector	1971-1980	1980-1990	1971-1990
Agriculture	3.1	1.0	2.0
Industry	3.6	-0.3	1.5
I. Industry Excl. Mining	1.2	5.3	3.3
II. Manufacturing only	10.0	5.7	7.7
Services	1.3	3.0	2.2
All economy	4.1	2.2	3.1

Sources: CBS (various years) and Abimanyu (1995).
Notes: The figures refer to annual average growth rate of sectoral value added per worker.

In addition to labour movement, output expansion may also affect the growth rate of labour productivity.[15] The speed of output expansion is determined

[15]See also the nominator of Equation (1.3).

by the rate of industrial investment and capital accumulation in the modern sector (Lewis, 1954 and Todaro, 2000). If returns on investments in the non-agricultural sector (i.e. urban industrial sector) are high, this stimulates investors to reinvest all their profits.[16] This produces new job creation and in turn, raises the level of wages in the modern sector. If the average urban wages in the non-agricultural sector are higher than average rural income, this induces workers to migrate from their home areas (Todaro, 2000).[17] In fact, in 1990, the average monthly income of workers in the urban manufacturing sector (Rp 109,227.00) was 117% higher than in the rural agricultural sector (Rp 50,459.00) (CBS, 1991). Also, total output in the manufacturing sector in real terms jumped around eight times in 1985 and around ten times in 1990 as compared to total output in 1980; this is an increase of around Rp 12 trillion (the CBS, 1994). That is why, as in Table 1.7, the growth of labour productivity in the manufacturing sector in the period 1980-1990 was higher than the growth of labour productivity in the agricultural sector.[18]

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[16]This assumes that the job creation in the modern sector is proportional to the rate of industrial investment and capital accumulation in that sector.

[17]If investors, however, invested their profits in more advanced technological equipment rather than just reinvested in the same equipment, this would actually induce less labour per unit of output. In turn, total output in this sector may grow, but wages and labour growth rate remain unchanged. This may also be the cause of *antidevelopmental economic growth* as all extra income and output growth are returned to the investors and there is no gain for labour income (Todaro, 2000).

[18]However, Todaro (2000) states that "institutional factors such as union bargaining power, civil service wage scales, and multinational corporations hiring practices tend to negate whatever competitive forces might exist in [the] LDC modern sector

As shown in Table 1.7, although the growth rate of labour productivity in the manufacturing sector declines from 10% to 5.7%, the growth of labour productivity in services increases from 1.3% to 3%. This is because in the late-1980s, investment in banking services in Indonesia jumped tremendously. Bank offices, for example, grew by almost 200 % in 1990, i.e. from 980 offices in 1980 to 2709 offices in 1990 (Bank of Indonesia, 1993).[19] This was because the government announced a new banking regulation package in October 1988, known as *PAKTO'88*, which allowed entry in the banking sector to new participants and significantly reduced the requirement of initial capital to establish a new bank. In addition, the 1990 average monthly income of workers in urban financial services (Rp 264,928.00) was almost triple that in the urban manufacturing sector. Because financial services as a labour-intensive activity in the late-1980s looked more promising, it appears that the rate of labour transfer from manufacturing to services increased. This ultimately caused the growth of labour productivity in urban manufacturing sector to be slower than the growth rate of labour productivity in the urban services sector.

The decline of the growth of labour productivity also implies that other factors play an important role. It certainly indicates that technological progress

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labo[u]r market".

[19]This is for private banking only. Bank offices include branch offices and main offices.

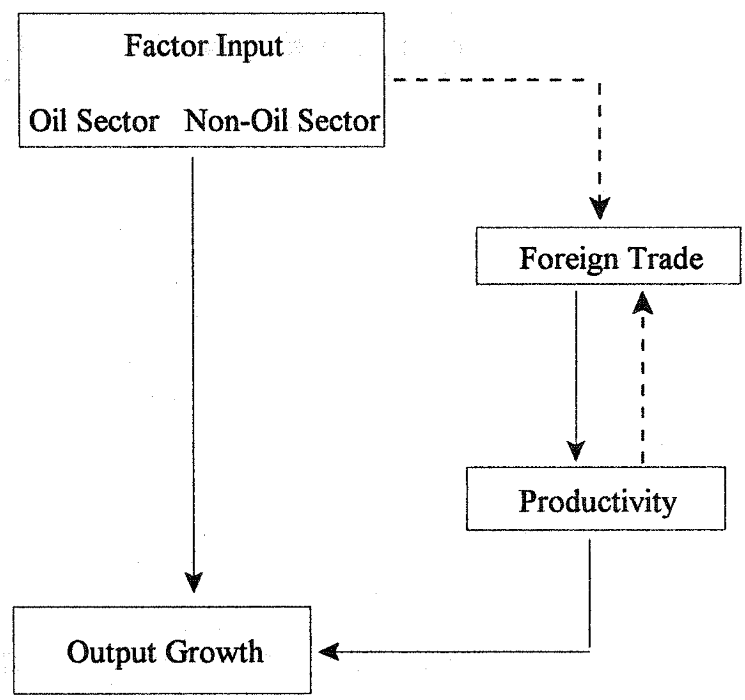
became a crucial factor in the production system. In the 1980s, economic units in Indonesia were switched from labour-intensive units to more capital-intensive units. The purpose of this switch was usually to improve the production system as a result of trade liberalization in the 1980s. Stated differently, because technological progress is likely to be a determinant of output growth, it is possible that the growth of labour productivity in Indonesia tends to fall.

Therefore, total factor productivity along with factor accumulation will be important elements in affecting output growth. This will be the subject of the next chapter.

1.3. Synthesis of the Results

The study finds that output growth in Indonesia can be traced to the increase in capital growth, labour growth and productivity growth. The study also finds that there is a link between foreign trade and productivity. Thus, we can learn lessons about the main causes of growth in Indonesia using a standard growth model. The thesis ultimately characterizes the links of growth, productivity and foreign trade as depicted in Figure 1.2. The first link is a direct relationship between factor input (i.e. capital and labour in the oil sector and non-oil sector) and output growth. The study finds that, although in general, factor input has a positive link with output growth, in Indonesia capital growth tends to have a higher impact on output growth than labour growth. This means that the Indonesian economy has become more capital intensive and less labour intensive. Stated differently, Indonesia has undergone a transition from a more traditional economy to a more advanced industrial economy.

Figure 1.2: Growth Links



Notes:

———————→ : Direct Impact

- - - - - - - - → : Potential Impact (Not explored in this study)

The study seems to underline the Solow Neoclassical growth theory, which noted that productivity (or technical change) is an important factor in affecting growth. However, the study does not argue that factor accumulation is not important. Rather, the study shows that productivity together with factor accumulation play an important role in explaining economic growth of Indonesia. This concludes that output growth results from increases in capital, increases in labour quantity and quality (through better educational attainment) and improvements in technology (See also, Todaro, 2000).

Although the Indonesian economy was heavily dependent on the oil sector in the 1970s and early 1980s, the study does not find a significant impact of the oil sector on economic growth. The externality effect of oil on the Indonesian economy is shown to be relatively small (i.e. less than five per cent), and largely due to capital accumulation. The small impact of oil on the economy supports the argument that fluctuations of world oil prices, the monopoly position of Pertamina in the domestic market, and the government's trade liberalization policy tend to reduce the net effect of the oil sector.

Another link, as shown in Figure 1.2, is the assertion that foreign trade induces output growth to rise through productivity growth. This happens because foreign trade may increase economies of scale of domestic firms. The positive link between foreign trade and productivity and growth means that an increase in exports provides a stimulus to GDP and in turn, an increase in local demand which may lead to the technological progress of domestic firms. Hence, foreign trade becomes an engine of growth in Indonesia.

The study also confirms that the impact of the oil sector on productivity and output growth is smaller than the non-oil sector. This is because the oil sector is relatively stagnant as a result of the depletion of oil reserves and OPEC's production quota. Stated differently, the policy of trade liberalization may have been well-timed and well-placed to boost the Indonesian economy from the mid-1980s on.

On the other hand, the causality of export and productivity growth is somewhat ambiguous. Bernard and Jensen (1999), for example, argue that "the positive correlation between exporting and productivity levels appears to come from the fact that high productivity plants are more likely to enter foreign markets". If this is the case, it seems that factor inputs which increase technological progress may play an important role in influencing the growth of Indonesian exports.

As shown in Figure 1.2, regardless of the causal relationship between foreign trade and productivity growth, an increase in capital inputs may affect the export share variable. (See the dotted line.) In this context, if capital inputs vary across sectors due to different rates of capacity utilization, and these rates vary systematically with export demand, then the significance of the export share variable on productivity and output growth is due to this capital variation. Thus, in this case, the export share variable becomes an intervening variable. The study, however, finds a very small correlation between capital growth and the export share variable and an insignificant relationship with the second lag of the export share variable.[20] Because of this small correlation, along with the treatment of capital as a single independent variable, the export variable has a direct impact on productivity. This happens because in spite of having (imperfect) data on capital stock, the long-run export demand fails to show a direct competitive pressure on productivity of domestic firms. Stated differently, the role of the long-run export demand in influencing sectoral capacity utilization rates is not significant.

A similar argument can also be made for the labour input variable. An increase in the quality of labour (e.g., improved skill composition) may induce export share growth. Sectors with more skilled labour will have a faster export growth than ones with less skilled labour input. If this variation is correlated, then the significance of the export share variable will be due to differences in the skill of labour. The study, however, finds a very small correlation between labour inputs and export share. Thus, we may assume that the variation between sectors with more skilled labour and less skilled labour does not have a significant effect on productivity and output growth.

As of the mid-1990s, most of Indonesia's manufactured exports can be

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[20]In certain cases, the increase in capital services raises GDP. So, the share of exports in GDP tends to decline, *ceteris paribus*.

characterized as natural resources and unskilled labour intensive goods (Wee, 2002). In this case, improvements in capital and labour inputs will have a small impact on exports. Having said this, the depletion of renewable resources, along with strong competition from other low wage industrializing countries such as China, Vietnam and Bangladesh, has caused Indonesian exports which rely on natural resources and unskilled labour to decline. Wee (2002) and Rosser (2002) note that "in the 1990s the growth of Indonesia's manufactured exports began to slow down" as a result of the economic reforms in Vietnam and China. In turn, this persuaded Indonesia's industrial policy makers to promote more technological and skilled-labour intensive industries. Indeed, today's firms tend to operate in a more advanced business environment that are characterized by high rates of technological change, intense competition, and rapid product cycles. Therefore, the best economic incentives for sustaining Indonesian exports will be to continue macroeconomic stability which supports labour productivity and technological development.

The study also finds that different estimation techniques such as OLS and Instrumental Variable methods tend to yield different estimation results. Because an endogeneity problem occurs in our regression model, we get inconsistent and biased estimates if we use an OLS estimation procedure as measurement errors occur. Therefore, we note that different estimation techniques produce different outcomes. (See also Razzak, 2003).

Because the contribution of labour and capital growth varies, a more careful measurement of factor shares is required to obtain a Total Factor Productivity (TFP). To check the robustness of this measure, the study proposes the use of alternative data sets based on energy consumption and educational attainment.

At least two recommendations can be proposed. First, the Government of Indonesia should eliminate the monopoly in the oil industry. The monopoly tends to reduce the positive effects of the oil industry in Indonesia. Second, the government should selectively develop key industrial success areas to obtain the benefits of international competition, i.e., to foster efficiency. Thus, strong and healthy domestic firms will induce productivity and economic growth.

There is much that the government can do to improve labour productivity. Chief among these is education and training, which can ultimately raise the standard of living of Indonesians and improve international competitiveness. This may be important because, in the twenty-first century, Indonesian exporters may no longer be able to compete with other countries on the basis of low wages.

Another lesson that can be cautiously observed is that the economic growth of Indonesia was "not a myth" as suggested by Krugman (1994), who argued that growth in Asian countries, including Indonesia, has been driven by factor accumulation rather than productivity growth. During the sample period, this study finds that the contribution of productivity growth has been higher than increases in the quantity and quality of factor inputs. (See also, for example, Aswicahyono, 2000, and Hill, 2000). In this context, Easterly and Levine (2001) also conclude that the TFP residual - besides factor accumulation- plays an important role in "explaining differences in economic performance across countries". Because productivity tends to account for the growth in Indonesia, it is useful to set up national policies which are closely associated with productivity growth rates. This relates to technology and externalities (Easterly and Levine, 2001). Therefore, trade policies are a strategic decision to increase income growth and to impose technology transfer from the more highly technological countries.[21]

Finally, given this trade policy, economic activities only flowing to the richest people, as happened in the New Order Era, must be ended.[22] This is because these activities may reduce any "good" economic performance. The rich get richer while the poor, in real terms, gets poorer, if not unchanged.

One of the main problems in examining the sources of growth in developing countries is the lack of reliable economic data. Although data are relatively available, the quality of the data needs careful scrutiny, especially the IO data sets.

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[21]The study addresses two important results. The first is that the sustainability of Indonesian exports is in a challenge. Neither oil nor non-oil exports offer security for long-term growth in Indonesia. Current leading exports such as manufactured goods have been growing very slowly, it at all. Regardless of data limitations, these sectors appear to have reached their peak values or the market perhaps has been saturated. The second result is that job creation/ absorption is restrained as domestic firms which are (unskilled) labour-intensive units experience a decline.

[22]In the New Order Era, the economy was dominated by the "Few Rich People", such as Liem Sioe Liong (Sudono Salim) and The Kian Seng (Bob Hassan), who were very close to President Soeharto.

The study shows that measures of productivity growth vary depending on the data and method used. Further studies on the determinants of productivity and output growth in an individual sector are important, especially to formulate sectoral policy recommendations.

The study shows that the coefficients of factor inputs are quite sensitive to the estimated model specification. Thus, since each sector may have different characteristics, it is important to investigate sectoral structural shifts using, for example, a fixed effect model in each sector.

To improve the quality of labour income, self-employment incomes have to be included in future labour force surveys. This improvement is required to obtain better information on Indonesia's labour share measures, so productivity can be better estimated.

CHAPTER 2

A TWO-SECTOR MODEL OF GROWTH

2.1. Introduction

This study seeks to fill an empirical gap in the recent literature by investigating the determinants of output growth in Indonesia. To this end, the study uses a growth model to disentangle the growth in output into growth in capital and labour inputs in the oil and non-oil sectors and growth in productivity. Then, using Ordinary Least Square (OLS) and Instrumental Variables estimation techniques, the study attempts to estimate the relative contribution of factor inputs and productivity change to Indonesia's economic growth.

The analysis also compares the magnitude of the oil sector with the non-oil sector. This comparison is used to measure the externality and efficiency effects of the oil sector in the Indonesian economy; something that has never been done before for the case of Indonesia. The Government of Indonesia has viewed oil as an engine of economic growth. In this context, as a strategic industry, the government subsidizes the production cost of oil to stabilize domestic fuel prices, causing an allocative inefficiency. Given the linkages of oil as outlined in Chapter 1, any inefficiency in this industry may actually spill over to other industries. Thus, the production possibilities of oil will affect the production of other sectors.

This means that we can approach the effect of oil on the Indonesian economy by measuring the externality and efficiency effects. These effects represent spillover effects of oil on the economy. In the literature, spillover effects become significant indicators for the dissemination of productivity. The effects occur when one industry gains "improvement" from other industries (usually export-oriented industries) which usually have superior "knowledge". Therefore, the study examines the contribution of the oil sector to economic growth, and explores the relationship between the growth of inputs and productivity, while investigating the externality and efficiency effects on the Indonesian economy.

The chapter is divided into six sections. After the introductory section, Section 2 lays out the model developed in this study. A two sector growth model is introduced to estimate the impact of oil on the Indonesian economy. Section 3 addresses the data and model specification used in the study. This section is also designed to set up a capital stock data bank for Indonesia based on the Nehru-Dhareswar data bank. Section 4 addresses the estimation issue and checks the aspects of micronumerosity, multicollinearity and stationarity of the data. Section 5 presents the econometric results and analyzes the results while Section 6 provides concluding remarks.

2.2. The Model

2.2.1. The Role of Oil in the Economy

The model used here to derive the effects of the oil sector on output growth essentially follows the production function approach developed by Feder (1983), Caballero and Lyons (1992), İşcan (1998b) and others. In the model, the economy is viewed as if it consists of two distinct sectors: one producing oil goods, and the other producing non-oil goods. Suppose output per sector is a function of factors allocated to each sector. In addition, non-oil sector output (W) depends on oil sector output (O). In this case, the following production functions follow:

$$W = f(K_W, H_W, O, A_w) \qquad (2.1)$$

$$O = g(K_O, H_O, A_o) \qquad (2.2)$$

where:

1. W and O are output in the non-oil sector and oil sector, respectively;
2. K_i is physical capital services in sector i, s.t. $i = W, O$;
3. H_i is total employment in sector i;
4. A_i is a measure of total factor productivity (TFP) in sector i.

Equations (2.1) and (2.2) imply that oil production has externality effects on the rest-of-the-economy but the rest-of-the-economy has no externality effect on the oil sector. In other words, the externality or spillover relationship between the oil and non-oil sectors is unidirectional. (We relax this assumption later).

An alternative way to look at the oil and non-oil sector relationship is to treat oil as an intermediate input in the production process in Indonesia. Oil is, in fact, mainly used as a fuel (energy source) by the non-oil sector. However, it is potentially more relevant to consider the effect of oil on the economy in externality terms rather than in intermediate input terms. The production possibilities of the non-oil sources are greatly affected by the production of the oil sector because there is no perfect substitute for oil. Equations 2.1 and 2.2 also allow us to compare the efficiency effect of the production factors (capital and labour) in the oil and non-oil sectors on economic growth. Therefore, the inclusion of O separately in equations 2.1 and 2.2 allows us to capture both the externality and efficiency effects of the oil sector, while the treatment of oil as an intermediate input captures only the efficiency effect of oil on economic growth.

To measure the contribution of K and H in each sector, a growth model is needed. For this, we begin by differentiating equations (2.1) and (2.2) with respect to time. This gives:

$$\frac{dW}{dt} = \left(\frac{\partial f}{\partial K_W}\right)\left(\frac{dK_W}{dt}\right) + \left(\frac{\partial f}{\partial H_W}\right)\left(\frac{dH_W}{dt}\right) + \left(\frac{\partial f}{\partial O}\right)\left(\frac{dO}{dt}\right) + \left(\frac{\partial f}{\partial A_W}\right)\left(\frac{dA_W}{dt}\right), \quad (2.3)$$

$$\frac{dO}{dt} = \left(\frac{\partial g}{\partial K_O}\right)\left(\frac{dK_O}{dt}\right) + \left(\frac{\partial g}{\partial H_O}\right)\left(\frac{dH_O}{dt}\right) + \left(\frac{\partial g}{\partial A_O}\right)\left(\frac{dA_O}{dt}\right). \quad (2.4)$$

Equation (2.3) means that the change in non-oil output (dW/dt) is a function of the marginal productivities of capital (K) and labour (H) multiplied, respectively, by the change in capital and by the change in employment in W. A similar interpretation holds for equation (2.4). In addition, in equation (2.3), $\partial f/\partial O$ describes the marginal externality effect of oil output on the output in sector W, while dO/dt refers to the change in oil output. Equations (2.3) and (2.4) also show productivity shift factors in sectors W and O, given by the productivities of TFP in each sector multiplied by the change in TFP in each sector.

Suppose for each input the ratio of sectoral marginal products for each factor deviates from unity, such that

$$\left[\frac{\left(\partial g/\partial K_O\right)}{\left(\partial f/\partial K_W\right)}\right] = 1 + \theta_K , \quad (2.5)$$

and

$$\left[\frac{\left(\partial g / \partial H_O\right)}{\left(\partial f / \partial H_W\right)}\right] = 1 + \theta_H \quad . \tag{2.6}$$

When $\theta_i \neq 0$, for $i = K, H$, this equation reflects the difference in factor efficiencies due to a mis-allocation of resources. The allocation of resources that would optimize national output is $\theta_i = 0$, for $i = K, H$. This occurs if factors are perfectly mobile across sectors. Otherwise, there may be a difference in innovativeness, adaptability or efficiency across sectors (Feder, 1983, p. 61).[1]

Denoting real gross domestic product by Q, by definition,

$$P_Q Q = P_W W + P_O O. \tag{2.7}$$

Dividing both sides of equation (2.7) by P_Q, we obtain

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[1]See also Esfahani (1991, p. 97).

$$Q = \left(\frac{P_W}{P_Q}\right) W + \left(\frac{P_O}{P_Q}\right) O \tag{2.8}$$

Substituting equations (2.1) and (2.2) into (2.8), we get

$$Q = \left(\frac{P_W}{P_Q}\right) \left[f(K_W, H_W, O, A_W)\right] + \left(\frac{P_O}{P_Q}\right)\left[g(K_O, H_O, A_O)\right] \tag{2.9}$$

Let oil and non-oil value added functions be homogenous of degree one in prices (*P*) and the productivity index (*A*). Then,

$$Q = \left[F(K_W, H_W, O, A_W, \frac{P_W}{P_Q})\right] + \left[G(K_O, H_O, A_O, \frac{P_O}{P_Q})\right] \tag{2.10}$$

Taking derivatives of equation (2.10) with respect to time (*t*), we get

$$\frac{dQ}{dt} = \left(\frac{\partial F}{\partial K_W}\right)\left(\frac{dK_W}{dt}\right) + \left(\frac{\partial F}{\partial H_W}\right)\left(\frac{dH_W}{dt}\right) + \left(\frac{\partial F}{\partial O}\right)\left(\frac{dO}{dt}\right) + \left(\frac{\partial F}{\partial A_W}\right)\left(\frac{dA_W}{dt}\right)$$

$$+ \left(\frac{\partial F}{\partial\left(\frac{P_W}{P_Q}\right)}\right)\left(\frac{d\left(\frac{P_W}{P_Q}\right)}{dt}\right) + \left(\frac{\partial G}{\partial K_O}\right)\left(\frac{dK_O}{dt}\right) + \left(\frac{\partial G}{\partial H_O}\right)\left(\frac{dH_O}{dt}\right) + \left(\frac{\partial G}{\partial A_O}\right)\left(\frac{dA_O}{dt}\right)$$

$$+ \left(\frac{\partial G}{\partial\left(\frac{P_O}{P_Q}\right)}\right)\left(\frac{d\left(\frac{P_O}{P_Q}\right)}{dt}\right) \tag{2.11}$$

where dQ/dt is the change in output for the whole economy.

Meanwhile, equations (2.5) and (2.6) can also be written as

$$\left(\frac{\partial G}{\partial K_O}\right) = (1+\theta_K)\left(\frac{\partial F}{\partial K_W}\right), \tag{2.12}$$

$$\left(\frac{\partial G}{\partial H_O}\right) = (1+\theta_H)\left(\frac{\partial F}{\partial H_W}\right). \tag{2.13}$$

Substituting equations (2.12) and (2.13) into (2.4), we obtain, after some manipulation,

$$\frac{dO}{dt} = (1+\theta_K)\left(\frac{\partial f}{\partial K_W}\right)\left(\frac{dK_O}{dt}\right) + (1+\theta_H)\left(\frac{\partial f}{\partial H_W}\right)\left(\frac{dH_O}{dt}\right) + \left(\frac{\partial g}{\partial A_O}\right)\left(\frac{dA_O}{dt}\right) \tag{2.14}$$

Substituting equation (2.14) into (2.11), we obtain

$$\frac{dQ}{dt} = \left(\frac{\partial F}{\partial K_W}\right)\left(\frac{dK_W}{dt}\right) + \left(\frac{\partial F}{\partial H_W}\right)\left(\frac{dH_W}{dt}\right) + \left(\frac{\partial F}{\partial A_W}\right)\left(\frac{dA_W}{dt}\right)$$

$$+ \left(\frac{\partial F}{\partial P_1}\right)\left(\frac{dP_1}{dt}\right) + \left(\frac{\partial F}{\partial O} + 1\right)(1+\theta_K)\left(\frac{\partial F}{\partial K_W}\right)\left(\frac{dK_O}{dt}\right)$$

$$+ \left(\frac{\partial F}{\partial O} + 1\right)(1+\theta_H)\left(\frac{\partial F}{\partial H_W}\right)\left(\frac{dH_O}{dt}\right) + \left(\frac{\partial F}{\partial O} + 1\right)\left(\frac{\partial G}{\partial A_O}\right)\left(\frac{dA_O}{dt}\right)$$

$$+ \left(\frac{\partial G}{\partial P_2}\right)\left(\frac{dP_2}{dt}\right), \tag{2.15}$$

where $P_1 = \left(\frac{P_W}{P_Q}\right)$ and $P_2 = \left(\frac{P_O}{P_Q}\right)$.

Rearranging terms, we obtain

$$\frac{dQ}{dt} = \left(\frac{\partial F}{\partial K_W}\right)\left(\frac{dK_W}{dt}\right) + \left(\frac{\partial F}{\partial O}+1\right)(1+\theta_K)\left(\frac{\partial F}{\partial K_W}\right)\left(\frac{dK_O}{dt}\right)$$

$$+\left(\frac{\partial F}{\partial H_W}\right)\left(\frac{dH_W}{dt}\right) + \left(\frac{\partial F}{\partial O}+1\right)(1+\theta_H)\left(\frac{\partial F}{\partial H_W}\right)\left(\frac{dH_O}{dt}\right)$$

$$+\left(\frac{dTFP}{dt}\right)+\left(\frac{dP_{1W}}{dt}\right)+\left(\frac{dP_{2O}}{dt}\right), \tag{2.16}$$

where the change of productivity with respect to time t, $(dTFP/dt)$, equals $\{(\partial F/\partial A_W) \times (dA_W/dt)\} + \{[(\partial F/\partial O) + 1] \times (\partial G/\partial A_O) \times (dA_O/dt)\}$, and the relative price effect of non-oil, (dP_{1w}/dt) is $\{(\partial F/\partial P_1) \times (dP_1/dt)\}$ and the relative price effect from oil is (dP_{2o}/dt) is $\{(\partial G/\partial P_2) \times (dP_2/dt)\}$. In other words, the change in productivity in the economy is the sum of the change of productivity in the non-oil sector and productivity growth in the oil sector, after accounting for spillover effects plus the relative price effect.

If the relative price effect is zero, economic growth consists of the growth of inputs in the non-oil sector and the oil sector, as well as productivity growth. If the price effect is non-zero, equation (2.16) holds. This suggests that reallocation of resources across sectors could be an important source of economic growth in

Indonesia. This relative price effect then reflects the economic rate of substitution between oil and non-oil.

Under the present formulation, productivity differentials with respect to capital and employment for each sector are due to externalities and efficiency effects. Equation (2.16) tells us that if there exists an optimum allocation of resources or the efficiency levels of the oil and non-oil sectors are the same, such that $\theta_K = 0$ and $\theta_H = 0$, and if there is no intersectoral externality from oil, i.e., $\partial F/\partial O = 0$, the impact of capital and total employment on economic growth from each sector will be the same. However, different efficiencies across sectors plus externality effects from the oil sector are likely to exist, i.e. $\theta_K \neq 0$ and $\theta_H \neq 0$ and $\partial F/\partial O \neq 0$. Therefore, the contribution to growth of capital in the oil sector to growth can be weighted by $[\{(\partial F/\partial O) + 1\} \times (1+\theta_K)]$ times the marginal productivity of capital, while the contribution of employment in the oil sector can be weighted by $[\{(\partial F/\partial O) + 1\} \times (1+\theta_H)]$ times the marginal productivity of employment.

When perfect competition and constant returns to scale prevail, all factors of production are paid their marginal products. Under these circumstances, the share of income with respect to capital and employment in sector *W* can be defined as

$$\beta_{KW} = \left(\frac{\partial F}{\partial K_W}\right) \left(\frac{K_W}{Q}\right), \tag{2.17}$$

$$\beta_{HW} = \left(\frac{\partial F}{\partial H_W}\right) \left(\frac{H_W}{Q}\right). \tag{2.18}$$

After dividing both sides of equation (2.16) by Q, and substituting equations (2.17) and (2.18), as well as denoting $[(dQ/dt)/Q] = gQ_t$, we obtain

$$gQ = \beta_{KW}gK_W + \alpha_{KO}gK_O + \beta_{HW}gH_W + \alpha_{HO}gH_O$$
$$+ \rho_{1W}gP_{1W} + \rho_{2O}gP_{2O} + gTFP \tag{2.19}$$

where:

1. $gK_W = [(dK_W/dt)/K_W]$ is the growth rate of the capital stock in the non-oil sector (W);
2. $gK_O = [(dK_O/dt)/K_O]$ is the growth rate of the capital stock in the oil sector (O);
3. $gH_W = [(dH_W/dt)/H_W]$ is employment growth in sector W;
4. $gH_O = [(dH_O/dt)/H_O]$ is employment growth in sector O;

5. $gTFP$ is total factor productivity growth (also known as technical change);

6. gP_{1W} and gP_{2O} are the relative price effect growth of the non-oil and oil sectors; and

$$\alpha_{HO} = \left(\left(\frac{\partial f}{\partial O}\right) + 1\right)\left(1 + \theta_H\right)\left(\frac{\partial F}{\partial H_W}\right)\left(\frac{H_O}{Q}\right),$$

$$\alpha_{KO} = \left(\left(\frac{\partial F}{\partial O}\right) + 1\right)\left(1 + \theta_K\right)\left(\frac{\partial F}{\partial K_W}\right)\left(\frac{K_O}{Q}\right),$$

$$\rho_{1W} = \left(\frac{\partial F}{\partial P_{1W}}\right)\left(\frac{P_{1W}}{Q}\right),$$

$$\rho_{2O} = \left(\frac{\partial F}{\partial P_{2O}}\right)\left(\frac{P_{2O}}{Q}\right).$$

Equation (2.19) tells us that the growth rate of real gross domestic product (economic growth) is a function of the growth rate of the capital stock in each sector, and employment growth in each sector plus total productivity growth and growth in relative price effects. It is useful to note that the parameter β_{KW} in equation (2.19) should not necessarily be interpreted as the capital-output ratio times the marginal value product of capital in the economy. If there is an optimum allocation of resources[2] and no inter- sectoral externality[3], equation (2.19) becomes the standard neo-classical growth accounting equation. The parameters β and α will equal the shares of sectoral capital and employment in GDP, respectively. In this case, the marginal value product of factors of production in the non-oil sector would be identical to those in the oil sector.

However, for developing countries, the parameter $[\{(\partial f/\partial O)+1\} \times (1+\theta_i)]$, i.e., the externality and efficiency effects for $i = K, H$, is likely to be non-zero due to, for example, different technology across sectors (Balassa, 1978, Feder, 1983 and Esfahani, 1991).[4] The total effects of the oil sector with respect to capital (K) and employment (H) are weighted by the sum of the externality and efficiency effects of the oil sector with respect to K and H.[5]

Inserting a time dimension and introducing error terms (ε_t), equation (2.19) becomes

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[2]This implies that each sector has the same efficiency, i.e. $\theta_K = \theta_H = 0$.

[3]This means $\partial f/\partial O = 0$.

[4]In our case, oil is an important energy input for other sectors. Due to the likelihood of forward linkages between oil sector and the rest of economy, it is possible that $\partial f/\partial O \neq 0$.

[5]We will use the terms "total" effect and the "externality and efficiency" effects interchangeably.

$$gQ_t = gTFP + \beta_{KW}\, gK_{Wt} + \alpha_{KO}\, gK_{Ot} + \beta_{HW}\, gH_{Wt} + \alpha_{HO}\, gH_{Ot}$$
$$+ \rho_{1W}\, gP_{1Wt} + \rho_{2O}\, gP_{2Ot} + \varepsilon_t \ , \qquad (2.20)$$

where *gTFP* is constant and t = 1967, 1968, ..., 2000.

The coefficient parameters in equation (2.20) indicate the contribution of factor accumulation by sector towards economic growth. One of our objectives is to determine the respective contributions of capital or labour or other factors (i.e. technical change, and price growth) to the economic growth of Indonesia over the time period in question.

The main departure of this study from the standard model is that our study extends the inputs and includes sectoral output as a potential input to aggregate output. By doing so, the study can investigate the contribution of capital and labour in the oil sector to Indonesian economic growth.

A priori, if capital increases while other variables such as labour inputs remain constant, the signs of the parameters β_{KW} and α_{KO} should be non-negative, showing a positive relationship between capital and growth in Indonesia. Meanwhile, because Indonesian labour is mostly unskilled, the growth rate of labour inputs is likely to have a small effect on output growth. Thus, β_{HW} and α_{HO} will be small (or not significantly large), although still positive.

Because of the existence of the externality and the efficiency effects from the oil sector, the impact of each independent variable will be different. This is what allows us to test the significance of the oil sector on overall economic growth.

Caballero and Lyons (1992) suggest regressing the aggregate and sectoral data to investigate variation in the growth of inputs. The difference of parameters in the aggregate (e.g., β_K) and sectoral (e.g., β_{KW}) models will denote the external effects.[6] They claim that if the parameter is non-negative, returns to scale will be larger at the aggregate level where the externality has been internalized. Borrowing their argument, in our study the difference of the point estimates of β_K and β_{KW} can be interpreted as the externality effect of the oil sector on economic growth. Because their approach is practical, we will employ the Caballero and Lyons method to measure the externality effect of the oil sector on economic growth in Indonesia.[7]

Once the externality effect across sectors is obtained, using a definition of β_{KW}, β_{HW}, α_{KO} and α_{HO} as in equations (2.17), (2.18) and (2.19), the efficiency effect (θ_i where $i = K, H$) of the oil sector can be estimated. A negative sign for θ_i will indicate that the oil sector is less efficient than the non-oil sector. For example, if $\theta_K < 0$, this means that capital in the oil sector is less efficient than in

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[6]Denoting social marginal productivities with respect to capital as $\partial F/\partial K$ and with respect to employment as $\partial F/\partial H$, factor shares are $\beta_K = (\partial F/\partial K) \times (K/Q)$, and $\beta_H = (\partial F/\partial H) \times (H/Q)$. The contribution of capital and employment in the aggregate level will be estimated by using a regression of aggregate inputs towards total output.

[7]The derivation of the growth model at the aggregate level is provided in Appendix 2.1.

the non-oil sector, *ceteris paribus*.[8]

The sign of the total factor productivity growth variable is expected to be non-negative when output is increasing faster than would be predicted by the growth of inputs alone. This implies that technological progress has a positive impact on economic growth in Indonesia.

The sign of the price effect of the non-oil sector is expected to be non-negative but the sign for the oil sector should be negative.[9] This is because this variable can be interpreted as the economic rate of substitution, i.e., the rate at which one factor can be substituted for another, while maintaining a constant cost to obtain an optimum output. Theoretically, this condition requires the economic rate of substitution to be equal to the technical rate of substitution. This means output will be optimum if and only if costs are minimized. Therefore, if the relative prices are constant, there will be no price effect in the model because $dP/dt = 0$. However, the absence of the relative price effects will introduce an omitted variable bias. Our model will be estimated with and without the price effect variable to see whether the bias significantly reduces the performance of the model.[10]

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[8]See equations (2.11), (2.12) and (2.13).

[9]We use domestic oil prices as the price variable for the oil sector.

[10]The result when the relative price effect is absent in the model is reported in Appendix 2.5.

Finally, two dummy variables will be introduced at a later point. These variables are related to the recessions of 1982 and 1998; they have a value of one if the year is after 1982 and 1998, respectively, and zero otherwise.[11]

2.2.2. The Effect of The Non-Oil Sector on The Oil Sector

If we relax the assumption of a zero externality effect from the rest of the economy to the oil sector, as per equation (2.2), equation (2.2) then becomes

$$O = g_W\,(K_O, H_O, W, A_O) \qquad (2.21)$$

The inclusion of an externality effect from the non-oil sector to the oil sector may be reasonable because not only technical change but also capacity utilization in the non-oil sector may affect production capacity in the oil sector. It is, moreover, of interest to determine if the non-oil sector yields a larger externality effect than the oil sector.

In this study, however, we will not test for the effect of the non-oil sector on the oil sector as per equation (2.21) for at least two reasons. First, we assume that technical change in the non-oil sector has been included when estimating

[11]The 1982 period is selected as a starting point for less dependence of the Indonesian economy on oil. This period shifted not only domestic but also foreign demand for non-oil commodities. Meanwhile, the 1998 period relates to the monetary crisis in Indonesia. These anomalous periods will be further discussed.

productivity growth in the model. Second, the inclusion of an externality effect from the non-oil sector requires more detailed and longer time-series data than we have. For example, the development in the non-oil sector of manufacturing and transportation sectors stimulates demand for oil. But, it is necessary to disaggregate the non-oil data to capture more precisely this externality effect, and due to data limitations, this is not possible here.

2.3. The Data and Model Specification

2.3.1 Data Sources

The study will be mainly based on data taken from the World Bank (WB) such as the Nehru-Dhareswar data set (ND data), and the *World Development Indicators 2001* CD-ROM. The other main data sources are the Central Board of Statistics of Indonesia (CBS), the International Monetary Fund (IMF), the Bank of Indonesia (BI), the Embassy of the USA and the website, for example, http://www.pertamina.com. Detailed sources for each variable are noted in the next section. All data, unless otherwise noted, is for the period 1967-2000.

The growth rate of any variable gV_t is calculated by using a simple growth formula as follows

$$gV_t = \frac{(V_t - V_{t-1})}{V_{t-1}} \times 100 \qquad (2.22)$$

2.3.2. Model Specification

2.3.2.1. Output

The dependent variable, i.e. the output growth rate, is measured in real rupiahs, the Indonesian currency. This variable is constructed by using the Indonesian Gross Domestic Product (GDP) deflated for 1987 prices. Data on GDP and the deflator are serially complete. These data are from the World Bank CD-ROM, expanded by sources from the International Financial Statistical Yearbook of the International Monetary Fund and the Indonesian Statistics Yearbook of CBS. On average, the Indonesian economy grew around 7 per cent annually, while in per capita terms the output growth rate was around 4% per year. In details, Table 2.1 reports the descriptive statistics of the output growth rate.[12] (Appendix 2.2 presents the complete data for growth used in this study.)

2.3.2.2. Capital Stocks

Because data on the capital stock are not serially complete in many developing countries, including Indonesia, economists sometimes need to estimate

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[12]See Table 2.1, page 75.

their own capital series. Some economists use gross capital formation (gross investment) to estimate the growth accounting equation (see, for example, Gillis *et al.*, 1996). Another method is to assume that a steady state condition exists such that the investment-capital ratio is constant (see, for example, Harberger, 1998).[13] While this steady state condition may be a strong assumption, it is better than assuming an initial capital stock of zero (Beck *et al.*, 1999). A standard approach in constructing a capital stock series is to employ the perpetual inventory method. Therefore, we adopt this method here.

The main sources of data for construction of the capital stock series were taken from the Nehru-Dhareswar Data (ND data).[14] We use various investment series published by the World Bank, the Central Board of Statistics of Indonesia (CBS) and the Bank of Indonesia to estimate a capital stock series. The Indonesian

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[13]See also Aswicahyono (2000), Tuwo (1998) and Beck *et al.* (1999). However, Levine and Orlov (1998) suggest deriving a guess of the initial capital stock in 1950 and assuming that a steady state capital output ratio existed in 1950. Meanwhile, King and Levine (1994) propose using an initial capital stock of zero. From this assumption, using the perpetual inventory method, we might then construct a capital stock series. However, most methods require data on the rate of depreciation which, yet, for Indonesia is not complete. We may use the historical depreciation rate which may be calculated from the Nehru-Dhareswar data for the aggregate capital stock. For depreciation of capital stock in the oil sector, the Government of Indonesia allowed the oil companies to calculate their depreciation based on a "Double Declining Balance" Method (The Embassy of USA, 1999). This method is a modification of relevant stipulations contained in the New Tax Law to allow Production Sharing contractors to depreciate their capital earlier. Thus, the depreciation rate of capital costs in the oil sector is set as high as 6.67% by the Government of Indonesia, assuming a 30 year life for Production Sharing Contracts.

[14]These data were downloaded on February 18, 2002 from http://www.worldbank.org/research/growth/ddnehdhs.htm.

statistics authority (CBS) has never published a capital stock series.[15]

Nehru and Dhareswar (1993) derived the physical capital stock series from compiling the investment series using the perpetual inventory method. To estimate an initial capital stock, they apply a modified Harberger approach. The results are a physical capital stock series for 1950-1990. Because Nehru and Dhareswar (1993) did not explicitly provide the depreciation rate used in constructing their data set, we need to estimate the historical depreciation rate (δ) used in the ND data. Then, using the average estimated depreciation rate, we employ a perpetual inventory method to extend the period of observation of the physical capital stock series from 1991-2000.

According to the perpetual inventory method,

$$K_{t+1} = (1 - \delta_t) K_t + I_t \qquad (2.23)$$

where K is the physical capital stock, δ is the depreciation rate, I is investment and t is the year. From equation (2.23), we can obtain the depreciation rate (δ) as

$$\delta_t = \frac{\left(K_t - K_{t+1} + I_t\right)}{K_t} \qquad (2.24)$$

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[15]This information was from Mr. Bana Bodri, the Head of Dissemination Services of the Central Board of Statistics of Indonesia.

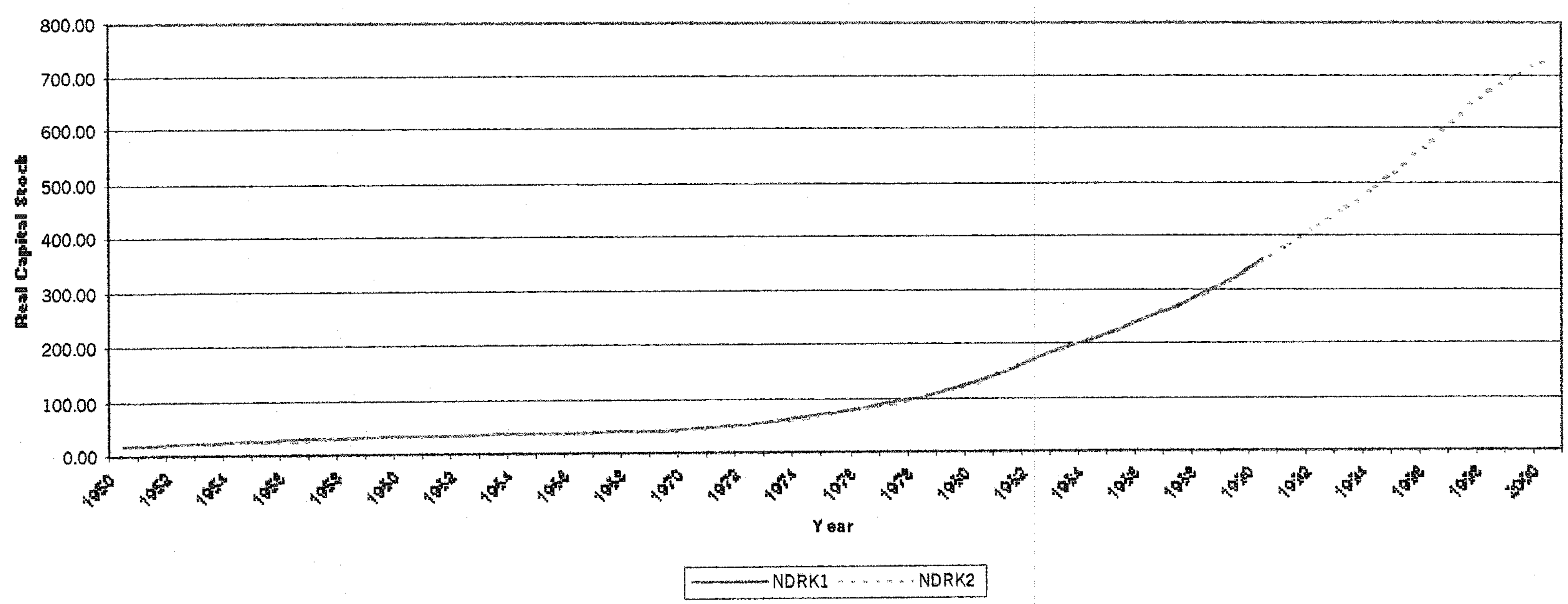
or simply,

$$\delta_t = \left(\frac{I_t}{K_t}\right) - gK_{t+1} \qquad (2.25)$$

Using equation (2.25), the historical depreciation rate used by Nehru and Dhareswar (1993) is found to be around 2.97%. Using this rate, the physical stock series is then estimated. This is then compared with the Nehru-Dhareswar capital stock series. On average, the difference between the two series is only 0.032% and is probably due to the average depreciation rate used.

Because the PIM formula also requires an investment series, we also need to compare our investment data with ND's. The former was estimated using the current values of investment series adopted from the World Bank Indicators and the CBS, and deflated by the GDP deflator taken from the International Financial Statistics Yearbook of the IMF and Bank of Indonesia reports. No significant difference with the Nehru-Dhareswar investment series is found. Based on these findings, we then extended ND's capital stock series from 1991-2000 using our calculated real investment series. This produces a capital stock series for the period 1950-2000. Figure 2.1 shows the results. On average, the capital stock in Indonesia grew around 9 per cent per year.

Figure 2.1: The Trend of Capital Stock in Indonesia 1950-2000 (in trillion rupiah)



<u>Notes:</u> NDRK1 is the original ND data
NDRK2 is the estimated and expanded capital stocks based on NDRK1

To use our model, it is also necessary to estimate the capital stock in the oil sector. For this, the same methodology can be used once the benchmark capital stock in the oil sector is estimated. For this, suppose we have

$$K_{ot+1} = (1 - \delta_{ot}) K_{ot} + I_{ot} \qquad (2.26)$$

where K_{ot+1} and K_{ot} are capital stock in the oil sector in two consecutive periods t+1 and t, δ_o is the depreciation rate in the oil sector, I_o is investment in the oil sector and t is time. After some manipulation, equation (2.26) can be rewritten as

$$K_{ot} = \frac{I_{ot}}{\left(gK_{ot+1} + \delta_{ot}\right)} \qquad (2.27)$$

Because the growth rate of the capital stocks in the oil sector is not available, following Harberger (1998), we use the growth rate of investment in the oil sector as a proxy for the growth rate of the capital stock in the oil sector.[16] Thus, the initial benchmark level of the capital stock in the oil sector in 1967 is

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[16]Nehru and Dhareswar (1993) also applied this procedure to obtain their initial aggregate capital stock.

$$K_{o1967} = \frac{I_{o1967}}{\left(gI_{o1967} + \delta_{o1967}\right)} \tag{2.28}$$

Using the current values of investment series in the oil sector adopted from the *Petroleum Reports of Indonesia*, the *Pertamina's Reports* and the *Bank of Indonesia Yearly Reports*, the real investment series in the oil sector of Indonesia can then be generated.

Taking the natural log of the real investment series (*LINV*), the growth rate of oil investment can be calculated as

$$LINV_t = a + b \times t \tag{2.29}$$

where *LINV* is the natural log of real investment, *a* is the intercept, *b* is the slope indicating the growth rate of oil investment and *t* is the time trend from 1967 to 2000, s.t. $t = 1, 2, \ldots, 34$. Using OLS, *b* is 0.0851, i.e., the growth rate of oil investment is, on average, 8.51%.

Because the depreciation rate in the oil sector is set to be 6.67%, the initial benchmark capital stock for 1967 can be estimated and the overall capital stock series for the oil sector can be obtained.

Finally, the capital stock of the rest of the economy, i.e., the capital stock in the non-oil sector (K_w), can be taken as the difference between total capital stock

(K) and the capital stock in the oil sector (K_O). On average, for the whole sample period, the capital stock in the non-oil and oil sectors grew an average of 9 per cent and 16 per cent per year, respectively. For the complete estimates, please see Appendix 2.2.

2.3.2.3. Labour Inputs

The data on labour inputs are number of workers. These data are serially available and were accessed from the *World Bank Development Indicators 2001* and various publications of the Central Board of Statistics of Indonesia (CBS).

The information on number of workers in the oil sector is taken from the *Petroleum Reports of Indonesia*, the *Statistics* [*sic*] *Yearbook of Indonesia* and *Labour Surveys in Indonesia*. Nevertheless, for certain years, we must use the average ratio of the number of workers in the oil sector and total workers to complete the oil labour series for 1967-2000.

The number of workers in the non-oil sector (H_w) is calculated as the difference between total workers (H) and the number of workers in the oil sector (H_o). On average, employment in Indonesia for this period grew around 3% per year. (See Appendix 2.2. for the complete data.)

2.4. Estimation Issues

Before starting the regression procedure, we need to do a specification test on our estimating equation. This involves three steps. First, we must determine the estimating equation which in this case is equation (2.20). Second, we need to examine the stationarity of our time series data, using the ADF procedure. Lastly, the functional form connecting the variables must be specified. In this context, potential problems occur when explanatory variables are also endogenous variables. As can be seen in equation (2.20), capital stock is one of our right-hand-side variables. In one hand, from the income approach of GDP, the change of capital stock (known as investment) is often treated as an explanatory variable of income. However, on the other hand, if investment equals saving and saving is a function of income, in turn, this causes investment to be an endogenous variable. Given this triangular nature of the estimated system, the correlation between disturbances may exist so that endogeneity is an important econometric issue. Therefore, given this endogeneity problem, a simple OLS technique theoretically gives biased and inconsistent estimators. A common strategy for dealing with this endogeneity is to use an instrumental variable (IV) technique.

In a compact form, equation (2.20) can be rewritten as

$$gQ = V\beta + \varepsilon \qquad (2.30)$$

where *gQ* is a vector of the dependent variable, *V*, and ε are vectors of independent variables and the related disturbance terms, respectively, and ß is the coefficient vector.

Because of the endogeneity problem, we need to modify equation (2.20) to fit into the IV estimation procedure. The estimable version of equation (2.30) can then be rewritten in the compact form as

$$gQ = V\beta + \varepsilon \tag{2.31}$$

where

$$V = Z\phi + \nu \tag{2.32}$$

where *Z* is a vector of the instruments, ϕ is vector constants, and ν is the vector of disturbance terms. Because ε and ν are correlated, we need to specify the additional exogenous variables (*Z*) in a specific form which might be uncorrelated with *gQ*. Thus, those additional variables is used to instrument for the endogenous variables.

The most important step in the IV estimation is to choose the instruments based on relevance and exogeneity. In this context, Bound *et al.* (1995), as well as Stock and Yogo (2002), suggest that there should be no direct association between instruments and its dependent variable. More specifically, when searching for plausible instruments to apply in equation (2.32), the candidates should be (only weakly) correlated with the endogenous RHS variables in the equation. Partial correlations of the instruments and the endogenous RHS variables are required to evaluate this. (See Tables 2.2 and 2.3).

Bound *et al.* (1995) argue that the parameter of the IV estimator is consistent if there is no direct association between an instrument and its dependent variable, even if biasedness is likely to appear. The instruments, however, are correlated with the endogenous right-hand-side variable. They also provide a useful table to check the validity of instruments. They conclude that the bias of the IV estimator relative to OLS is approximately inversely proportional to the F statistic on the instruments. Stated differently, the higher the first stage F-statistic on the instruments, the smaller the bias of the IV estimator relative to the OLS estimator. For example, if we have two excluded instruments and the F-statistic for the test of the joint statistical significance of the excluded instruments from the first-stage regression equals four, the bias of the IV estimator relative to the OLS estimator will be 2 per cent. But if the F-statistic of the excluded instruments is one, the bias will be 37 per cent. If the bias is small, we may legitimately neglect the appearance of this bias. Therefore, Bound's approach, among others, is useful to test biasedness in an IV estimation technique.

Although it could be argued that the labour growth rate may be endogenous, due to sample size restriction and to the fact that labour supply is a function of very long term trends and characteristics of the economy, such as women's fertility, in this study the labour growth variables are treated as exogenous. The validity of the instruments can be tested more formally by finding the partial correlations and using the approach outlined by Bound *et al.* (1995).

2.5. The Results

2.5.1. Descriptive Statistics

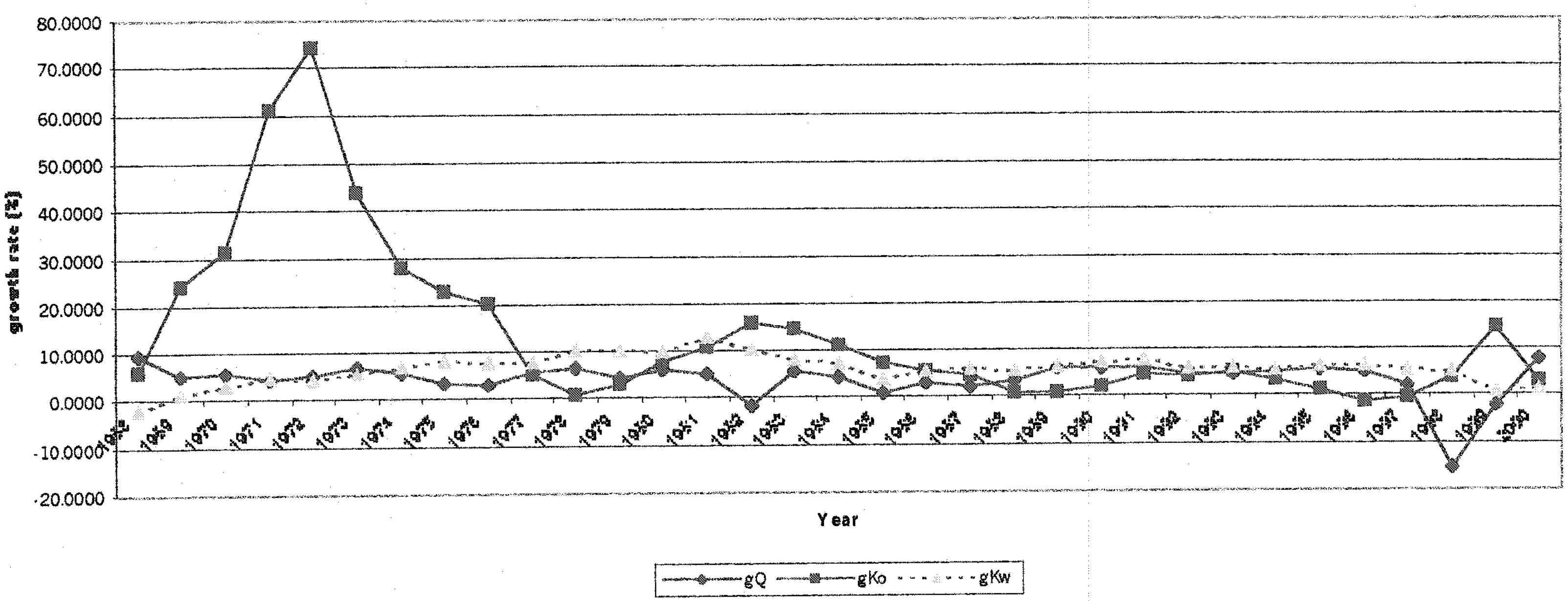
There are at least three most important periods during the Soeharto government, i.e. the late-1960s, the early-1980s and the late-1990s. The economy recovered surprisingly quickly from the major political crisis in the mid- 1960s, recording double digit growth (12%) in 1968. The capital stock grew around 0.31 per cent in 1968, which was slower than population growth. This became the smallest capital stock growth in Indonesia. When we consider the capital stock growth minus population growth, we get a negative figure of around -2%.

Thereafter, a rapid growth of real GDP of 8.2 per cent annually on average was able to be maintained until 1982, when a sharp decline in international oil prices induced a sharp slow-down of the economy. (See Figure 2.2.) This decline ultimately persuaded the Indonesian government to reform its foreign trade policy in the mid-1980s. Whereas in 1982, the oil industry had become the largest single economic sector in Indonesia, accounting for no less than 49% of GDP, in the early 1990s, this figure had fallen to less than 25% (CBS, 1992 and 1995). Moreover, although the contribution of oil declined after 1983, the Indonesian economy kept growing, on average, at over 7 per cent annually. Initially, the decline was due to the slowdown itself and after 1985, at least in part to the impact of a trade liberalization program introduced that year.

Figure 2.2 shows that there are three anomalous periods in Indonesia. The first of these is the year 1968. In the period 1968-1980, almost every year, the Indonesian economy had positive growth. After the small growth rate of capital stock in 1968, capital stock grew dramatically for at least two reasons: a relatively stable political situation in the late 1960s and the early 1970s which attracted more foreign investment; and the simple mathematical principle that, coming from the smallest growth rate in capital in 1968, the degree of growth in the next period was exaggerated. Regardless of this initial problem, on average, prior to 1977, the aggregate capital stock grew around 7.5 per cent annually. In the whole sample period, on the other hand, the aggregate capital stock in the oil sector and the non-oil sector grew annually, on average, 16 per cent and 9 per cent, respectively.

There was a big jump in the capital stock in the oil sector (almost 70 per cent per year) in the early 1970s, when the returns to investment in the oil sector rose sharply due to the increase in oil prices in the world oil market. On average, in the period 1968-1977, the capital stock in the oil sector grew around 38 per cent per year, while the capital stock in the non-oil sector only grew around 7 per cent

Figure 2.2: The Growth Rates of Output and Sectoral Capital Stock in Real Terms



Notes: gQ is Output Growth Rate
gK_o is Growth Rate of Capital Stock in the Oil Sector
gK_w is Growth Rate of Capital Stock in the Non-Oil Sector

per year. In the rest of our sample period, however, the capital stock in the oil sector grew slower than it did prior to 1977 (on average, around 8 per cent), while the capital stock in the non-oil sector grew slightly faster (about 10 per cent per year). The growth difference in these two periods creates a high standard deviation in the capital stock in the oil sector. The standard deviation in oil was found to be 18 per cent, as compared to 3 per cent in the non-oil capital stock.

The second anomalous period is the year 1982. If we look at Figure 2.2 carefully for the period 1983-1997, there appears to be a strong correlation between capital stock growth and economic growth. But the negative growth of per capita output in 1982 will affect the correlation strength between the two variables in the second decade. This situation also applies in the third decade of observation (1990-2000). The economic and political crisis in 1998 had significant impact on the Indonesian economy, causing the Indonesian economy to shrink. Due to the negative growth in the late 1990s, the significant and positive relationship between the capital stock growth rate and the economic growth rate is made weaker than it actually is.

Table 2.1 reports the mean, standard deviation and maximum and minimum values of the growth rates in output, capital stock, and labour at the aggregate level. It also provides the growth rate of each variable in per capita terms.

Table 2.1 shows that the mean of the output growth rate is 6.65 per cent. Although Indonesia experienced a negative growth for certain years, such as 1998

Table 2.1: Descriptive Statistics (%), 1968-2000

Variables	Variable Labels	Mean	Standard Deviation	Maximum Value	Minimum Value
Output Growth Rate	gQ	6.65	4.24	12.03	-13.01
Capital Growth Rate	gK	9.16	3.17	16.01	0.31
Capital Growth Rate in sector *o*	gK_o	16.32	17.96	78.87	1.48
Capital Growth Rate in sector *w*	gK_w	8.95	3.25	16.21	0.21
Labour Growth Rate	gH	2.69	2.21	10.64	-1.19
Labour Growth Rate in sector *o*	gH_o	2.71	0.30	3.22	1.97
Labour Growth Rate in sector *w*	gH_w	2.69	2.21	10.65	-1.19
Per Capita Output Growth Rate	gq	4.06	4.18	9.69	-15.11
Per Capita Capital Growth Rate	gk	6.50	2.96	12.86	-1.79
Per Capita Capital Growth Rate in sector *o*	gk_o	13.49	17.52	74.46	-0.99
Per Capita Capital Growth Rate in sector *w*	gk_w	6.30	3.05	13.05	-1.89
Employment Growth Rate	gh	0.19	2.10	7.84	-3.43
Employment Growth Rate in sector *o*	gh_o	0.21	0.19	0.53	-0.04
Employment Growth Rate in sector *w*	gh_w	0.18	2.10	7.82	-3.43
Real Prices Growth Rate in sector *w*	gP_{1W}	1.70	10.11	58.20	-8.23
Real Prices Growth Rate in sector *o*	gP_{2O}	-0.10	0.83	0.79	-4.43

Source: Author's Analysis

Notes:

The growth rates of each variable in per capita term is the growth rate of each variable minus the population growth rate. For example, the employment growth rate is the labour growth rate minus the population growth rate.

(-13%), in general the development performance seems to be economically sound, as shown by its reasonable economic growth with a small standard deviation (less than 5 per cent).

In Indonesia, the capital stock in the oil sector indicates the fastest growth rate (around 16 per cent per year) among factor inputs. It ranges from 1.5% in 1996 to 78.9% in 1972.[17] In addition, annual employment in the oil sector has also grown a little bit faster (2.71%) than in the non-oil sector (2.69%). This greater growth in capital relative to employment in the oil sector is because the oil industry is capital intensive. To pump oil from the ground, we may need an expensive advanced technology, costing at least US $ 60 million for one hectare of an oil field (Samudra *et al.*, 1999). If the *Light Steam Oil Flood* (LSOF) technology, a more advanced technology, is used to pump the oil, the production and investment costs will be even higher. Thus, the capital stock growth may not be necessarily proportional to the output growth. Extra money may be required if better exploration techniques are, or need to be, employed.

Table 2.1 also shows that labour mobility in the non-oil sector was higher than in the oil sector. This occurs for at least three reasons. First, a worker in the oil sector who may require a certain and specific expertise may not fit into the

[17]The high growth rate in the early 1970s occurred because there was a significant rise in international oil prices which in turn affected foreign oil investors. Or, this may indicate that the initial capital stock in the late 1960s was very small.

working requirements in other sectors. Second, the wages in the oil sector are likely to be better and higher than in the non-oil sector. For example, in 1994 the compensation of a worker in the oil sector was, on average, Rp 976.104, per month, while in the same year, the compensation of a worker in other sectors, such as agriculture and manufacturing was, on average, Rp 157.343, (CBS, 1997). The higher compensation in the oil sector makes workers more reluctant to switch their jobs. Third, the oil industry offers relative security and stability to workers.

As Table 2.1 shows, the employment growth rate in the oil sector was almost unchanged over the period. The standard deviation was only 0.30 per cent. The employment growth in the non-oil sector had a higher standard deviation of over 2 per cent. Thus, employment fluctuations in the oil industry were clearly smaller than in the non-oil sector.

2.5.2. Estimation Results

The next step is to analyze the magnitude of factor input growth on economic growth. Because of the anomalous periods identified above, two dummy variables are introduced into equation (2.20). We did not include a dummy variable to capture the negative growth of the capital stock in 1968 because our time period only starts in 1967.[18] Thus, equation (2.20) becomes

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[18]Unfortunately, due to data limitation, we cannot test the sensitivity of the 1968 condition in the model.

$$gQ_t = gTFP + \beta_{Kw}\, gK_{wt} + \alpha_{Ko}\, gK_{ot} + \beta_{Hw}\, gH_{wt} + \alpha_{Ho}\, gH_{ot}$$

$$+ \rho_{1W}\, gP_{1Wt} + \rho_{2O}\, gP_{2Ot} + \gamma_1 D^{82} + \gamma_3 D^{98} + \varepsilon_t \qquad (2.33)$$

where D^{82} is a 1982 dummy variable, s.t. if t = 1982, $D^{82} = 1$ otherwise $D^{82} = 0$, and D^{98} is a 1998 dummy variable, s.t. if t = 1998, $D^{98} = 1$ otherwise $D^{98} = 0$.

Before equation (2.33) is estimated, we employ the ADF procedure to test the stationarity of the time series data based on equation (2.20) by using the unit root procedure. The results are reported in Appendix 2.3. A large negative ADF statistic allows rejection of the hypothesis of a unit root and suggests that the series is stationary.

Because the model has been well specified, the next task is to determine the proper estimation method. In this respect, it is useful to compare the performance of OLS and IV estimation results to know whether the endogeneity problem affects the estimators.[19]

The instruments used in this study will include (1) following Easterly and Levine (1997), *RIOTS* as a measure of political uncertainty, (2) following Basu and Fernald (1997), the growth rate of the world oil price in real terms (*GRWOPRP*), (3) the growth rates of Indonesia's three major trading partners, Japan (*JPGR*), Singapore (*SPGR*) and the United States (*USGR*), and finally (4)

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[19]Thus, the OLS results are not treated as a "by-product" of our estimation results.

following Liviatan (1963), the lag of independent variables. Because our equation is dealing with the growth variable, we deliberately select a lag of two for the independent variables as instruments to avoid a direct association with the current endogenous RHS variable, even though the longer lag reduces the sample size.

Data for the instruments has been adopted from different sources. For example, data on *RIOTS* is taken from the Harvard CID-Worldbank DataMart website. Data on world oil prices, on the other hand, is from *the IMF's International Financial Statistics Yearbook.* Data on the growth rates of Indonesia's major trading partners, namely Japan (*JPGR*), Singapore (*SPGR*) and the United States (*USGR*), is from *the World Bank Development Indicators* CD-ROM and *the IMF's International Financial Statistics Yearbook.*

In this study, following Easterly and Levine (1997), Caballero and Lyons (1992) and Basu and Fernald (1997), we propose political condition to be one of our instruments. To evaluate empirically the hypothesis that political conditions affect economic growth, we use *Riots* as a measure of political condition.[20] Following Banks (1994) and Easterly and Levine (1997), the definition of *Riots* is any violent demonstration or clash of more than 100 citizens involving the use of

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[20]Caballero and Lyons (1992) and Basu and Fernald (1997) used the political party of the president in power (*POLI*) as an indicator of political conditions. Because of the long practice of an autocratic system in Indonesia, the application of POLI will yield a biased description. The President's power did not change for 30 years. So, POLI is definitely not a good indicator for political condition in Indonesia, since it is very unlikely to reflect political certainty.

physical force. If this occurred, the score is one, otherwise it is zero.

The *Riots* data are mainly taken from the Easterly-Levine Data Set (EL data) which are available on the *Harvard CID - Worldbank DataMart* (Datavine).[21] The Datavine website provided *Riots* from 1960-1989. Because the study spans the period 1967-2000, we need to extend the riot index until the year 2000.

Concerning the original riot index from the EL data set, two corrections have been made for 1971 and 1974. In 1971, political tension increased due to malpractices by the Government in conducting the 1971 general election. Thus, the score of 1971 should be one, not zero, as typed in the original EL data set. In 1974, political tensions between the Government and its former supporter were also sharpened and a political clash exploded in 16 January 1974, known as Malari (Malapetaka Januari or the January disaster). The Malari affair was initially about "anti-Japanese neocolonialism" but soon developed into "anti-Chinese rioting and anti -new rich demonstrations" (see, for example, Mackie and MacIntyre, 1994). Therefore, 1974 should also be a one rather than a zero as entered in the original EL data set.[22]

Next, the *Riots* data set is extended from 1990-2000 based on the relative

[21]The data was downloaded on June 10, 2002 from http://paradocs.pols.columbia.edu/datavine/mainFrameSet.jsp.

[22]The Riots data is actually a dichotomous measure.

political situation in these years. For example, we score one in 1991 and 1996 due to the Dilli massacre and the "sorrowful" July political party headquarters attacks. We also give a full mark for 1997 onward because the economic and political condition has been more tense and volatile since 1997. In 1998, for example, mass demonstrations forced Soeharto to step down.

The rationale behind this *RIOTS* selection is that a riot or any violent clash will certainly cause political uncertainty. In the short term, political uncertainty is likely to affect people's willingness to invest; thus it is very likely to have a negative effect on the growth rate of the capital stock. It may also boost capital flight and ultimately decrease economic growth.

The second instrument employed here is, following Basu and Fernald (1997), the growth rate of the world oil prices in real terms (or simply denoted as *Grwoprp*). In this context, it is assumed that if the government stabilizes domestic fuel prices, the use of international prices is expected to be uncorrelated with the disturbance term.

Following Liviathan (1963) and Gujarati (1988), the third instrument is the second lag of the capital stock growth rate for each sector. The second lag does not presumably have a direct association with the endogenous variable.

Finally, we include the growth rates of Indonesia's major trading partners i.e. Japan, Singapore and the United States, since the trading partner's growth rates are likely to be a factor affecting investment in Indonesia.

To apply the IV estimation procedure, the instruments have to be uncorrelated with the endogenous variable. Hence, it is useful to check the validity of the instruments in the model.

With the exception of the lag variable, theoretically our instruments do not directly relate to our endogenous variables, i.e. the capital growth rate in the oil and non-oil sectors. For example, the *Grwoprp* variable is certainly an exogenous variable because domestic oil prices are administered by the government. Therefore, the relationship between the *Grwoprp* and endogenous variables may be quite small.

Tables 2.2 and 2.3 present the partial correlations between the endogenous RHS variable and the selected instruments. Tables 2.2 and 2.3 are also useful to check the aspects of multicollinearity and micronumerosity.

As can be seen in Tables 2.2 and 2.3, except for the second lag variables, the correlation of the endogenous RHS variable and the "candidate" instruments are very small, less than 0.5. Although the correlation of the second lag variable and the endogenous RHS variable is slightly greater than 0.5, we still use this lag variable because not only is the correlation still not too high (less than 0.6) but also the introduction of this second lag variable is useful to capture the dynamics of capital stock growth. However, some unsatisfactory instruments such as *Riots*, *grwoprp*, and *usgr,* are dropped. Nevertheless, the results which include these three instruments are also reported in Appendix 2.4.

Table 2.2: Partial Correlations (Part 1)

Variables	Variable Labels	gQ_t	gK_{wt}	gK_{ot}	gH_{wt}	gH_{ot}	gP_{1W}	gP_{2O}
Output Growth Rate	gQ_t	1.0000						
Capital Growth Rate in sector *w*	gK_{wt}	0.2305	1.0000					
Capital Growth Rate in sector *o*	gK_{ot}	0.1602	-0.2013	1.0000				
Labour Growth Rate in sector *w*	gH_{wt}	-0.0531	-0.0856	-0.1387	1.0000			
Labour Growth Rate in sector *o*	gH_{ot}	0.1259	0.2071	0.1115	0.1328	1.0000		
Real Prices Growth in sector *w*	gP_{1W}	0.0339	0.0499	0.1120	-0.0911	0.4222	1.0000	
Real Prices Growth in sector *o*	gP_{2O}	-0.0396	0.0567	-0.1240	-0.0872	0.0351	0.1489	1.000
A 1982 Dummy Variable	D^{82}_t	-0.2491	0.2884	0.0255	0.0257	-0.0326	-0.0178	-0.0112
A 1998 Dummy Variable	D^{98}_t	-0.8305	-0.0938	-0.0968	-0.0022	-0.0444	0.0227	-0.0340
Riot Variable	$Riots_t$	-0.2727	0.0342	-0.1707	0.2070	-0.0773	-0.0740	0.1394
Growth Rate of The World Oil Prices	$grwoprp_t$	0.0683	0.0327	0.0211	0.1081	0.0316	0.0905	0.0381
The Second Lag of gK_w	gK_{wt-2}	-0.0318	0.5919	-0.4773	0.0075	0.1069	0.0219	-0.0131
The Second Lag of gK_o	gK_{ot-2}	0.2034	-0.1222	0.5819	0.0534	0.0167	0.0177	-0.1013
Japan's Growth Rate	jpgrt	0.4428	0.0745	0.4120	0.0933	0.1494	0.0528	0.0951
Singapore's Growth Rate	$spgr_t$	0.5250	0.1002	0.3448	-0.4339	-0.0288	0.2719	0.1235
US Growth Rate	$usgr_t$	-0.0433	-0.2201	0.0178	-0.0211	-0.0445	-0.0062	0.0181

Source: Author's analysis

Table 2.3: Partial Correlations (Part 2)

	$Riots_t$	$grwoprp_t$	gK_{wt-2}	gK_{ot-2}	$jpgr_t$	$spgr_t$	$usgr_t$
$Riots_t$	1.0000						
$grwoprp_t$	0.0729	1.0000					
gK_{wt-2}	0.2297	-0.1522	1.0000				
gK_{ot-2}	-0.2142	0.2599	-0.2177	1.0000			
jpgrt	-0.3017	-0.1973	-0.3755	0.1345	1.0000		
$spgr_t$	-0.2965	0.0307	-0.3499	0.0147	0.4440	1.0000	
$usgr_t$	-0.1171	-0.1221	0.1052	0.0000	0.1102	0.0535	1.0000

Source: Author's analysis
Notes: Variable and Variable Labels refer to Table 2.2.

Bound *et al.* (1995), Stock and Yogo (2002), Moreira (2001) and Söderlind (2002) all note that even a small correlation between the instruments and the endogenous explanatory variable (or the endogenous RHS variable) can produce inconsistent and biased estimators. More specifically, the instruments which are relatively weakly correlated with the endogenous RHS variables may be more biased than an OLS estimator (Basu and Fernald, 1997), if the error term is influenced by the dependent variables, which in turn affect some other endogenous variables in the system. Therefore, it is also instructive to examine the bias of the IV estimates relative to OLS, using the first stage F- statistics. In this context, for example, Staiger and Stock (1997) suggest declaring an instrument weak if the first stage F-statistic is less than 10. Bound *et al.* (1995), on the other hand, introduced a bias to the IV table to see whether we are allowed to neglect the bias. Stock and

Yogo (2002) additionally proposed to compare the minimum eigenvalue of the first stage F-statistics with the critical values provided in their studies. If the minimum eigenvalue of the first stage F-Statistic is larger than the critical value, then the relative bias is statistically not small, and the instruments will not be valid.

In this study, to check the validity of the instruments, we use both the procedure provided by Staiger and Stock (1997) and the approach outlined by Bound *et al.* (1995). The first stage F-statistics are reported in Table 2.4, after running an OLS regression of equation (2.32). As seen in Table 2.4, the instruments selected for the model are all significantly valid at a 1% level. Table 2.4 reports the F-statistics from the first stage regression range from 8 to 10. Following Staiger and Stock (1997), the instruments are deemed weak if the first stage F- statistic is less than 10. This means, in this case, that we may have weak instruments. For the aggregate model, however, we obtain an F- statistic of 10.09, exceeding the rule of thumb figure of 10. Thus, the instruments in the aggregate model are significantly valid.

Because we obtain weak instruments, we need to check whether the bias can be ignored. Using Bound's bias table, we conclude that the bias is quite small, ranging from 0.00 - 0.02 which means the bias of the IV estimator is less than 2 per cent from the OLS estimator. From this perspective, we conclude that, although we may have weak instruments, the bias of the IV estimation is

Table 2.4: The Instruments

Instruments Variables	Instruments Labels	Endogenous RHS Variables		
		gK_w	gK_o	gK
Labour Growth Rate in sector *w*	gH_w	0.0528 (0.1776)	-0.8750 (1.1415)	
Labour Growth Rate in sector *o*	gH_o	0.0446 (0.0499)	0.2627 (0.3963)	
Labour Growth Rate	gH			-0.0689 (0.1655)
Real Price Growth in sector *w*	gP_{1W}	-0.5618(0.4465)	-0.6656(3.5942)	-0.1016(0.3736)
Real Price Growth in sector *o*	gP_{2o}	0.0046(0.0304)	-0.2210(0.2466)	-0.0109(0.0283)
A 1982 Dummy Variable	D^{82}	-0.9428 (2.1186)	10.1798 (14.2991)	-1.0302 (1.9587)
A 1998 Dummy Variable	D^{98}	4.3989 (2.2162)^c	23.6337 (16.7609)	3.8471 (2.1425)^b
US Growth Rate	usgr	-0.5315(0.1799)^a		-0.5738 (0.1695)^a
Singapore's Growth Rate	spgr	0.3591 (0.1429)^b	1.4568 (1.1093)	0.2404 (0.1365)^b
Japan's Growth Rate	jpgr	0.3411 (0.1527)^b	2.0105 (1.1429)^b	0.4092 (0.1372)^a
Second lag of gK_w	gK_{wt-2}	0.8623 (0.1439)^a		
Second lag of gK_o	gK_{ot-2}		0.5674 (0.1458)^a	
Second lag of gK	gK_{t-2}			0.8665 (0.1405)^a
	Constant	-2.0325 (1.7896)	-14.4863(9.4576)^c	-0.1098 (1.7970)
R^2		0.7031	0.5776	0.7012
F-Statistics (Excluded Instruments)		9.21^a	8.38^a	10.09^a

Source: Author's analysis
Notes: a, b, and c indicate 1%, 5% and 10% level of significance. gK refers to a model for all sectors as in Appendix 2.1. Numbers in parentheses are standard errors.

legitimately negligible. In other words, the instruments are valid and plausible.[23]

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[23]The coefficient estimates of *resid1* (i.e. residuals of the first stage regression of gK_w) and *resid2* (i.e. residuals of the first stage regression of gK_o) from the second stage regression without instrumenting for the endogenous variables are 0.0380 with a 0.3702

Using the selected instruments, we may then employ the IV estimation procedure to regress equation (2.31). As a comparison, we also provide the results of the OLS estimation procedure. (See Table 2.5.)

Using the OLS method, the model performance looks good, as the F-statistic is quite high (14.92) and is significant at the 1 % level. Some variables are significant. Thus, for example, if there is an endogeneity problem, the magnitudes of the impact capital growth rates the in non-oil sector and the oil sector on economic growth are 0.33 per cent and 0.03 per cent, respectively. The negative sign on the labour growth rate is not expected, but the coefficient is not significant. This implies that the number of workers is not a good estimator to explain the labour input.

If now we assume the endogenous explanatory variables are correlated with the measurement errors, the IV estimation will be the more appropriate technique, assuming there is sufficient correlation between the disturbances to warrant estimation by the instrumental variables technique. To test this, we perform the Hausman test to test the consistency of the OLS results. This produces a χ^2 of 23.11 at a 1% level of significance, indicating that the OLS estimators are not consistent. Thus, we may assume that the IV estimation is valid and provides a

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standard error and 0.3950 with a 0.4787 standard error. Because the coefficients on the residuals are not statistically significant, our instruments have therefore passed this "uncorrelatedness" test used by Davidson and Mackinnon (1993).

consistent estimator for our model.

Table 2.5: The OLS and 2SLS Results of Equations (2.33)[24]

Dependent Variable: gQ, n=33 (1968-2000)					
Independent Variables	**Labels**	**OLS**		**2SLS**	
		Coefficient	**S.E.**	**Coefficient**	**S.E.**
	Constant	2.8678[a]	0.9277	0.3149	1.4976
Capital Growth Rate in sector *w*	gK_w	0.3295[b]	0.1281	0.6649[a]	0.0286
Capital Growth Rate in sector *o*	gK_o	0.0265	0.0213	0.0505[b]	0.0286
Labour Growth Rate in sector *w*	gH_w	-0.0431	0.1750	0.0416	0.1827
Labour Growth Rate in sector *o*	gH_o	0.0047	0.0568	0.0241	0.0595
Real Prices Growth in sector *w*	gP_{1W}	0.1905	0.4770	0.1570	0.4857
Real Prices Growth in sector *o*	gP_{2O}	-0.0329	0.0351	-0.0282	0.0359
A 1982 Dummy Variable	D^{82}	-8.1977[a]	2.1073	-9.5772[a]	2.2347
A 1998 Dummy Variable	D^{98}	-19.7662[a]	2.0306	-19.0475[a]	2.0900
F_Statistics		14.92[a]		14.99[a]	
R^2		0.8326		0.8416	

Source: Author's analysis
Notes: S.E. is robust standard errors; a, b and c indicate 1%, 5% and 10% level of significance, respectively.

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[24]We also regress the aggregate variable using the IV estimation. The result is as follows:

$$gQ = \underset{(1.42)}{1.6595} + \underset{(0.20)^b}{0.5163}\, gK + \underset{(0.18)}{0.0444}\, gH + \underset{(0.45)}{0.1333}\, gP_{1W} - \underset{(0.04)}{0.0293}\, gP_{2O} - \underset{(2.27)^a}{8.7649}\, D^{82} - \underset{(2.1)^a}{19.3750}\, D^{98}$$

F-statistics = 17.81[a] and $R^2 = 0.8134$

Numbers in parentheses are robust standard errors. a, b and c indicate 1 %, 5% and 10% level of significance.

As in Table 2.5, the performance of the model when applying Two Stage Least Squares (2SLS) now looks slightly better. The results support the hypothesis that the output growth rate is a function of the growth rate of factor inputs. These results are significant, not only in the statistical sense but also in confirming the OLS results. In other words, the 2SLS results show that this conclusion is valid, regardless of the endogeneity problem. Alternatively, if we do not accept the selected instruments, then we must fall back on the more conservative OLS results. All of this suggests that the OLS results can be treated as a lower bound while the 2SLS results are treated as an upper bound for the estimated parameters.

As of the 2SLS results, although the coefficient estimate of the capital growth rate in the non-oil sector (0.67%) is higher than in the oil sector (0.05%), the positive and significant estimated coefficient of the capital growth rate in the oil sector supports the argument that the oil sector affects economic growth in Indonesia. Further, the total impact of capital growth on economic growth is around 0.52%. (See Footnote 24.)[25] More specifically, this means that a 1 per cent increase in the capital stock growth rate increases the rate of economic growth by 0.52%.

The labour input growth rate now has a positive sign but its impact on

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[25]This impact is slightly bigger than the İşcan's findings (1998b) ranging from -0.29% to 0.064% and the Tyler's findings (1981) ranging from 0.24% to 0.29% but similar to Benhabib and Spiegel's findings (1994) of around 0.5%. Their findings are for different countries and different time periods. So, no particular reason for the coefficient estimates to be similar. Having said that our findings lie between their estimates.

economic growth is very insignificant. This means that the labour growth rate is not a robust estimator for labour shares.[26] This may be due to the low skills of workers, so that a growth in the number of workers will not necessarily increase output.[27]

The greater significance of the capital growth rate, versus the labour growth rate, tells us that capital has a greater influence on economic growth than labour. This, of course, has been the conventional wisdom since the Harrod-Domar growth model and the Solow model were first introduced several decades ago. It is also important for us to note that the impact of the capital growth rate in the non-oil sector (0.33% from OLS and 0.67% from 2SLS) is higher than in the oil sector (0.03% from OLS and 0.05% from 2SLS).[28]

Following the procedure provided by Caballero and Lyons (1992), the externality effect can be measured as the difference of the aggregate coefficient

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[26]We will, however, provide an alternative method to compute labour share. This is the object of Chapter 4.

[27]From the estimation results, we found that the coefficient estimate for the labour growth rate is around 0.04%. This is a lot smaller than İşcan's findings (1998), which ranged from 0.46% to 0.58%, but slightly bigger than Benhabib and Spiegel's-figure of 0.02%.

[28]The coefficient estimates are also similar to the coefficient estimates when the relative prices variable (*gP*) is not included in the model. (See Appendix 2.5.) This means that although the absence of the relative price effects induces an omitted variable bias, the exclusion of this variable does not cause a serious problem. In other words, the relative price variables in our study are orthogonal so that the variance-covariance matrix of this variable can be assumed to be zero. This happens because the Government attempts to stabilize domestic oil prices; hence the variation of domestic oil prices is very low (less than 1 per cent).

estimates and the sectoral coefficient estimates. Given this procedure, the externality effect of the oil sector on economic growth from capital stock change ranges from 0.19% to - 0.15% (i.e. calculated from 0.52% minus 0.33% for OLS results and 0.52% minus 0.67% for the 2SLS results). The externality effect from labour inputs is from 0.09% to 0.003% (i.e. calculated from 0.0444 % minus -0.043 % for OLS results and 0.0444% minus 0.0416% for the 2SLS results). Meanwhile, the findings of Caballero and Lyons (1992) are around 0.15%, despite the fact that their study measured the differences of the aggregate manufacturing and two-digit manufacturing returns to scale.

Using definitions of β_{KW}, β_{HW}, α_{KO}, and α_{HO} as in equations (2.17), (2.18), and (2.19), the efficiency effect (θ) can also be calculated. The results are -0.42% from OLS and -1.22% from 2SLS for θ_K and -3.02% from OLS and -0.94% from 2SLS for θ_H. The negative sign of the efficiency effect implies that the oil sector is less efficient than the non-oil sector. This argument is also supported by the findings that the marginal value product of the capital stock growth rate in the non-oil sector (around 0.67%) is higher than in the oil sector (only 0.05%).[29] It is also relevant that the oil industry is more protected by the government than non-oil industries.

Given the externality and the efficiency effects, the total effect of the oil

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[29]These are upper bounded numbers.

sector on economic growth therefore ranges from 0.69% from OLS to -0.19% from 2SLS for capital stock and from -2.20 % from OLS to 0.06% from 2SLS for labour inputs.[30] Two observations emerge from these results. First, on average, the total contribution of the oil sector to economic growth is seen to be less than 5 per cent.[31] Second, the total effect from labour is greater than the effect from capital. This means that although the oil sector perhaps requires little labour, the influence of labour on the externality effects and the efficiency of the oil sector is higher than capital. This may reflect an increase in Indonesia's labour quality due to rising educational attainment across the population.[32] The oil sector may also use a disproportionate share of the skilled labour in the country, relative to its share of output.

In Table 2.5, we found that productivity growth as estimated from 2SLS is around .31 per cent, but insignificant.[33] Because the standard error is large, we

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[30]This is calculated from $(1+\partial F/\partial O)*(1+\theta_K)$ for capital stock and $(1+\partial F/\partial O)*(1+\theta_H)$ for labour inputs.

[31]It should be recognized that the depletion of oil reserves is causing the role of oil in the economy to decline. Oil exploration in Indonesia will become more difficult and require more advanced and expensive technology. This is because the locations of the largest untapped reserves are mostly offshore and existing oil wells now (or will) require more effort to pump the "hidden oil". In other words, the difficulties in extracting oil (will) ultimately result in the loss of efficiency. Given this, it is not surprising to find that the effect of oil on economic growth is low.

[32]For example, the literacy rate jumped from 50% in the 1960s to 95% in the 1990s.

[33]Because we already calculated growth rates in percentage terms, the interpretation of each coefficient is also a percentage.

cannot conclude anything further about the size of TFP.[34] However, this result is similar to the findings of Young (1995), whose estimates range from 0.2% to 0.37% for some Asian countries.[35]

A study conducted by Hanson *et al.* (1995) found that TFP in Indonesia rose only after 1985, when deregulation policy started. Prior to 1985, there was no significant increase in TFP. They found that output growth can reasonably be explained by growth rates in factor inputs. It was also found that around one third of the annual growth in GDP per worker for 1986-1992 was directly due to higher productivity growth in the deregulation period. More than half was from additional capital per worker. Finally, Hanson *et al.* (1995) concluded that around 15% was due to the improvement in workers' education. Hence, by their estimates, increased productivity represented about 61 per cent of the rise in the growth rate of per capita GDP. Given our longer time period, particularly the inclusion of years before 1986, this result does not contradict our conclusion of low productivity growth over the whole period.

2.5.3 An Analysis of the Results

This study has found that economic growth in Indonesia has been primarily

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[34]We will compute the size of TFP using a growth accounting method which is the subject of Chapter 4.

[35]Other Indonesian studies such as Abimanyu and Hie (1994) and Poot *et al.* (1994) found Indonesia's TFP growth around 1%.

due to the increase in growth of the capital stock and the productivity growth rate. Using the OLS method, we found that TFP in Indonesia is higher than the growth rate in factor inputs. This suggests that the technological growth experienced has been relatively higher than labour productivity but smaller than capital growth.[36] Due to its insignificance, it is difficult to infer whether TFP affects growth. Nonetheless, the organizational structure of Indonesian industry is designed to support improvements in efficiency. This reflects the fact that after the 1985 deregulation policy, new opportunities to enter the world market were increasingly available for non-oil industries. While the Indonesian economy was heavily dependent on the oil sector in the 1970s and early 1980s, it was clearly making the transition towards an advanced industrial economy. This market expansion strategy ultimately persuaded Indonesian industries to be more "competitive" and "efficient". Yet, due to data limitations, we cannot provide a direct test of the impact of this time period difference. Nevertheless, equation (2.20) can be extended to capture the impact of foreign trade on productivity growth. This extension will be discussed further in the next chapter.

It is also useful to note that capital productivity in Indonesia is higher than labour productivity. This may be because the ability to organize labour is lower than the ability to obtain and manage capital, due to inadequate human skills and a

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[36]This can also be interpreted as the growth of a capital intensive unit which requires more advanced technology.

lack of management knowledge on the part of Indonesian workers.

The dummy variables also confirm that crises have a significant relationship with economic growth. The decline of oil prices in 1982 is accompanied by a decrease in economic growth in Indonesia. Recall that, prior to 1982, oil was the primary source of government revenue. Therefore, the sharp fall in world oil prices in 1982 caused government spending to fall and a reduction in economic growth. If we accept this argument, it also suggests that Indonesia requires stable world oil prices. In this context, the role of OPEC in organizing oil production is important to providing stable and fair prices for oil producers and consumers. On average, the magnitude of the sharp decline of world oil prices in 1982 was about 9.57 per cent (significant at a 1% level). This simply means that if the world oil price falls as it did in 1982, the fall contributes about 9.57 per cent of the decline in economic growth.[37]

The political crisis in 1998 also had a negative and significant impact on economic growth. As discussed earlier, political uncertainty induces capital flight and in turn, decreases economic growth. The magnitude of the D^{98} variable is -19.05 per cent (significant at a 1% level). This implies that, on average, about 19 per cent of the 15.11 per cent decline in the 1998 economic growth was directly due to the political crisis. Due to this crisis, the capital growth rate declined

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[37]As a matter of fact, international oil prices also declined by 50% in the mid-1980s and this caused the government to diversify its export policy.

around 4% in 1998, where a decline of the capital growth rate by 1% will eventually cause economic growth to decline by 0.52% (significant at a 5% level). Therefore, in general, political uncertainty will result in a double impact on economic growth.

Interestingly, the riot variable shows no significant effect on the capital growth rate in any sector. This may be because riots do not have any significant effect on the political decision process in Indonesia.[38] Nevertheless, if the Government does not solve the causes of riots, the riots may ultimately create political uncertainty, which in turn will harm the economy.

These findings conclude that while growth in the capital stock plays an important role in increasing per capita incomes, political uncertainty can offset the positive impact of capital accumulation. Although the regional currency crises in 1997, which started from Thailand, then spread to South Korea and Japan, could be the primary cause of economic crisis in Indonesia, a political crisis in Indonesia in 1998, namely the fall of Soeharto, also became a significant trigger for the Indonesian GDP in per capita terms to fall by almost 15%. Therefore, it is important to maintain political certainty in Indonesia. To do so, the autocracy system is unlikely to support a good government system in Indonesia because it

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[38]For example, in the early 1970s although many people protested a development program to build the "Indonesian Miniature Garden" (Taman Mini Indonesia Indah), the Soeharto government continued the project by using the gains from the international oil price shock. In fact, investment in the oil sector grew over 23 per cent annually in the early 1970s.

causes political rioting and restricts democracy.

The growth rates of Indonesia's major trading partners also play significant roles in capital growth rates. Growing foreign markets are likely to raise Indonesian exports. The rise in exports will then increase income and, in turn, investment. Therefore, these variables are chosen to be the instruments in our model.[39]

So far we have estimated how factor inputs affect economic growth. We found that capital is an important ingredient for economic growth in Indonesia. Indeed, it is capital growth in the oil sector which explains much of the impact of the oil sector on overall economic growth in Indonesia

However, the coefficient estimates of the oil sector are smaller than the estimates for the non-oil sector. (See Table 2.5.) This happens for at least two reasons. First, the depletion of oil reserves and the fluctuation of oil prices in the 1980s and the early 1990s have affected oil investment in Indonesia. Second, due to the instability of oil revenues, the Government initiated trade reform in the non-oil sector in the mid-1980s which attracted new investment to the non-oil sector.

Our findings also indicate that the oil sector has an externality effect on the Indonesian economy. This externality effect is generated through capital accumulation. Despite the fact that this externality effect is small (i.e. less than 5

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[39]We also provide the results of the first regression which includes the riots variable and the world growth of oil prices. The result is reported in Appendix 2.4.

per cent), the oil sector influences the economy via its capital inputs as a result.[40] In general, however, this means that oil is relatively less important as a determinant of growth. This finding is against the government's argument about the importance of oil in the economy. Three arguments must be considered, however. First, the limitations of our data set may eliminate the positive impact of the oil sector. Second, changes in oil production, which are set by OPEC's quota, are very small. Hence, although world oil prices are high, this may not yield a significant impact on growth in per capita income. Third, because the oil sector within our time framework is monopolized, it is not surprising that (allocative) inefficiency occurs. This may offset the positive impact of efficiency in the whole economy.[41]

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[40]See the previous discussion on externality effect.

[41]Further, following Ray (1998), our findings may overstate the positive impact of oil on living standards because they omit considerations of negative externalities, such as noise and pollution, arising from the use of oil. The surrounding residents of an oil exploration site may suffer from increased noise and pollution. In addition, until recently, Pertamina still produced "leaded gasoline" to provide low fuel prices. The existence of "leaded gasoline" in Indonesia will certainly expedite the decay of gasoline-fueled engines. If this occurs, it will increase the capital equipment expenses of non-oil sector companies. This means that the existence of these negative externalities may, at least partly, offset the positive. Because of this, it is not surprising that our finding for externalities is quite small (around 0.02%). Further, technological innovation can also eliminate the economic power of an existing patent and inflict losses.

2.6. Concluding Remarks

This chapter has developed a relevant model to investigate the causes of growth in the Indonesian economy using a standard two sector growth model. The model is based on six major variables including one dependent variable (economic growth), six independent variables (capital, labour and real prices growth rates in sectors w and o), and technical change.

Two anomalous periods, in 1982 and 1998, are controlled for because these periods significantly affect the Indonesian economy. To do so, we introduce dummy variables to modify equation (2.20).

Our primary concern in this chapter has been to estimate equation (2.33). By doing so, it is expected that the externality effect and the efficiency effect from the oil sector can be measured, something which has never been done for Indonesia, as far as this author knows. OLS is unlikely to be an appropriate method to estimate equation (2.33) due to the endogeneity problem. We therefore modify equation (2.33) to apply an IV estimation procedure. In doing the IV estimation, we run a regression for equations (2.31) and (2.32) and select the growth of world oil prices, riots, the growth rates of Indonesia's major trading partners and the second lag of the capital variables as the instruments. Using an appropriate procedure provided by Staiger and Stock (1997) and Bound *et al.* (1995), we conclude that the selected instruments are valid and plausible.

Given data availability, it seems that the model performs well because it has high F statistics. Using the OLS and 2SLS estimations, we conclude that the determinants of economic growth in Indonesia are particularly from productivity growth, capital growth and the instrument variables. Labour growth, on the other hand, provides only a small impact on economic growth in Indonesia.

The political climate, as a remote variable, is also an important factor in maintaining economic growth in Indonesia. Political stability is required to secure oil investment by foreign investors. Another factor is oil prices in the world market. Regardless of data limitation, our findings show that these remote variables indicate higher magnitudes than factor input growth and TFP.

Although the increase of capital stock in the oil sector is likely to influence economic growth, the magnitude of the capital growth rate in the oil sector is smaller than in the non-oil sector. The existence of monopoly power in the oil sector may have had an adverse effect on the allocative efficiency of the Indonesian economy. Overall, the total effect of the oil sector on growth is very small, contributing on average 0.18 per cent per year. This indicates that policy decisions to place increased emphasis on the non-oil sector, such as the 1985 reform, were probably well-placed. These findings show that Indonesian economic growth has evolved to depend less on oil sector development over time. Given that when the oil reserves have been depleted, the government will have to find new revenue sources to sustain its development programs, this is a positive development.[42] In turn, these findings suggest that it would be useful to explore further causal factors that may encourage greater efficiency and more rapid growth. Trade liberalization may be one such factor.

The next issue then is to decompose productivity growth into some foreign trade variables. This decomposition will address the question, "What is the causal relationship between oil exports and the causes of growth identified in this chapter?". This will be the subject of Chapter 3.

[42]We have tried to capture the impacts of the policy reforms by adding a 1985 dummy variable. Unfortunately, due to data limitations, the results are insignificant and there is a problem of collinearity with the 1982 dummy variable. So, this 1985 dummy variable has not been included in the model.

CHAPTER 3

SECTORAL PRODUCTIVITY GROWTH

3.1. Introduction

The previous chapter has analyzed the sources of Indonesian growth, finding it to be a combination of growth in productivity and factor accumulation. To fully understand the source of Indonesian growth, therefore, requires an explanation of the causes of the productivity growth. This is what this chapter attempts to do. Recently, economists such as Harberger (1998) and İşcan (1998b) have addressed the need to more fully explain the causes of productivity growth. İşcan (1998b, p.123) further argues that "regional economic integration and liberali[z]ation of international trade are likely to have positive effects not only on productivity levels but also on long-term productivity growth rates in developing countries". Based on this argument, we will specifically examine the effect of foreign trade on productivity in the Indonesian economy.

In order to look at the relationship between trade and the causes of growth as identified in the previous chapter, we construct a model to decompose productivity growth into export and import components and use sectoral productivity to examine the contribution of the foreign trade variables.[1] The basic estimating equation is equation (2.1.5) as specified in Appendix 2.1.[2] For convenience, it is useful to rewrite this equation here:

$$gQ_t = gTFP + \beta_K\, gK_t + \beta_H\, gH_t + \varepsilon_t \qquad (3.1)$$

where gQ is the output growth rate, gK is the growth rate of capital stock and gH is employment growth.

While equation (3.1) is required to investigate the causes of growth in the Indonesian economy, by itself it is not adequate to explain how exports link positively to productivity levels and/ or growth rates. To analyze the impact of exports on productivity, however, equation (3.1) can be extended. This model extension is mainly based upon İşcan (1998a and 1998b). We deliberately exclude the price variable in equation (3.1) for at least three reasons. First, as indicated in Chapter 2, the exclusion of the price variable does not cause a serious problem. Thus, the assumption of orthogonality of this variable is valid. Second, if the variable is not orthogonal, we realize that the exclusion of this variable induces an

[1]In other words, this chapter will enhance our model by using a larger number of sectors (i.e. 66 sectors) than the previous model, which is only two sector.

[2]Because we will cope with the sectoral data, equation (2.20) is equal to equation (2.1.5) excluding the price variables. We will capture the impact of the oil sector by constructing a dummy variable for the dependence of the economy on oil exports as discussed in Section 3.3.

omitted variable bias problem. But Wanner (2003) solves this problem by proposing one of the following methods: 1) a first difference model, 2) a fixed effect model, or 3) a random effect model. By using Wanner's proposal, unbiased estimates of β can still be obtained. This study employs a fixed effect model in part for this reason. Third, we do not have price data broken down into individual sectors. Most price data are constructed in aggregate data.

The main hypothesis to be tested is whether there is a relationship between exports, imports and growth, both output and productivity growth. If foreign trade fosters economic growth, the signs for exports, imports and the three dummy variables will be positive. This implies that exports and imports are likely to support (output growth and) technological progress because these foreign trade variables are also indirectly related to productivity growth. This may hold for several reasons. First, because the Government of Indonesia (GOI) diversified its trade policy to encourage non-oil exports, this will ultimately enhance production capacity of domestic manufacturing industries; in turn, this may lead to greater output. This premise is consistent with growth theorists such as Balassa (1978) and Tyler (1981) who argue that a country with a high rate of export growth tends to have a fast output growth rate. Thus, the GOI would obtain two benefits from encouraging non-oil exports, namely, alternative sources of foreign exchange via non-oil export revenues and via foreign investment in the non-oil sector and enhanced capacity utilization of domestic firms as a result of trade openness.

Stated differently, a higher export revenue and a greater capacity utilization are achieved because of market expansion of non-oil products.

Second, exports and imports often yield competitive pressures for local firms because foreign products may be more innovative and/ or cheaper. (See, for example, Bernard and Jensen, 1999 and 2001, and Tybout and Erdem, 2003.) To survive, local firms must enhance their efficiency, including technical improvement, product development, and cost saving in response to competition from abroad. Regardless of this technical efficiency, local firms may still have a low production cost because the GOI subsidized domestic oil prices during our sample period. Although subsidies actually improve their competitiveness in the domestic market, the existence of a subsidy is certainly inconsistent with the allocative efficiency argument. Thus, "true" economic efficiency may not necessarily appear as a result of more trade openness.

Because Indonesia is a growing economy, the estimated coefficients on each predetermined variable are expected to be non-negative. If they are, the coefficients on exports and imports will show the importance of foreign trade for the Indonesian economy. Consequently, economic policies concerning price incentives for exports and imports become of central importance to economic growth (Tyler, 1981).

To explore these issues, the remainder of this chapter is divided into nine sections. Section 2 overviews theories about trade and productivity, Section 3 develops a model, Section 4 discusses data and methodology, Sections 5, 6, 7, and 8 present the results and provides an analysis of the results, and some concluding remarks are offered in Section 9.

3.2. Literature Review

Issues about trade affecting productivity and economic growth have been long discussed. Economists recognize at least two mechanisms in which trade affects growth. The first mechanism is a direct effect of trade on growth developed by theorists such as Balassa (1978) and Tyler (1981). The second channel is an indirect effect of trade on growth via productivity, developed by theorists such as Sjöholm (1997) and Alcalá and Ciccone (2001).

Recent growth theorists such as Feder (1983) and Piazolo (1996) emphasize the contribution of exports to economic growth through their effect on capital accumulation and technical change. Although the nexus between exports and economic growth has become a central hypothesis of an effective development strategy, the empirical evidence on the growth effects of exports (or foreign trade) is varied.[3] Empirically, evidence in favor of export performance has come from statistical work on the relationship between export growth and output growth

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[3]See, for example, Balassa (1978), Tyler (1981), Feder (1983), Moschos (1989), Clark (1995), Abimanyu (1995), Piazolo (1996) and İşcan (1998a and 1998b), among others.

following the work of Emery (1967). The theory behind this work is that export growth represents an increase in demand for the country's output and this promotes a rise in real income. On the other hand, Sjöholm (1997) also found that export growth is likely to induce technological change which can be achieved through increased competitive pressure, embodiment in imported inputs and knowledge transfer through commercial contacts.

Numerous studies have spurred a growing literature on the relationship between trade and productivity. Most of them confirm that factor inputs are more important for growth in developing countries than in developed countries. Other studies have found that productivity begins to play an important role for a country which increases exports. However, the measure of trade on productivity used in the empirical work remains a controversial issue. Table 3.1 summarizes the major studies on the direct and indirect effects of trade on growth.

As seen in Table 3.1, the measures of trade used in examining the relationship between trade and growth have varied from a single export variable to openness to an effective rate of protection (ERP). However, Chand and Sen (2002, p.1) note that "...the available empirical evidence on this issue has been far from conclusive". Any study either using macro data or even applying micro data does not find an unambiguous positive relationship between trade and growth (see, for example, Rodrik, 1995).

Harrison (1996) concludes that the correlation across different types of

Table 3.1: Some Empirical Studies of Export, Productivity and Economic Growth

Study	Data Set	Method	Other Variables	Main Result
Emery (1967)	Cross Country (50) 1 Time Period [1953]	OLS (GNP on Export)	Current Account	Positive Impact of Export on Growth
Voivodas (1973)	Cross-Country (22) Time Series (1956-1967)	OLS (GDP on Export)	None	Positive Impact of Export on Growth
Balassa (1978)	Cross-Country (10) 2 Time Periods (1960-1966 & 1967-1973)	OLS (GNP growth in Export growth)	Labour Force Growth, Investment/Output	Positive Impact of Export on Growth
Fajana (1979)	Time Series (1954-1974) for Nigeria	OLS (GDP growth on Export Share or Export Change/ Output)	Trade Balance and Current Account	Positive Impact of Export on Growth
Tyler (1981)	Cross Country (55) 1 Time Period (1960-1977)	OLS (GDP Growth on Export Growth)	Labour Force Growth, Investment Growth	Positive Impact of Export on Growth
Krueger and Tuncer (1982)	Time Series (1963-1976) for Turkey	OLS (Growth on Factor Inputs)	Purchased Inputs	Positive Impact of Productivity on Growth
Feder (1983)	Cross Country (31) 1 Time Period (1964-1973)	OLS (GDP Growth on Export Growth)	Labour Force Growth, Investment/ Output	Positive Impact of Export on Growth
Jung & Marshall (1985)	Cross Country (37) 1 Time Period (1950-1981)	Granger Causality of GNP or GDP Growth and Export Growth	None	Some countries have positive impact of Export on Growth
Chu (1988)	Time Series (1969-1981) for Taiwan	Leontief Input Output Analysis	None	Export is a source of Growth

Source: Author's Analysis

Table 3.1: Some Empirical Studies of Export, Productivity and Economic Growth (continued)

Study	Data Set	Method	Other variables	Main Result
Dodaro (1991)	Cross Country (41) 1 Time period (1973-1985)	OLS (Export on per capita GNP and GDP Growth on Export)	Export Dummy	Positive Impact of Export on Growth
Tybout (1992)	Cross Countries (4) Time Period (1976-1988)	OLS (Import Substitution and TFP)	None	Import Substitution positively affects TFP
Doraisami (1996)	Time Series (1963-1993) for Malaysia	Granger Causality of GDP Growth and Export Growth	None	Positive Impact of Export on Growth and Growth on Export
Harrison (1996)	Cross Countries (51) 2 Time Period (1960-1984 & 1979-1988)	Spearman Rank Correlation of GDP Growth and Openness	Investment	Positive Impact of Openness on Growth
Sjöholm (1997)	Cross Section (7762 establishments in 1980 and 15709 establishments in 1991) for Indonesia	OLS with a Minimum Absolute Deviation procedure (Growth on Export)	Export and Import Dummies	Trade has impact on Growth via Productivity
İşcan (1998b)	Cross Sectors (47) 1 Time Period (1970-1990) for Mexico	Generalized Method of Moment (GMM) with Fixed Effect of Growth on Export	Effective Rate of Protection	Trade has impact on Growth via Productivity
Bernard and Jensen (1999)	Cross Industries (434) 1 Time Period (1958-1996) for US manufacturing	Granger Causality of Productivity and Export Growth	Firm Size, Employment, Shipments	Positive correlation between export and productivity growth
Alcalá and Ciccone (2002)	Cross Country (150 in 1985 and 115 in 1990)	GMM with Fixed Effect of Openness and Productivity	Price level, Number of Workers, Population	Openness has impact on Growth via Productivity

Source: Author's Analysis

openness as a proxy of trade policy and growth is not always strong, although it is still positive. She adds that "the strength of the association depends on whether the specification uses cross section or panel data"(p.419). For some countries (particularly industrializing countries), openness may not be a good indicator of trade policy.[4]

Alcalá and Ciccone (2002) also argue that using openness, defined as the ratio of nominal imports plus nominal exports to nominal GDP, is often misleading. This is because the relatively greater productivity gains in the tradable goods sector may lead to a rise in the relative price of non-tradable goods; in turn, this may decrease openness. Instead, they suggest using real openness and tradable GDP openness to examine the relationship between trade and growth. In this context, real openness is defined as imports plus exports (in US dollars) relative to Purchasing-Power- Parity GDP (PPPGDP), while tradable GDP openness is defined as nominal imports plus exports divided by the nominal value of production in the tradable goods sector. They claim that real openness and tradable GDP openness eliminate cross-country differences in the relative price of non-tradable goods from the summary measure of trade.

İşcan (1998b) further disentangles exports and imports to measure the effect

[4]In this context, Bernard and Jensen (1999) and Tybout and Erdem (2003) state that trade liberalization heightens competitive pressure thus ultimately induces productivity gains.

of trade and trade liberalization on productivity in Mexican industries. He concludes that "trade variables are positively correlated with the level and the growth rate of productivity". (See Table 3.1.) He also provides an alternative way to consider effective rates of protection (ERP) as a measure of protection to investigate its impact on productivity. His results show that there is a negative and significant effect of protection rates on the productivity level to the extent that sectors with larger reductions in protection rates had greater increases in productivity levels. Thus, ERP is a good measure of sectoral exposure to international trade because this variable can indicate the impact of sectoral differences on productivity.

The issue in this study is not cross-country differences but cross-sector differences. To handle these, either ERP or the export-import ratio can be used as a measure of trade impact on productivity growth. Although ERP is often claimed to be a more direct measure of trade policy, the unavailability of enough observations on ERP prevents us from utilizing it in our study. (See also Chand and Sen, 2002) Therefore, the only practical choice is to employ the export-import ratio.

As can be seen from Table 3.1, the empirical method used in different studies also varies. Some use simple regression techniques such as Spearman Rank Correlation and OLS. Others employ a more sophisticated regression method such as an IV or GMM procedure with or without fixed effects. Regardless of which methodology is applied, however, most economists confirm that exports have a positive effect on growth while the effect of imports on growth is slightly ambiguous.

In general, at least three main conclusions can be drawn. First, the share of output growth explained by productivity growth is generally greater in developed countries than in developing countries. Productivity growth usually accounts for about 50% of output growth in developed countries and less than 30% in developing countries (Senhaji, 2000, and Alcalá and Ciccone, 2002). Meanwhile, capital stock growth is usually the most important factor (accounting for more than 40%) in developing countries. Second, variations in output growth are mostly caused by variations in factor input growth rather than variations in productivity gains. Third, most studies are not comparable because they have differences in country size, periods, sectoral coverage and even estimation method. Though non-comparable, economists conclude that capital accumulation cannot sustain long-term growth, while TFP can because it improves technology in the economy (Senhaji, 2000). In other words, if trade has a positive relationship with productivity growth, trade is likely to be the determinant of long-term growth.

3.3. The Model

3.3.1. The Trade Model

As in the standard growth model, equation (3.1) is related to growth in total factor productivity. The relationship to productivity growth is indeed more important than the relationship to productivity level. What matters is how the productivity level changes over time (Ray, 1998). The change of productivity over time represents technological change. Nevertheless, in this study, both the growth in, and the level of, productivity will be explored.

Following İşcan (1998b), productivity growth (*gTFP*) can be expressed as the sum of a temporary change in the productivity level (g*TTFP*) and a permanent change in the trend productivity (g*PTFP*). Thus,

$$gTFP = gTTFP + gPTFP \tag{3.2}$$

To capture the idea that foreign trade stimulates the productivity level and its growth rate, economists such as İşcan (1998b) usually use two variables, exports and imports, to indicate trade orientation. In this study, we begin with a discussion of export performance variables and add the import variable later. In analyzing the impact of export performance, the study divides Indonesian exports into two components, i.e., the share of exports in output (*sX*) of a sector and the ratio of sectoral exports and total exports (*sTX*). These components are designed to represent trade liberalization and trade orientation in Indonesia. For years, the Government of Indonesia (GOI) emphasized its fiscal revenues from oil exports and switched to a greater emphasis on non-oil exports only after oil earnings became unstable (Susanti *et al.*, 1995 and Woo *et al.*, 1994).[5] This oil dependence will also be reflected by adding a dummy variable, which will be more fully explained in the next section.

Again, following İşcan (1998b), allow the temporary change in productivity level (g*TTFP*) to linearly depend on the change in the share of exports in output. This share variable is

$$gsX = g\left(\frac{X}{QNX}\right) .$$

where *gsX* is the change in share of exports in output (*QNX*), or simply the export share, over time.[5] Also, because we have split exports from GDP, output denoted by *QNX* is now interpreted as GDP minus exports, or simply, output net of exports. This split is required to avoid a collinearity problem between any of the independent variables in the model. The change in the export share variable can eventually be interpreted as an indicator of foreign trade policy in Indonesia.

To avoid the problem of contemporaneous correlation between independent

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[5]See also Table A.3.1.1 in Appendix 3.1.

[5]For simplicity, we initially omit the sectoral subscript *i*. The sectoral subscript will be added later.

variables and error terms, the current temporary change in productivity level is made to depend on past values of the change in the export share variable. The current independent variable (exports) is likely to be correlated with the error term because, for example, a local currency depreciation will raise foreign demand, leading to an increase in Indonesian exports and output (Pindyck and Rubinfeld, 1998, p. 179 and İşcan, 1998b, p. 129).

Thus, we have

$$gsX_{(t-j)} = g\left(\frac{X}{QNX}\right)_{(t-j)} ,$$

where *QNX* is GDP minus exports, t is the current time period, and $j = 1, 2, ..., n$ denoting the number of lags. Changes in the export share, *gsX,* now indicate changes in the lagged export shares.

Further, as advocated by the export-led growth theorists, the permanent change in the trend productivity (g*PTFP*) will linearly depend on export orientation. For example, Poot *et al.* (1992) report that in Indonesia, (manufacturing) industries with a higher export ratio tended to have higher productivity growth during their sample period. Therefore, this study will include the sectoral export ratio to capture the trend effects. In this context, the study defines the ratio of sectoral exports and total exports, or simply the (sectoral) export ratio, as

$$sTX_i = \frac{X_i}{TX},$$

where X_i is sectoral exports and TX is total exports during the sample period. This sectoral export ratio is interpreted as a measure of trade orientation in Indonesia.

The measures of the export variables above are consistent with the theory of endogenous growth. This is because the pace of growth is not simply caused by exogenous technical progress but is determined by input and trade variables (İşcan, 1998a and 1998b, and Ray, 1998). Therefore, the study specifies the link between productivity growth and the export performance variables, after introducing sector-specific disturbances, as

$$gTFP = \Sigma_j \gamma_1 gsX_{(t-j)} + \gamma_2 sTX_{it} + \tau_t + \mu_i \qquad (3.3)$$

where the lag length (j) is ≥ 1, τ_t is the fixed year effect to control the aggregate growth effect (also known as *unobserved heterogeinity*), and μ_i is sector-specific disturbances.[6] In this context, İşcan (1998b, p.130) defines fixed effects as "unobservable differences across sectors which may arise due to issues such as ownership structure, or skill and human capital composition". Differences in sectoral labour skills certainly lead to differences in productivity. The introduction

[6]Sector-specific disturbances are all other errors which are associated with the collection and measurement of the (panel) data.

of these effects will essentially allow the intercept term to vary over time and over cross-section units (Pindyck and Rubinfeld, 1998). Equation (3.3) indicates that productivity growth effects can be identified by looking at the changes in past sectoral export shares and current sectoral export ratios (Nickell, 1996 and İşcan, 1998b).

The next task is to introduce the import variable into equation (3.3). According to İşcan (1998b), sectors which extensively use imported intermediate inputs are likely to gain advantages from technical change in the outside world. This may occur because, for example, foreign suppliers often provide better quality intermediate inputs which, in turn, persuade domestic firms to improve their productivity. For example, yarns imported from China are generally cheaper and stronger than those produced by local firms in Indonesia. These better inputs will, of course, yield a better quality textile. This condition will not only make Indonesian textiles better but also, in turn, will stimulate local yarn producers to improve their quality to compete with the imported yarns.

Meanwhile, imports of finished goods and services are likely to induce local competition, which is thought to have a positive impact on productivity growth.[7] Foreign finished goods often introduce more innovative products and lower prices. From the buyer's perspective, the existence of foreign competitors

[7]It is now common that foreign food and beverages face head-on competition from local producers.

certainly produces a better local market performance. If local producers do not adjust their products and prices to meet their foreign competitors' products, their local customers may easily switch their product selection.

Thus, there are at least two import variables theoretically affecting productivity growth. These are imported intermediate inputs and total imports. In our data set, for several years, data on imported intermediate inputs are not available.[8] Hence, this study will only use the share of sectoral imports in output, or simply the (sectoral) import share, to capture the impact of the import variable on growth.[9] The inclusion of this import variable may then be interpreted as an indicator of the intensity of the effect of foreign competition on the domestic market.

In this study, the import share (*sM*) is defined as

$$sM = \frac{M}{Q}$$

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[8]Total imports are the sum of imported raw materials, intermediate inputs, finished goods, equipment and machinery, as well as services. For Indonesia, data on imports are not broken down into these components but are reported in aggregate values. Because not all sectoral imports of goods and services have been reported consistently, looking at total imports is therefore the only practical choice.

[9]The study does not use net exports (i.e. exports minus imports) because imports are big in Indonesia's foreign trade. The ratio of exports and imports is around 80%. That is why we treat the import variable separately.

where M is total imports and Q is output net of exports.[10] Thus, introducing this import variable into equation (3.3), we obtain

$$gTFP = \Sigma_j \gamma_1 gsX_{(t-j)} + \gamma_2 sTX_t + \gamma_3 sM_t + \tau_t + \mu_i \qquad (3.4)$$

Again, it is useful to note that, for simplicity, we omit the sectoral indices in equation (3.4), and they will be added later. The model assumes that sectoral productivity growth effects can be identified by looking at changes in the past sectoral export share, the sectoral export ratio and the sectoral import share (see also, for example, Chu, 1988, Grabowski, 1994, Nickell, 1996, Piazolo, 1996 and İşcan, 1998b).

Substituting equation (3.4) into (3.1) yields an estimated output growth equation of:

$$gQNX_t = \Sigma_j \gamma_1 gsX_{(t-j)} + \gamma_2 sTX_t + \gamma_3 sM_t + \beta_{K1} gK_t + \beta_{H2} gH_t + \tau_t + \mu_i + \varepsilon_{it}, \qquad (3.5)$$

[10]This is the standard measure of import dependence. The other measure usually requires imported inputs data which are not available for Indonesia. See, for example, Chu (1998).

where:

1. *gQNX* is the growth rate of sectoral output minus sectoral exports
2. *gsX* is the change in the share of sectoral exports in sectoral output
3. s*TX* is the ratio of sectoral exports to total exports
4. *sM* is the change in the share of sectoral imports in sectoral output
5. *gK* is the growth rate of sectoral capital stock
6. *gH* is the employment growth in sector *i*
7. γ and β are the coefficient parameters of respective predetermined variables (i.e. *gsX, sTX, sM, gK* and *gH*).
8. τ_t is the fixed year effect
9. μ_i is sector-specific disturbances
10. ε_{it} is all other error terms.

The lag length (*j*) is selected to be 2 because a longer lag length will decrease the sample size.[11] Equation (3.5) ultimately specifies an empirical relationship between export performance and productivity, as well as economic growth. The interpretation of equation (3.5) is that the growth rate of real output (net of exports) is composed of the contribution of the factor accumulation (capital and labour) growth rate and the gains from exports and imports. In detail, equation

[11]We will also present the results with one lag.

(3.5) means that economic growth is a function of the change in the lagged export shares and the export ratio, as well as the growth rate of the capital stock and employment. The significance of the change in the lagged export share variables and the export ratio is that export performance is likely to influence technological progress and, in turn, economic growth. This is due to competitive pressure from abroad.[12]

The significance of the parameter coefficient of the import variable ultimately shows the importance of foreign trade variables for the Indonesian economy. As with the export variables, the sign of the import variable is also expected to be non-negative. This means trade liberalization through the importation (and sale) of foreign products affects local competition which, in turn, theoretically promotes productivity growth. Not only are foreign products claimed to be more innovative but also their prices are often cheaper than similar products which are produced by local firms. If this is the case, the only way for local producers to survive in the market is to improve their technology. Hence, imports (of finished goods) are also likely to stimulate technological progress. It is useful to note, however, that the import variable used here is certainly not the perfect indicator of the effect of foreign competition because data on imports in this study

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[12]Explanations for these premises have been widely discussed by a number of economists such as Balassa (1978), Feder (1983), Grabowski (1994), Piazolo (1996) and İşcan (1998b).

are not broken down into inputs. Because imported inputs data are not completely available and the main focus of this study is sectoral exports, we will not examine this issue further.

3.3.2. The Dummy Variables

Because, for years, the Government of Indonesia focused its exports on oil, we want to specifically examine the effect of oil exports on productivity. Thus, it is useful to modify equation (3.5). To do this, we introduce dummy variables for year of observation to estimate the possible differences in productivity performance across periods. The dummy variable is intended to specify the period of pre- and post-trade liberalization, which also represents the transition of the economy from its dependence on oil exports. In other words, a dummy formulation involves testing for structural change in the productivity parameter after 1985.

There are essentially two major reasons for this dummy selection. First, pre-1985, oil was the largest single earner of foreign exchange providing revenues which supported the rapid development of the Indonesian economy in the 1970s and 1980s. It accounted for no less than 49% of government revenues during this period.

Second, after 1985, the economy became less dependent on oil exports. For example, whereas in the late 1970s and the early 1980s oil exports accounted for almost half of the government's revenues, in the 1990s the figure was less than 40%.[13] This, at least partly, reflects the Government of Indonesia's (GOI) policy of encouraging the non-oil and non-gas sectors. The reasons for this policy were twofold. First, oil is an exhaustible resource and is limited in quantity. Second, oil prices in international markets were relatively volatile, producing foreign exchange fluctuations in Indonesia. For example, the Indonesian economy benefitted from the OPEC oil embargo and price hikes in the 1970s and the early 1980s, while the economy was harmed when the international price fell in the mid-1980s. The decline of oil export earnings in the mid-80s was sufficient to threaten the development of the country. In turn, this led to the shift in policy in 1985.

To account properly for this dependence argument, we define dummy variables D^{85}, D^{90} and D^{95}, which take a value of one if the year of observation is 1985, 1990, 1995, respectively, otherwise zero. By doing so, we are estimating a "two-way" fixed effects regression, controlling for both time and sectoral fixed effects. In this context, years of observations in 1990 and 1995 (D^{90} and D^{95}) are also introduced for at least two reasons. First, trade liberalization also occurs in 1990 and 1995. Second, the inclusion of the three period dummy variables (i.e. D^{85}, D^{90} and D^{95}) is useful in order to know which year is significantly applicable without simply assuming one of the other is sufficient to tell us so we may identify

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[13]See Figure A.3.1.1 in Appendix 3.1.

the differential productivity effect.

Adding this new dummy variable, equation (3.5) can be rewritten as

$$
\begin{aligned}
gQNX_t = {} & D^{85}\,[\,\Sigma_j\, \gamma_4\, gsX_{(t\text{-}j)} + \gamma_5\, sTX_t\,] \\
& + D^{90}\,[\,\Sigma_j\, \gamma_6\, gsX_{(t\text{-}j)} + \gamma_7\, sTX_t\,] \\
& + D^{95}\,[\,\Sigma_j\, \gamma_8\, gsX_{(t\text{-}j)} + \gamma_9\, sTX_t\,] + \gamma_{10}\, sM_t \\
& + \beta_{K2}\, gK_t + \beta_{H3}\, gH_t + \tau_t + \mu_i + \varepsilon_{it} \qquad (3.6)
\end{aligned}
$$

where τ_t is the fixed effect, μ_i is sector-specific disturbances, and ε_{it} is all other error terms. D^{85} is a 1985 export dummy variable (s.t. if year = 1985, $D^{85} = 1$ otherwise zero), D^{90} is a 1990 export dummy variable (s.t. if year = 1990, $D^{90} = 1$ otherwise zero), and D^{95} is a 1995 export dummy variable (s.t. if year = 1995, $D^{95} = 1$ otherwise zero).[14]

Equation (3.6) says that the growth rate of output in Indonesia is a function of the change in the export share at time *t-1* and *t-2*, the export ratio at time *t*, the import share at time *t*, the growth in factor accumulation (*K* and *H*) and the export dummy. The inclusion of the two lags is very problematic due to our small sample size. This may affect our regression results. Therefore, we will also run the model

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[14]We do not introduce a dummy variable with the year 1980 in the model because we want to avoid the dummy variable trap. Due to the second lagged variable construction, we only have 4 years (i.e. 1980, 1985, 1990 and 1995) for our panel data. This panel data will be explained later.

with one lag. The existence of the export dummies in the model as multipliers ultimately allows the estimation of both the level and growth effects of exports on overall growth. Alternatively, we may add a new dummy as a sole independent variable in the model. However, this sole independent dummy will only capture the level effect on growth. Aside from this effect, adding a sole independent dummy variable may also reduce the degrees of freedom.

3.4. The Data

3.4.1. Sources of Information

To estimate equations (3.5), and (3.6), the time series data set applied in Chapter 2 will not be enough because it only gives us 34 observations. The data needs to be extended to provide adequate degrees of freedom. This can be done by expanding the number of observations. This cannot be done by extending the number of annual observation, because the Indonesian data prior to 1966 are not available on an annual basis. Meanwhile, the monthly or quarterly data of Indonesia are also not reliable, and were not collected prior to 1975.[15] Alternatively, we could use sectoral data such as agriculture, manufacturing, education and services. Unfortunately, for Indonesia, the only complete sectoral data are for the manufacturing sector. Other sectors are not serially available prior

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[15]Some of the data such as employment and domestic prices were not even collected yet. If they were collected, these data were often not reliable.

to 1985. Therefore, the only feasible option is to use input-output (IO) tables to get more observations. The IO tables for Indonesia, however, are not available annually and are only produced every five years. The IO tables published by the Central Board of Statistics of Indonesia provide data for 1971, 1975, 1980, 1985, 1990, and 1995. Unfortunately, the 2000 IO data is not available yet. The IO tables of Indonesia are usually broken down into 9 sectors, 19 sectors, 66 sectors and larger matrix sectors (e.g. 179 sectors).

The IO option is the most practical and hence, the preferred choice to estimate equations 3.5 and 3.6. By combining all the available IO data, we ultimately end up with a panel data set over a period of time (i.e.,1971 - 1995). This provides an increased number of data points, and incorporating information associated with cross section and time series variables can substantially eliminate the problems of dealing with omitted variables (i.e., unobserved heterogeneity). For example, technological progress usually cannot be estimated using a cross section analysis. But with a longitudinal or panel data set, technological improvements can be incorporated because of the existence of the time series component. In other words, a panel data set is useful to examine a time series effect together with a cross section analysis.

According to the CBS, the construction of the IO table was based on a commodity-based rule and an activity-based rule. These rules are required to obtain a proper classification when compiling all aspects of production and distributions of goods and services. A commodity-based rule is a grouping method based on physical similarities including type, kinds, chemical composition, nutritional contents, roles, prospects and function in daily life. For example, consider the paddy sector (sector 1) and the vegetable and fruits sector (sector 5). The paddy sector is a single commodity sector. But the vegetable sector is a multiple commodity sector formed by combining several commodities such as wild spinach, water cabbage, carrots, green beans and so on. Because those commodities have physical similarities, they are grouped into the vegetable and fruits sector. This commodity-based rule is generally used to form a primary sector such as agriculture, mining, quarrying, and electricity, gas and water supply and so on.

The other grouping method is an activity-based rule. This rule deals with a notion of goods and services based on similar activities. Yet, it is difficult to distinguish a perfectly unique activity among sectors. For example, a milling activity is a single activity but it may produce different products, such as corn from a corn mill and rice from a rice mill depending on the raw material and purpose. Meanwhile, under a commodity-based rule, corn and rice are different commodities, so that a corn mill and a rice mill may be classified as being in different sectors. Thus, an activity-based rule is indeed difficult to apply, since no two activities are perfectly the same. Because of this, activity sectors are relatively little used. In fact, the CBS forms an activity-based-sector for the manufacturing sector only.

The CBS assumes that when commodities are different, they will be assigned to different sectors. For example, if the vegetable and fruit sector (sector 5) also produces wood, which may be used for firewood or charcoal, and cheap construction materials, then these are transferred into the wood sector (sector 21). The key issue is that all categories of production must be covered by the available classification system. Thus, vegetable and fruits will be considered as the main products in sector 5, while wood is considered to be a secondary sector. This transfer mechanism indeed makes it difficult to find a precisely comparable sectoral content for the same classification number due to variations in technological progress in a sector. To eliminate this problem, sector adjustment is required, so a sector over time may be comparable. (See Appendix 3.2.)

Another weakness of the IO table is that it has not been published annually. In this quinquennial period (i.e., 1971-1995), Indonesia experienced positive economic growth. (See Figure 2.2.) In the 1970s, for example, the Soeharto government enjoyed significant gains from oil exports due to OPEC's new quota system, which rapidly increased world oil prices in the 1970s. As a result, within this period, the Indonesian economy grew at around 8 per cent annually. In the mid- 1980s, as another example, the Indonesian economy kept growing, on average, at 7 per cent because a new trade policy was introduced to alter government revenues from oil exports. This means that the quinquennial period of the IO tables may only cover "good years" of the Indonesian economy. It may not represent the whole business cycle in Indonesia. This, of course, restricts us in drawing precise shifts among sectors. To overcome this situation, we take an average value over time so that the expected shift can still be captured and compared with our previous results as reported in Chapter 2.[16]

3.4.2. The Estimating System of Equations

This study will use a panel data set to estimate equations (3.5) and (3.6) at the sectoral level. Consequently, equations (3.5) and (3.6) need to be revised to allow this sectoral approach to be used. Using *i* to denote the sector, we now have

$$gQNX_{iT} = \Sigma_j \, \gamma_1 \, gsX_{i(T-j)} + \gamma_2 \, sTX_{iT} + \gamma_3 \, sM_{iT} + \beta_{K1} \, gK_{iT} + \beta_{H2} \, gH_{iT} + \tau_{iT} + \mu_i + \varepsilon_{iT} \quad (3.7)$$

and

$$\begin{aligned} gQNX_{iT} = {} & D^{85} [\Sigma_j \, \gamma_4 \, gsX_{i(T-j)} + \gamma_5 \, sTX_{iT}] \\ & + D^{90} [\Sigma_j \, \gamma_6 \, gsX_{i(T-j)} + \gamma_7 \, sTX_{iT}] \\ & + D^{95} [\Sigma_j \, \gamma_8 \, gsX_{i(T-j)} + \gamma_9 \, sTX_{iT}] + \gamma_{10} \, sM_{iT} \\ & + \beta_{K2} \, gK_{iT} + \beta_{H3} \, gH_{iT} + \tau_{iT} + \mu_i + \varepsilon_{iT} \end{aligned} \quad (3.8)$$

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[16]In other words, we assume that the average value may represent an annual shift among sectors.

The data is longitudinal and time is discrete. Therefore, the estimating equations use T as the time subscript.

3.4.3. Data Construction

The input-output data is collected by the Central Board of Statistics of Indonesia (CBS). The CBS uses a modified classification of the International Standard Industrial Classification of all economic activities (ISIC) to define the sectors appearing in the I-O table.

Due to data availability, the principal table used here is the 66 sector data set.

This study covers the period 1971 - 1995. All the variables required by equations (3.7) and (3.8) are available for this period.

It is also important to note that CBS may modify the industry classification from period to period; new sub-sectors may appear and old sub-sectors disappear from one table to the next. Because of this, a simple ratio analysis between the two periods is not possible unless the industry composition can be expressed in the same manner. In other words, we have to be able to convert the numbers included in the previous IO table into the more recent one, or vice versa. For more detail on how this has been done, see Appendix 3.2.

The annual growth rate (g) of different variables can be calculated using the formula

$$gV_{iT} = \left(\frac{V_{iT} - V_{i(T-j)}}{V_{i(T-j)}} \right) \times \frac{1}{d(T-j)} \times 100 \tag{3.9}$$

where V denotes real values of respective variables such as Q, K, H, X and M while $d(T\text{-}j)$ is the difference of the time period of the IO tables published in time T and j refers to the previous IO table period. For example, the growth rate of real per capita output in sector 1 in 1995 ($gQ_{1,1995}$) is calculated as

$$gQ_{1,1995} = \left(\frac{Q_{1,1995} - Q_{1,1990}}{Q_{1,1990}} \right) \times \frac{1}{5} \times 100$$

where T is 1995, j is 1990 and $d(T\text{-}j) = 5$.

3.5. Descriptive Statistics

As in Figure 3.1, sector 25 (oil) has been the highest exporting unit. (A list of these 66 sectors is provided in Appendix 3.3.) This is because the Government used oil to boost the Indonesian economy. Though oil remains a *prima dona*, the Government has diversified its revenues from oil to non-oil products, such as rubber (sector 7), wood manufacturing (sector 37), textiles (sector 36), and other estate crops (sector 16). Meanwhile, exports of sector 66 (unspecified sector) have also grown significantly. Yet, sector 66 is undefined activity and commodities which cannot be classified into other sectors, so it is difficult to provide further explanation of developments in sector 66.

In addition, as seen in Figures 3.2, 3.3, 3.4, 3.5 and 3.6, oil has the highest export ratio in the Indonesian economy. See also Table A.3.3.2 for the mean and standard deviation of each sector. Non-oil commodities seem to have a relatively steady export ratio. However, oil export share growth rates have varied over time. Price fluctuations in the world market are the main cause of oil revenue fluctuation. For example, in 1985, although the oil export ratio, defined as oil exports divided by total exports in 1985, was still high, its export share growth rate dropped significantly, due to the fall in world oil prices. Meanwhile, export growth rates of non-oil commodities before 1985 were generally lower than those after 1985. This means trade reforms in 1985 have actually changed Indonesia's export orientation. Further, some sectors such as sectors 1 (paddies), 2 (nut trees), 12 (coffee), 13 (tea) showed negative export growth rates. There are at least two reasons for this. First, it was due to the decline in the world prices of these commodities (Hill, 2000, p. 136). Second, it is clear that these sectors were not planned to be export-oriented sectors. Commodities in these sectors were usually aimed at fulfilling domestic demand. An increase in domestic demand will, of course, reduce exports in these sectors, because exports are often treated as the residual of production and domestic demand.

Figure 3.1: The Share of Sectoral Exports in Sectoral Output (sXi) 1971-1995

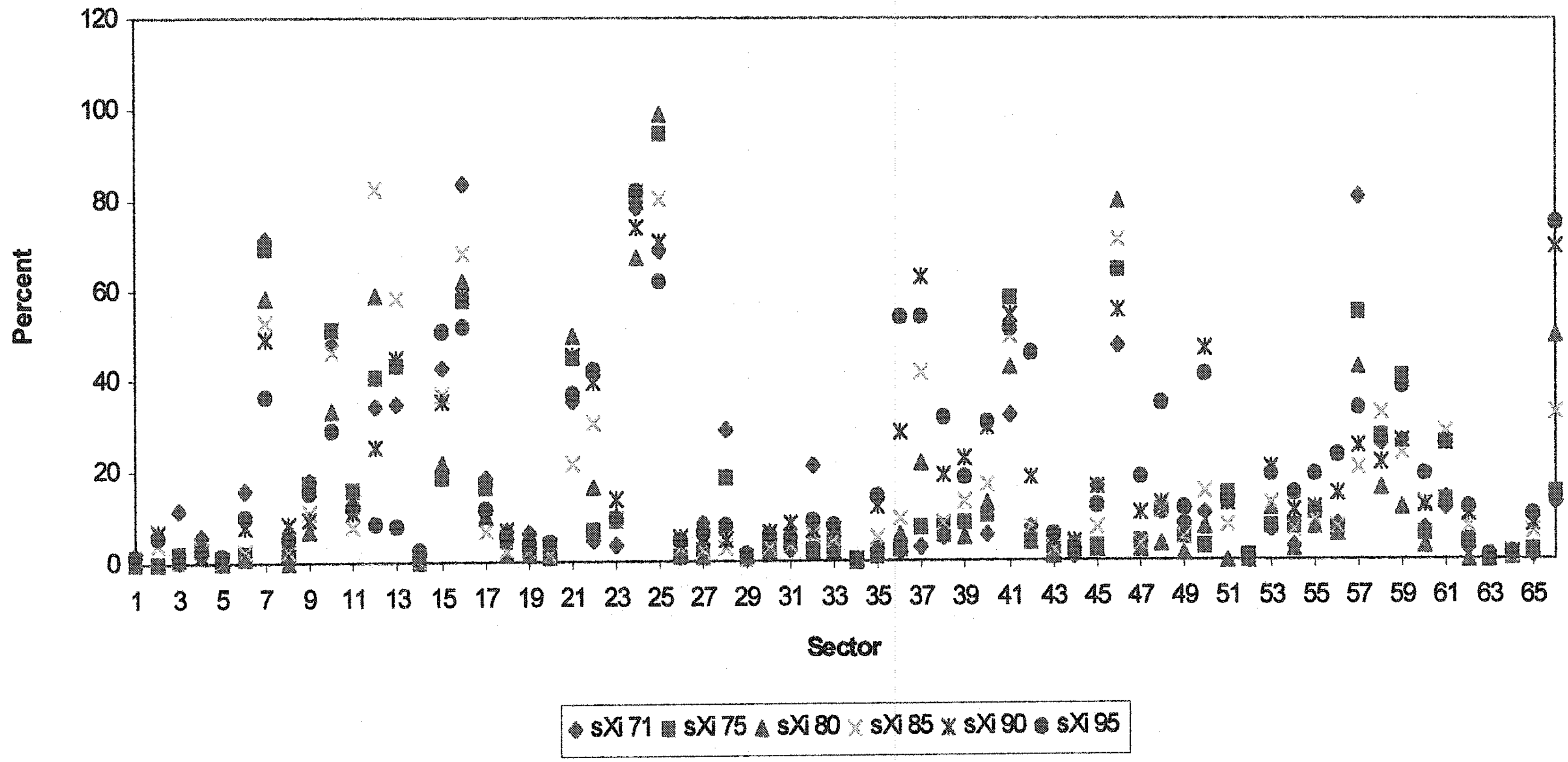


Figure 3.2: Sectoral Output Growth Rate (gQNXi), Export Ratio (sTXi) and Export Share Growth Rate (gsXi), 1975

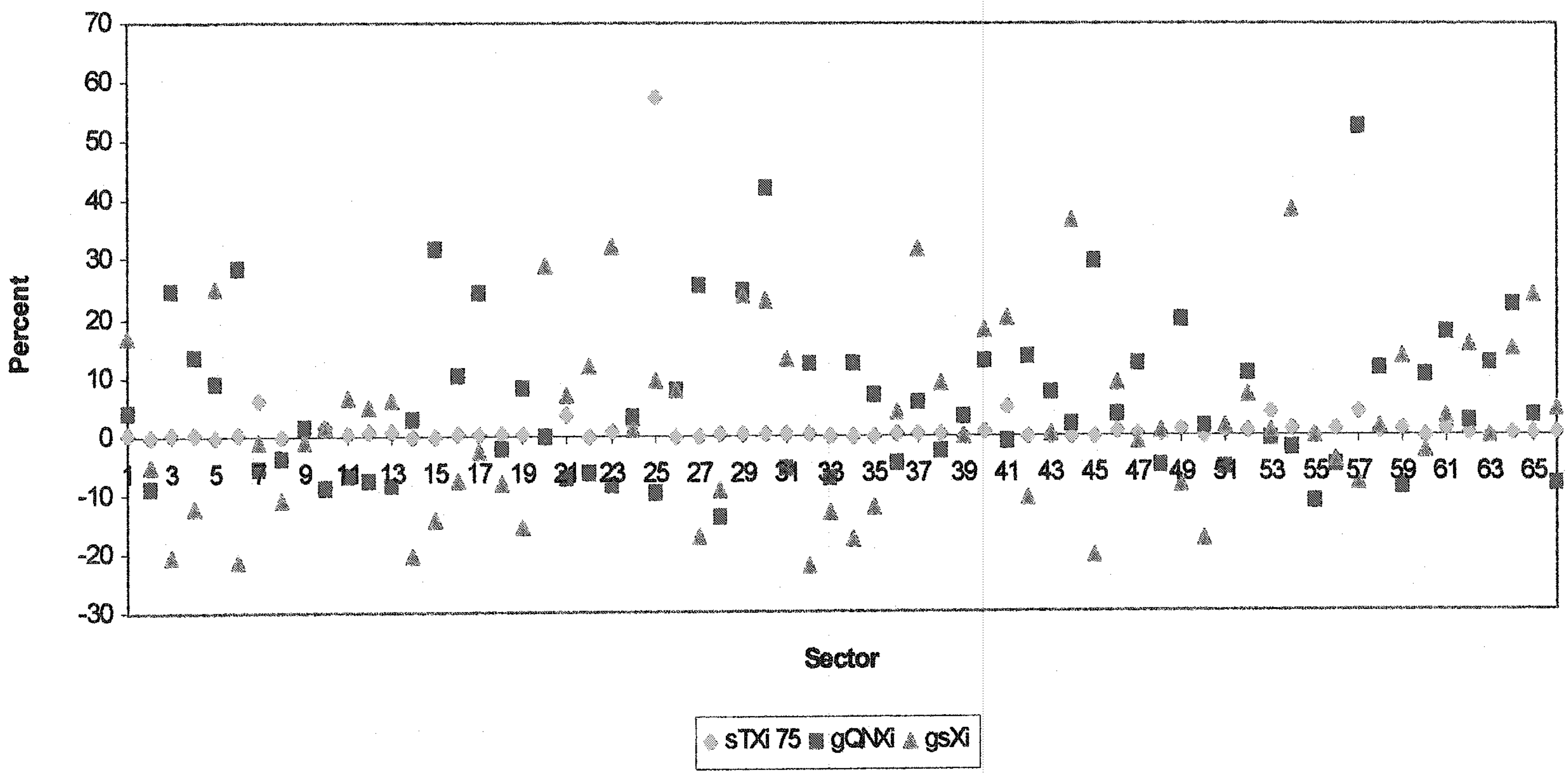


Figure 3.3: Sectoral Output Growth Rate (gQNXi), Export Ratio (sTXi), and Export Share Growth Rate (gsXi), 1980

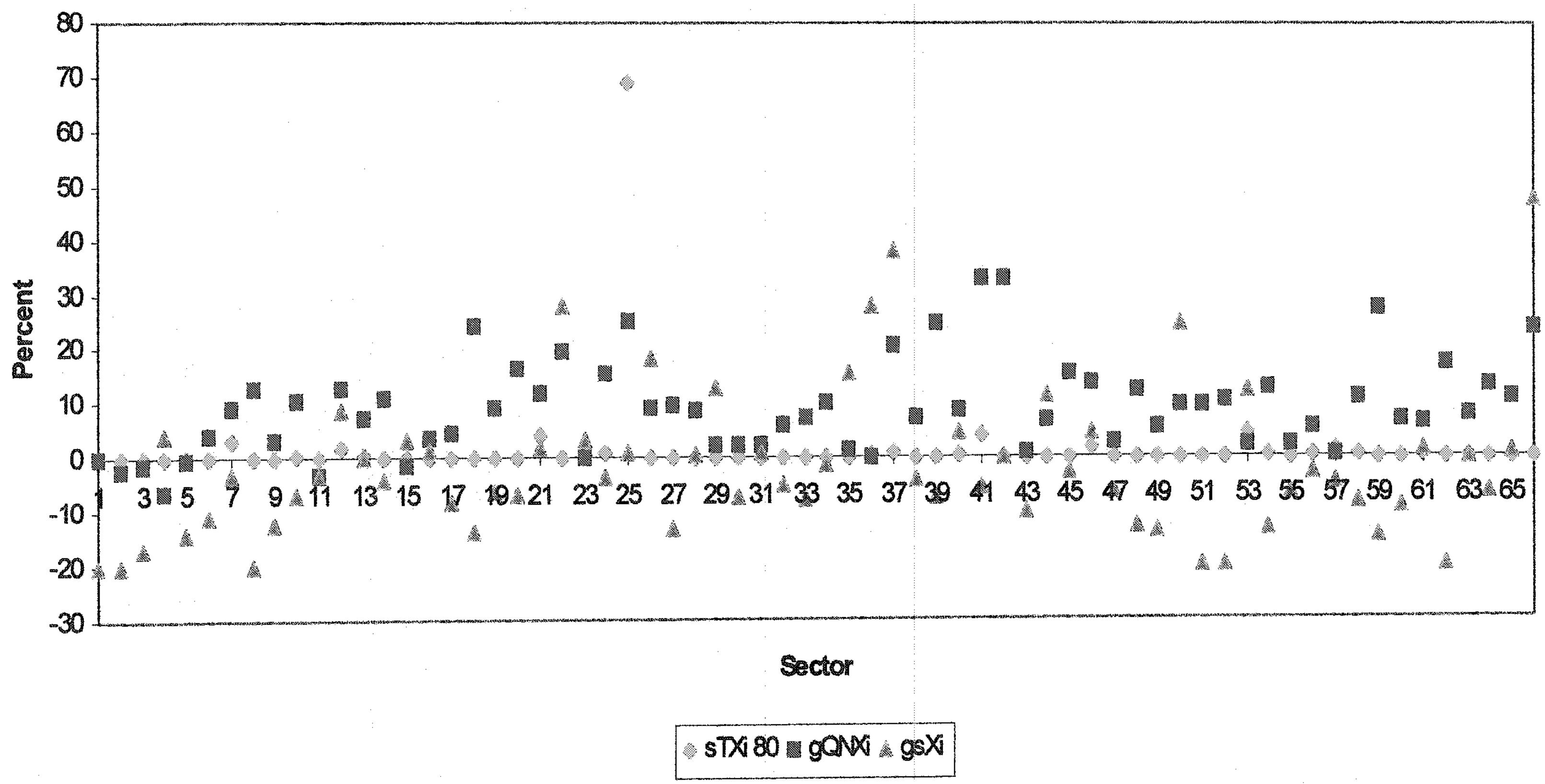


Figure 3.4: Sectoral Output Growth Rate (gQNXi), Export Ratio (sTXi) and Export Share Growth Rate (gsXi), 1985

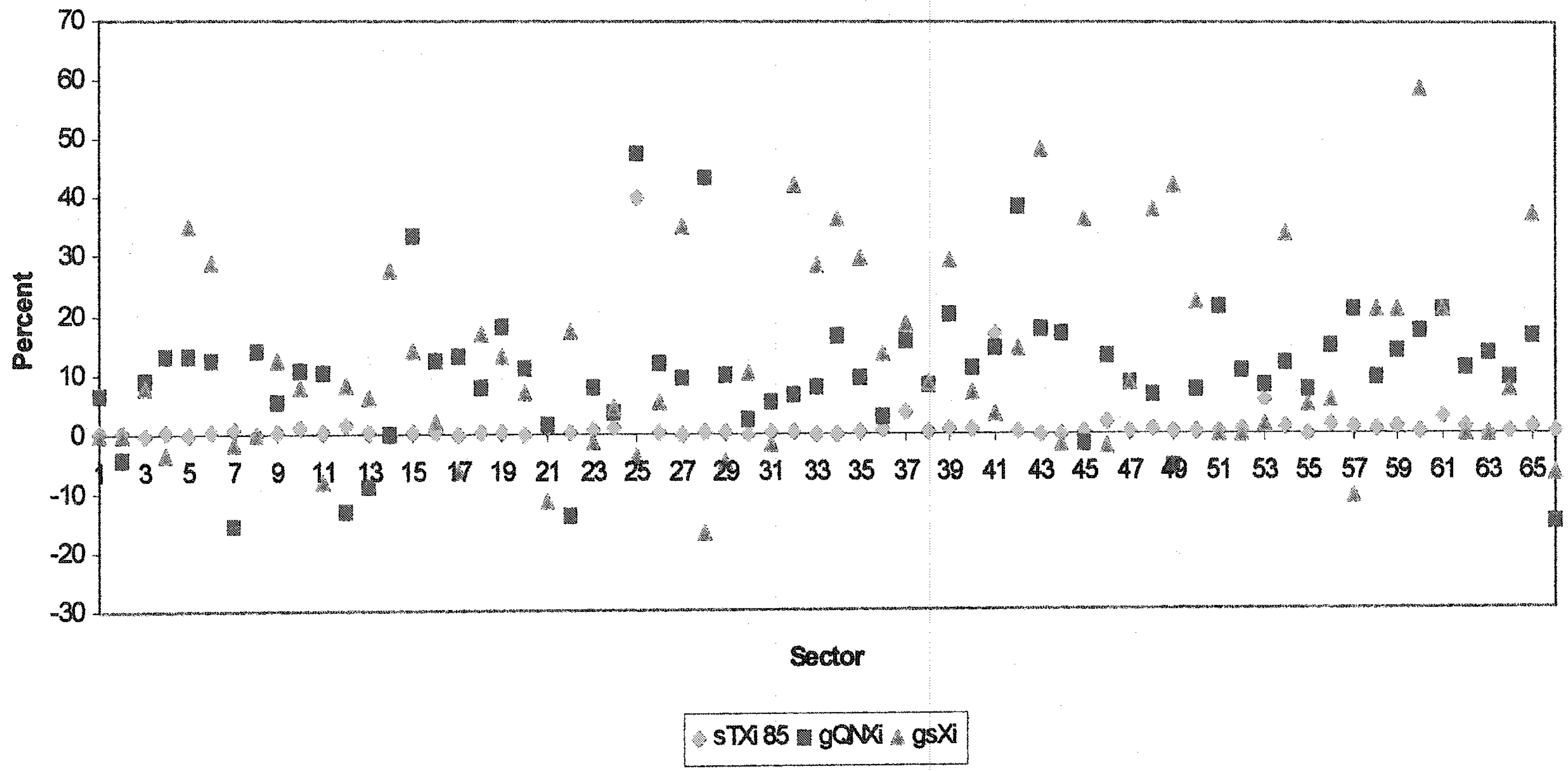


Figure 3.5: Sectoral Output Growth Rate (gQNXi), Export Ratio (sTXi) and Export Share Growth Rate (gsXi), 1990

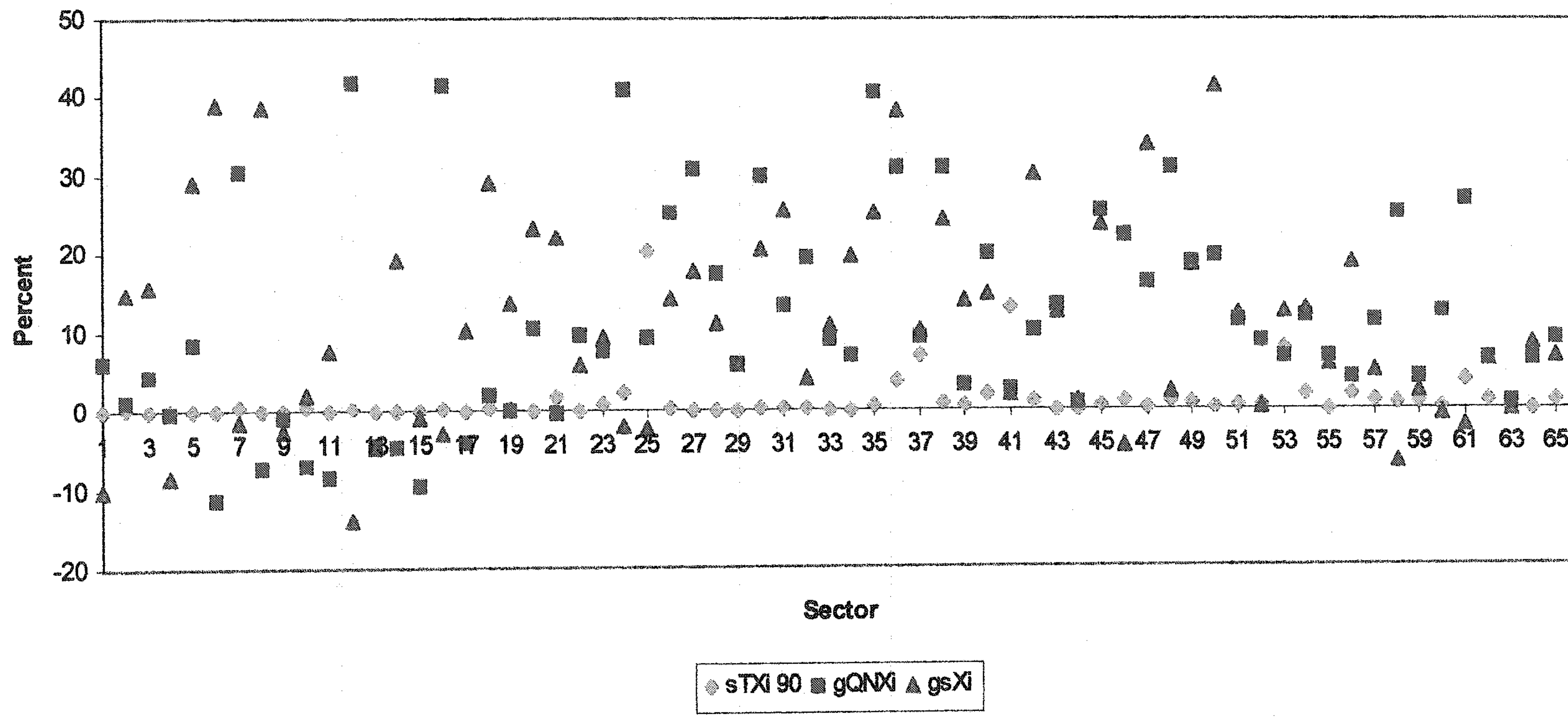
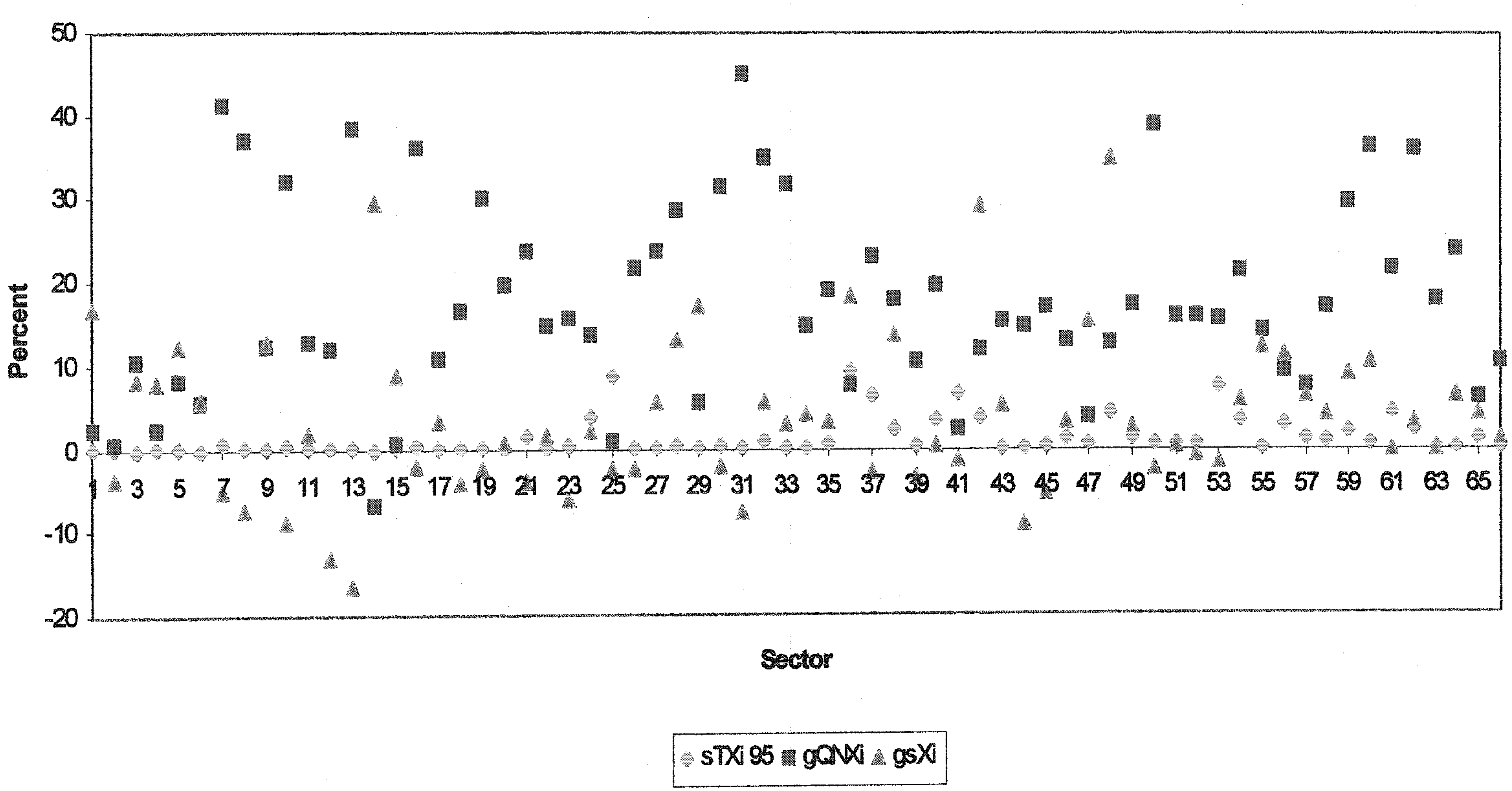


Figure 3.6: Sectoral Output Growth Rate (gQNXi), Export Ratio (sTXi) and Export Share Growth Rate (gsXi), 1995



On average, the growth rate of sectoral output minus exports in Indonesia is calculated at around 11% annually during the sample period. The variation in this rate is quite high, i.e. around 12%. The minimum value is around -15%, which is the growth rate in the rubber sector (sector 7) from 1980 to 1985, while the water transport sector from 1971 to 1975 shows the maximum growth rate, i.e. about 53%.[17]

In general, sectoral exports grow by 6% per year. The variation in the growth rate in sectoral exports is also high, i.e. around 15%. The highest growth rate is the growth in oil exports, which is around 60% from 1971 to 1975. This was caused by the OPEC oil embargo in the 1970s which stimulated oil prices to rise in international markets.

After 1985, the growth in oil exports tends to decline. For example, in 1990, the oil export growth declines by 7%. Table 3.2 reports descriptive statistics during the sample period. This table presents the values of the output-net-export growth rate, and the export share growth rate at the sectoral level.

Table 3.2 shows the positive growth of the Indonesian economy at the sectoral level. The sectoral output-net-export growth rate ranges from 5.81 per cent in 1975 to 13.40 per cent in 1990. This may reflect the government's program

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[17]The annual growth rates are calculated by using the growth rate formula as in equation (3.9) with respect to T and j. For example, for the growth rate in 1985, the data used is 1980-1985, while for the growth rate in 1975, T is 1975 and j is 1971.

Table 3.2: Descriptive Statistics (%), 1975-1995

Descriptive Statistics	1975	1980	1985	1990	1995
Output-Net-Export Growth Rate (gQNX)					
Mean	5.81	9.30	10.38	12.03	17.85
Standard Deviation	13.63	8.48	11.50	13.40	11.57
Minimum Value	-13.68	-6.14	-15.48	-11.29	-6.79
Maximum Value	52.62	33.00	47.59	41.75	45.03
N (*T-j*)	4 (1975-1971)	5 (1980-1975)	5 (1985-1980)	5 (1990-1985)	5 (1995-1985)
Export Share Growth Rate (gsX)					
Mean	2.57	-1.75	12.40	11.44	4.01
Standard Deviation	15.05	13.57	16.47	12.93	9.57
Minimum Value	-22.11	-20.00	-16.64	-13.81	-16.40
Maximum Value	60.44	47.59	58.90	41.53	35.02

Sources: Author's analysis based on CBS

to successfully encourage the non-oil sector after 1985. The standard deviation ranges from 8% to 14% per year. Before 1985, oil was the highest growth sector at around 50%. After 1985, the manufacturing sector, along with the agricultural sector, was the fastest growing sector, accounting for around 40 per cent of sectoral output growth. See also Figure 3.1 which shows the evolution of the export share growth rate over time and across sectors.

Sectoral export share growth also changed from oil to non-oil exports. For example, in 1975, oil contributed 60% of Indonesian exports, while in 1995, manufacturing exports, such as electronic equipment, made the highest contribution to Indonesian exports at 35% per year. On average, sectoral export shares grew around 6% per year, ranging from -1.75% to 12.40%. The negative export growth share appears because some export commodities dropped significantly. For example, the manufacture of oil and fat products dropped by 40 per cent, from Rp 20 million to Rp 12 million. The standard deviation declines from 15% in 1975 to almost 10% in 1995. But, regardless of the variation in non-oil export growth, the Indonesian economy became less dependent on oil exports. This implies that the trade liberalization policy of 1985 was successful in switching the export emphasis from oil to non-oil products.

Meanwhile, the share of imports in sectoral output also changed from manufactured basic iron and steel to more finished goods. For instance, in 1975 the highest import share (93%) was basic iron and steel, while in 1985 the highest import share was electronic equipment (around 64%).

Despite the fact that Indonesia exports oil, it also imports fuel products. The import share of oil ranges from 1.64% in 1971 to 8.53% in 1980. Part of the reason for importing fuel products, usually middle distillate, is to meet the shortage in supply needs when there is increasing domestic demand (Pertamina, 1998). The rapid domestic demand for fuel products is usually caused by a significant increase of production in the non-oil sectors. Another reason for fuel imports is that crude oil imported from the Middle East is mainly used as feedstock for the Cilacap refinery's lube base production. This imported crude oil is usually cheaper and is better quality than Indonesian crude oil (Pertamina, 1998). Most recently, the import share of fuel products was around 2%, indicating that most of the domestic demand is being fulfilled by domestic supply.

3.6. Estimating the Productivity and Trade Model

3.6.1. Introduction

Our model is equation (3.7). For convenience, it is useful to restate this equation here:

$$gQNX_{iT} = \Sigma_j\ \gamma_1\ gsX_{i(T-j)} + \gamma_2\ sTX_{iT} + \gamma_3\ sM_{iT} + \beta_{K1}\ gK_{iT} + \beta_{H2}\ gH_{iT} + \tau_{iT} + \mu_i + \varepsilon_{iT} \qquad (3.7)$$

Equation (3.7) decomposes the growth rate of sectoral output minus sectoral exports at time T ($gQNX_{iT}$) into the change in the share of sectoral exports in sectoral output at time T-j ($gsX_{i(T-j)}$), the ratio of sectoral exports to total exports at time T (sTX_{iT}), the change in the share of sectoral imports in sectoral output at time T (sM_{iT}), the growth rate in sectoral factor inputs at time T (gK_{iT} and gH_{iT}), the fixed year effect (τ_{iT}), sector-specific disturbances (μ_i) and all other error terms (ε_{iT}).

Before estimating equation (3.7), we conduct a specification test. This involves several steps. First, the functional form connecting the variables must be specified. In this context, two potential econometric problems occur: the endogeneity problem and the importance of controlling for sector fixed effects. To remedy this, 2SLS with fixed effect regressions may be required.[18] The important step when applying 2SLS is to select the instruments. As in Chapter 2, this instrument selection will be done by following the procedures recommended by Bound *et al.* (1995) and Staiger and Stock (1997). The uncorrelatedness test developed by Davidson and Mackinnon (1993) will also be applied.

Second, using the ADF procedure, we also show that our data set is stationary.[19] The results are reported in Appendix 3.4.

The next step is to check the existence of multicollinearity and micronumerosity. In this context, Table 3.3 presents the partial correlations among the independent variables including the endogenous RHS variable, the exogenous

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[18]The time trend will be included in this specification.

[19]We also conduct an autocorrelation test, although this test is not required. This is because our data set is only 5 year intervals. Nevertheless, we found the Durbin-Watson statistic of 1.96. This means no autocorrelation occurs.

Table 3.3: Partial Correlations

Variables	Variable Labels	$gQNX_{iT}$	gK_{iT}	gH_{iT}	gsX_{1iT}	gsX_{2iT}	sTX_{iT}	sM_{iT}
Output-Net Export Growth Rate	$gQNX_{iT}$	1.0000						
Capital Growth Rate in sector *i*	gK_{iT}	0.4257	1.0000					
Labour Growth Rate in sector *i*	gH_{iT}	0.2464	-0.0315	1.0000				
The First Lag of Sectoral Export Growth Rate	gsX_{1iT}	0.0727	-0.0298	-0.0191	1.0000			
The Second Lag of Sectoral Export Growth Rate	gsX_{2iT}	0.1174	0.0234	-0.0485	-0.0585	1.0000		
Sectoral Export Ratio	sTX_{iT}	0.1494	0.0648	0.0542	0.0390	0.0154	1.0000	
Sectoral Import Share	sM_{iT}	0.1169	-0.0582	-0.0200	-0.1805	0.1176	0.1916	1.0000
Riot Variable	$Riots_{iT}$	-0.2168	-0.2497	0.0813	0.0830	-0.3680	0.0100	-0.0009
Growth Rate of The World Oil Prices	$grwoprp_T$	-0.1975	-0.3717	0.0363	0.2740	-0.1585	0.0103	0.0351
The Second Lag of gK_{iT}	gK_{2iT}	0.0424	0.0096	-0.0478	-0.1202	-0.0322	-0.0841	0.1398
Japan's Growth Rate	$jpgr_T$	-0.1720	0.0052	0.0268	-0.2935	-0.0629	-0.0078	-0.0367
Singapore's Growth Rate	$spgr_T$	0.0651	-0.1140	-0.0594	0.2479	0.2660	0.0008	0.0449
US Growth Rate	$usgr_T$	0.0986	0.3066	0.0097	-0.3068	-0.0492	-0.0067	-0.0470

Source: Author's analysis

Table 3.3: Partial Correlations (continued from previous page)

Variable Label	$Riots_{iT}$	$grwoprp_T$	gK_{2iT}	jpg_T	$spgr_T$	$usgr_T$
$Riots_{iT}$	1.0000					
$grwoprp_T$	0.6395	1.0000				
gK_{2iT}	0.0310	-0.0143	1.0000			
$jpgr_T$	0.1187	-0.0404	0.0724	1.0000		
$spgr_T$	-0.4876	0.3484	-0.0631	-0.3418	1.0000	
$usgr_T$	-0.1357	-0.8478	0.0423	0.1744	-0.7905	1.0000

Source: Author's analysis

variables and the selected instruments. As can be seen in Table 3.3, the correlations of the independent variables are very small, less than 0.5. However, some instruments are likely to be dropped. The reason is that the correlation of these instruments is greater than 0.5 (in absolute value). The instruments which can be dropped are political uncertainty in Indonesia, the Singaporean growth rate and the US growth rate, i.e., *Riots*, *spgr* and *usgr*, respectively. In other words, we need to select the instruments which are weakly correlated with our other variables. These findings seem to be consistent with the findings of the previous chapter.

Once the variables *Riots*, *spgr* and *usgr* are excluded, the assumption about no perfect multicollinearity in the model is also met. However, a small correlation between the instruments and the endogenous RHS variable can still yield inconsistent and biased estimators. Therefore, following the procedures recommended by Bound *et al.* (1995) and Staiger and Stock (1997), we will also check the validity of the instruments.

3.6.2. The First Stage Regression Results

As in Table 3.4, we may conclude that based on the F-statistics, the instrument selected for the model is significantly valid at a 1% level. The F-statistic for excluded instruments, as in Scenario I of Table 3.4, is 12.05.[20] (For Scenario II, the F-statistic for excluded instruments is even higher than Scenario I.) Following Staiger and Stock (1997), we argue that the instruments selected for the model are significantly valid because the F-statistic exceeds the rule of thumb of a value of 10.[21] To further check the validity of the instruments, we also conduct the "uncorrelated" test recommended by Davidson and Mackinnon (1993). The coefficient on the residuals of the second stage regression without instrumenting

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[20]Scenario I means that the model is estimated including the first and second lags of sectoral export growth rate while Scenario II includes the first lag of the sectoral export growth rate only in estimating the productivity and trade model.

[21]As a comparison, we also provide the results of the first stage regression adding *riots*, *spgr*, and *usgr* as the instruments selected. However, the *riots* variable is dropped because it is considered constant. The F-statistic of 9 is obtained when either *usgr* or *spgr* is included in the instruments. This means the instruments are weak. But, using the bias table provided by Bound *et al.* (1995), we conclude the bias is quite small, less than 3 per cent. So, the bias is legitimately negligible when doing the IV estimation. See Appendix 3.5.

Table 3.4: The Instruments

Instrument Variables	Instruments Labels	Endogenous RHS Variable (gK_i)	
		Scenario I	Scenario II
Sectoral Labour Growth Rate	gH_i	-0.0408 (0.0326)	-0.0403 (0.0318)
The First Lag of Sectoral Export Growth Rate	gsX_{1i}	0.0835 (0.0740)	0.0753 (0.0720)
The Second of Sectoral Export Growth Rate	gsX_{2i}	-0.0309 (0.0600)	
The Sectoral Export Ratio	sTX_i	-0.1818 (0.2813)	-0.1902 (0.2795)
The Sectoral Import Share	sM_i	0.0331 (0.0953)	0.0299 (0.0947)
Japan's Growth Rate	jpgr	0.1578 (0.6163)	0.1603 (0.6110)
The Growth Rate of The World Oil Price	grwoprp	-0.4923 (0.0820)[a]	-0.4820 (0.0792)[a]
The Second Lag of gK_i	gK_{2i}	0.0066 (0.0819)	
Constant		3.6332 (2.6680)	3.3974 (2.6081)
F-Statistics (Excluded Instruments)		12.05[a]	18.55[a]

Source: Author's analysis

Notes: a indicates 1% level of significance (z-score). Scenario I is the model including the second lagged specification, while Scenario II includes the first lagged specification only. Numbers in parentheses are standard errors.

for endogenous variables is 0.2134 with a 0.1396 standard error. Because this coefficient on the residuals is not statistically significant, the selected instruments have therefore "passed" the uncorrelatedness test recommended by Davidson and Mackinnon (1993).

3.6.3. The Results of Estimating the Productivity and Trade Model

Using instruments similar to those in the previous chapter,[22] we estimate equation (3.7). The results are reported in Table 3.5. After doing several specification tests for autocorrelation, collinearity, and instruments selection, the model now performs reasonably well as indicated by the Wald χ^2 statistics test.[23] The Wald statistic is a test of the joint significance of the independent variables. This means that at a 1 per cent level of significance, our model is jointly different from zero. In addition, the correlation of errors in the fixed effect model is also quite low (24%). Because the correlation between errors and measured independent variables is less than 50 per cent, this indicates that errors are only weakly correlated with the independent variables. This means that the assumption about random errors being uncorrelated with measured variables is met. Also, the

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[22]See also Table 3.4 and Appendix 3.5 about the first stage regression results for sectoral effects results, treating the growth rate in sectoral capital stock as endogenous.

[23]These specifications tests are required to show whether we meet the assumptions of the model. The assumptions of the fixed effect model are that 1) random errors are uncorrelated with either measured or unmeasured independent variables, 2) no autocorrelation, 3) no perfect multicollinearity, and 4) homoscedasticity (Wanner, 2003).

Table 3.5: The Estimation Results of Equation (3.7)

Dependent Variable: Sectoral Output-Net Export Growth Rate (gQNX), number of observation= 264, number of sectors= 66				
Independent Variable	**Label**	**OLS**	**OLS, FE**	**2SLS, FE**
		Coeff.	**Coeff.**	**Coeff.**
Constant		9.3519[a] (0.8278)	8.9157[a] (1.2642)	8.4108[a] (1.3490)
The First Lag of Sectoral Export Share Growth Rate	gsX_{1i}	0.0977[b] (0.0433)	0.1215[b] (0.0502)	0.1359[a] (0.0528)
The Second Lag of Sectoral Export Share Growth Rate	gsX_{2i}	0.0821[b] (0.0396)	0.0478 (0.0448)	0.0366 (0.0471)
The Sectoral Export Ratio	sTX_i	0.1609 (0.1183)	0.4072[c] (0.2170)	0.4492[b] (0.2269)
The Sectoral Import Share	sM_i	0.0794[a] 0.0304	0.1140[c] (0.0726)	0.1205[c] (0.0755)
Sectoral Capital Growth Rate	gK_i	0.3898[a] (0.0467)	0.4037[a] (0.0513)	0.6039[a] (0.1332)
Sectoral Labour Growth Rate	gH_i	0.1089[a] (0.0214)	0.1000[a] (0.0248)	0.1090[a] (0.0263)
Wald χ^2 (6)		110.96[a]		413.82[a]
F-Statistics			14.33[a]	
Correlation (τ_i,Xb)		0	-0.1653	-0.2390
R^2 within		0.3003	0.3093	0.2545
R^2 between		0.3068	0.2461	0.2483
R^2 overall		0.3016	0.2853	0.2850

Notes: OLS is Ordinary Least Square without sectoral fixed effects, OLS, FE is Ordinary Least Square with sectoral fixed effects, and 2SLS, FE is an instrumental variable with sectoral fixed effects. Coeff. is the coefficient estimate, numbers in parentheses are robust standard errors; a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. The first stage regression results for instruments selection are presented in Table 3.4. The estimation results without the second lagged specification are reported in Appendix 3.6.

fixed-effects estimators are robust and valid (unbiased). This indicates that the output growth is a significant function of factor inputs and the trade variables.

Table 3.5 reports the estimates of output growth associated with factor inputs and the trade variables. Using the OLS method with and without sectoral fixed effects, the model performs well to the extent that our independent and dependent variables are jointly related because both the Wald χ^2 (110.96) and the F-statistics (14.33) are quite high and significant at the one per cent level, depending on which method is used. Most variables are significant. This means that in the absence of the endogeneity problem, the coefficient estimates of trade variables and factor inputs are quite significant. The existence of sectoral fixed effects allows us to control model performance. This control usually improves the intercept and the coefficient estimates, though its variation is often quite small.

However, given the potential endogeneity problem, as in Chapter 2, an instrumental variable (IV) estimation technique is more appropriate.[24] Because sectoral fixed effects seem to influence the panel regression model, the IV estimation will also attempt to capture sectoral fixed effects.

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[24]Using the Hausman test, we conclude that there is sufficient difference between the coefficients of the standard OLS and IV regression. The Hausman test gives an F-statistic of 62 and is significant at the one per cent level. Meanwhile, using the procedure suggested by Davidson and MacKinnon (1993), we also check the existence of endogeneity of the RHS variable. Based on their procedure, we conclude that endogeneity is likely to occur in our model because the *t* statistic of the endogenous RHS variable is significant at the five per cent level.

3.6.4. Robustness

Using the selected instruments, we employ an IV estimation technique to regress equation (3.7). As a comparison, we also provide the results without using the second lagged specifications. (See Appendix 3.6.) As in Table 3.5, the coefficient estimates on factor inputs are almost similar to the estimates reported in the previous chapter. As a further check for robustness, Table 3.6 reports the robustness results of estimating equation (3.7) using different sets of instruments. These instruments include 1) *usgr*, *spgr*, *jpgr* and the second lag of gK_i (as in Chapter 2), and 2) *usgr*, *jpgr*, *grwoprp*, and the second lag of gK_i. Using the 2SLS and 2SLS, FE estimation procedures, the coefficient estimates are similar. It is likely that sectoral capital growth is more sensitive to economic growth than sectoral labour growth. For example, the coefficient estimate of sectoral capital growth (0.60) is higher than sectoral labour growth (0.11).

3.6.5. Discussion of the Results

As shown in Table 3.5, the labour input variable now has a positive sign although its impact is still quite small (almost one-sixth of the sectoral capital growth). This means that the share of labour in output in each sector is still very low. This may be because the information used to estimate labour inputs is not

Table 3.6: The Robustness Results of Equation (3.7)

Dependent Variable: Sectoral Output-Net Export Growth Rate (*gQNX*), number of observation= 264, number of sectors= 66					
Independent Variable	**Label**	**2SLS**		**2SLS, FE**	
		Coeff.	**S.E.**	**Coeff.**	**S.E.**
Constant		8.4782[b]	3.5466	8.4108[a]	1.3490
The First Lag of Sectoral Export Share Growth Rate	gsX_{1i}	0.1341[a]	0.0456	0.1359[a]	0.0528
The Second Lag of Sectoral Export Share Growth Rate	$gsWX_{2i}$	0.0386	0.0406	0.0366	0.0471
The Sectoral Export Ratio	sTX_i	0.4216[b]	0.1904	0.4492[b]	0.2269
The Sectoral Import Share	sM_i	0.1172[b]	0.0617	0.1205[c]	0.0755
Sectoral Capital Growth Rate	gK_i	0.6014[a]	0.1154	0.6039[a]	0.1332
Sectoral Labour Growth Rate	gH_i	0.1091[a]	0.0227	0.1090[a]	0.0263
Wald χ^2		57.08[a]		413.82[a]	
F-Statistics					
Correlation (u_i,Xb)		0		-0.2390	
R^2 within		0.3009		0.2545	
R^2 between		0.2520		0.2483	
R^2 overall		0.2863		0.2850	

Notes: S.E. stands for robust standard errors. The results were obtained by estimating equation (3.7) with different sets of instruments. The first set of instruments includes *usgr*, *spgr*, *jpgr* and the second lag of gK_i, while the second set includes *usgr*, *jpgr*, *grwoprp* and the second lag of gK_i. See also notes in Table 3.5.

adequate.[25] Nevertheless, these findings are similar to the results reported in Table 2.5, showing that the impact of capital inputs on economic growth is higher than that of labour inputs at the sectoral level.

In terms of sectoral productivity, Table 3.5 shows that sectoral exports have a positive impact on total factor productivity. In general, the export ratio variable (sTX), defined as $sTX_{iT} = \frac{X_{iT}}{\sum_{n=1}^{66} X_{nT}}$, indicates a higher contribution to sectoral productivity than the export share variable (sX), defined as $sX_i = \frac{X_i}{QNX_i}$ where QNX_i is output net of exports in sector i. This means that industries with a higher export ratio have a higher effect on productivity growth than on productivity level. Thus, exports are often used as a stimulus for domestic industries to improve their efficiency.[26]

In the trade context, we may be capturing the unmeasured factors. For example, if exports are highly correlated with human capital use, then because

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[25]We will address this issue in the next chapter.

[26]This is because some export oriented products are internationally standardized by the export intermediaries and foreign buyers. Therefore, domestic firms have to ameliorate their production methods to meet the export standards in fulfilling their foreign demand.

human capital is not measured in our model, we may be attributing growth to exports. Thus, a reversed causal sequence can also be envisaged.[27] See, for example, Doraisami (1996), Dutt and Ghosh (1996) and Bernard and Jensen (1999). However, this study is not intended to explore the causality procedure.

In general, we find that the first lag of the export share growth rate, gsX_1, which controls for the sectoral productivity level effects, is significant at the one per cent level, while the second lag of export share growth rate, gsX_2, is not significant at the ten percent level (although both are positive). This means that the second lag of the sectoral export share may not be a good indicator to analyze the sectoral productivity level in the long run. This may be due to the fact that our sample period is too small to capture the long run impact. That is why we also provide an alternative estimation procedure without introducing the second lagged specification. The results are reported in Appendix 3.6, which shows that all variables are now significant. However, it seems that although the coefficients of the sectoral capital stock growth rate and the sectoral export ratio increase about 2.5%, the coefficients of other variables remain relatively the same. Thus, it seems that there is no significant difference whether the first lag of the export share

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[27] Alternatively, high productivity firms are more likely to increase exports not in reverse (Bernard and Jensen, 1999). This argument, however, may be true if skilled labour can be augmented through education and training so the rate of technical progress is affected (Ray, 1998). In our case, as seen in Table 3.3, the correlation of exports and factor input is low. Thus, we may hold the argument that exporting induces faster productivity.

growth rate is included in the model, although the degrees of freedom increase.

The coefficient estimate of the export ratio, *sTX*, which controls for the sectoral productivity growth effects, is significant at the five per cent level. On average, during the sample period, export performance increases the sectoral productivity level and growth. The lagged export share variables contribute 0.14% and 0.04% to the sectoral productivity level, respectively. Meanwhile, the export ratio contributes 0.45% to sectoral productivity growth. The significance of these coefficient estimates is important. For example, the coefficient estimates suggest that increasing the share of exports to output by a full percentage point may result in a 0.14 per cent increase in the productivity level in the short-run. In addition, increasing the long run export ratio by a full percentage point may add up to 0.45 per cent to long-run productivity growth at the sectoral level.

As seen in Table 3.5, the import share variable, which captures how foreign competition affects sectoral productivity and sectoral output growth, is significant at the ten percent level and has a positive sign. Thus, foreign competition causes productivity and economic growth to rise. It indicates that the increase in the import share by a full percentage point may produce a 0.12 per cent increase in productivity and economic growth.

Theoretically, however, the role of imports is ambiguous. This is because if imports keep increasing, domestic output must decline given the "fixed" domestic demand. Thus, at a certain level, imports may have a non-linear effect on productivity and growth. Although this non-linear effect is theoretically rational, we hold the argument that given our sample period, imports show a positive effect on productivity and growth. This is because most imports in Indonesia are intermediate inputs and capital goods which could then embody technology that is unavailable to domestic firms (Poot *et al.*, 1992 and Hill, 2000). Therefore, we argue that imports could lead to improved productivity performance.

Our findings also indicate that the coefficient estimates become higher when we change our estimation technique. For example, the coefficient estimate of the sectoral capital growth rate increases from around 0.40 per cent when we use an OLS with fixed effects to around 0.60 per cent when we use instrumental variables with sectoral fixed effects. This indicates that when the endogeneity problem is addressed, the coefficient estimates increase around 50 %. Stated differently, the existence of a correlation between the endogenous explanatory variables and the measurement errors worsens the model's performance.

The results also show that the export ratio, indicating export orientation, is likely to have a larger effect on productivity growth than past values of export shares.[28] Stated differently, trade openness may indeed be a good indicator of the

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[28]Indeed, Indonesia's human capital has increased during our sample period. However, because the correlation of export variables and factor inputs is low, we assume that the unmeasured factors from human capital have a small impact on exports. In fact, as in Chapter 4, Indonesia's educational attainment is low, i.e. around 4 years. This means that the state of knowledge of Indonesians, on average, is low. If this is the case, our efficiency argument about productivity as a function of exports may hold.

stimulus of technological change in Indonesia. This implies that trade liberalization is likely to have significant productivity effects on the Indonesian economy. To capture the idea that trade liberalization policies in Indonesia foster both an increase in productivity and growth, a dummy variable is introduced into the model. The results are presented in Table 3.6.

In general, given the data availability, our findings suggest that the export variables are likely to have a positive effect on both productivity and economic growth in Indonesia. These findings indicate that exports are an important part of achieving greater economies of scale via a technical change mechanism. Therefore, exports can also be a strategic way to improve production methods of domestic firms. Piazolo (1996) adds that "stronger exposure to international competition through higher exports will also raise the pressure on the export industries to keep costs low and provides an incentive for the development and production of new technologies, i.e. product innovations and efficient production processes". Based on Piazolo's argument, the coefficient estimates of the export variables must have positive signs, which, in turn, means that exports have been an ingredient of growth. Using both the standard OLS and the IV estimation method, the coefficient estimate of the first lag of the sectoral export share variable is statistically significant, but the second lag of the sectoral export share variable is not. This indicates that the second lag of the sectoral export share may be a poor measure for long-run sectoral productivity.

The effect of imports on productivity and economic growth mainly depends on the import structure, including the consumer share and the investment goods share. After 1986, the share of investment goods was relatively high, i.e. around 85% (Piazolo, 1996). Because of this high investment share, we may expect imports to have a positive impact on productivity and economic growth, as foreign competition and an import strategy influence domestic firms to achieve greater scale economies and thus, ultimately, promote growth.

The sensitivity of foreign trade variables to productivity certainly supports the export-led growth theories that trade variables are a good source of growth. We find that the effects of the lagged export share, the export ratio and the import share variables on sectoral productivity are all positive. This indicates that trade liberalization will yield a spillover effect on the entire economy. Both exports and imports are then required to improve the productivity level and growth in Indonesia.

These findings certainly support the new growth economists such as Alcalá and Ciccone (2001) who argue that exports (and imports) will generate spillover effects on productivity which ultimately promote economic growth.

3.7. Estimating The Export Dummy Model

3.7.1.Introduction

Our export dummy model is equation (3.8). For convenience, this equation is rewritten as:

$$\begin{aligned} gQNX_{iT} = {} & D^{85} [\ \Sigma_j\ \gamma_4\ gsX_{i(T-j)} + \gamma_5\ sTX_{iT}\ ] \\ & + D^{90} [\ \Sigma_j\ \gamma_6\ gsX_{i(T-j)} + \gamma_7\ sTX_{iT}\ ] \\ & + D^{95} [\ \Sigma_j\ \gamma_8\ gsX_{i(T-j)} + \gamma_9\ sTX_{iT}\ ] + \gamma_{10}\ sM_{iT} \\ & + \beta_{K2}\ gK_{iT} + \beta_{H3}\ gH_{iT} + \tau_{iT} + \mu_i + \varepsilon_{iT} \end{aligned} \qquad (3.8)$$

The difference between equation (3.7) and equation (3.8) is the interaction terms between the export variables and the dummy variables.

Aside from this dummy construction in equation (3.8), another dummy variable will be introduced to capture the impact of trade liberalization in the mid-1980s. This dummy variable is D^{LIB} which equals 1 if the year of observation is after 1985 (i.e. 1990 and 1995 for post-liberalization) and otherwise is zero. Thus, equation (3.8) becomes

$$\begin{aligned} gQNX_{iT} = {} & D^{LIB} [\ \Sigma_j\ \gamma_4\ gsX_{i(T-j)} + \gamma_5\ sTX_{iT}\ ] + \gamma_{10}\ sM_{iT} \\ & + \beta_{K2}\ gK_{iT} + \beta_{H3}\ gH_{iT} + \tau_{iT} + \mu_i + \varepsilon_{iT} \end{aligned} \qquad (3.9)$$

As a comparison, D^{LIB} will also be treated as a single independent variable being inserted in equation (3.7) as

$$gQNX_{iT} = \Sigma_j \gamma_4 gsX_{i(T-j)} + \gamma_5 sTX_{iT} + \gamma_{10} sM_{iT} + D^{LIB} + \beta_{K2} gK_{iT} + \beta_{H3} gH_{iT} + \tau_{iT} + \mu_i + \varepsilon_{iT} \qquad (3.10)$$

İşcan (1998b) notes that during the introductory period of trade liberalization policies, some sectors may benefit from the "dynamic effects of trade"(p.131). The introduction of a dummy variable to capture the policy effects is therefore also essential to identify the differential productivity effects.

Indeed, a dummy variable may not be the best approach to measure the whole impact of trade policy. One problem with this approach is that a dummy variable cannot capture the "qualitative" factors affecting trade policy. Other factors, such as country size or foreign capital inflows or administrative system, theoretically affecting trade may also be excluded. (See, for example, Syrquin and Chenery, 1989, Edwards, 1992 and Harrison, 1996). This is a weakness of this dummy variable selection. This study, however, is not intended to measure the whole impact of trade policy. Instead, the purpose of introducing a dummy variable is to capture whether there is any difference between the pre- and post-reform periods in terms of our trade variables. In the same vein, Ahluwalia (1991), Harrison (1994) and İşcan (1998b) have applied dummy variables to demarcate a pre-reform period from a post-reform one.[29] Hence, following Ahluwalia (1991),

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[29]Chend and Sen (1996) and Michaely *et al.* (1991) note that trade reforms in developing countries are often not imposed as once and for all events.

Harrison (1994) and İşcan (1998b), the dummy variable settings are used to fulfill our purpose, i.e. to specify whether pre-and post-trade liberalization has influenced Indonesian exports.

In addition, because Indonesia's trade policy was set up to diversify non-oil commodity exports, we may then assume that the parameters for sectoral import shares are not affected by this trade policy. Because of this assumption, a dummy variable is not multiplied on the sectoral import share. Regardless of whether these reforms affect our trade variables, Appendices 3.8, 3.9, 3.10, and 3.11 provide alternative results to capture these reforms in the model.

3.7.2. Results of Estimating The Export Dummy Model

Before starting the regression procedure, we need to check for the existence of multicollinearity and micronumerosity. Table 3.7 presents the partial correlations among the independent variables including the endogenous RHS variable, the pure exogenous variable and the selected instruments. As can be seen in Table 3.7, the correlations of independent variables are very small, less than 0.5. These findings mean that multicollinearity may not exist in our specification.

Using similar instruments to those in Table 3.5, we then run a regression on equations (3.8), (3.9) and (3.10).[30] The results are presented in Tables 3.8 and 3.9,

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[30]The first stage regression results for these selected instruments are reported in Appendix 3.7.

while the estimation results of equation (3.10) are reported in Appendix 3.10.[31] Appendix 3.10 also reports the estimation results if the sectoral import share variable interacts with D^{LIB}.

As previously stated, the regression equation estimated in Table 3.5 does not control for the independent effects of oil dependence and trade liberalization policies in Indonesia. In order to do this, three types of dummy variables are introduced. These dummy variables are D^{85}, D^{90} and D^{95}. D^{85} has a value of one if the year of observation is 1985 and is zero otherwise, D^{90} has a value of one if the year of observation is 1990 and is zero otherwise, and D^{95} has a value of one if the year of observation is 1995 and is zero otherwise. Table 3.8 reports the estimation results of equation (3.8).

As an alternative, we will also treat the three dummy variables as a single variable. The results are reported in Appendix 3.8. In addition, we also regress the model excluding the second lagged specification for both dummy constructions. The results are presented in Appendix 3.9.

Table 3.9 reports the estimation results of equation (3.9) while the estimation results of equation (3.10) are presented in Appendix 3.10. As can be seen in Tables 3.8 and 3.9, although the model performs well as it has quite high F statistics, the inclusion of dummy variables generally changes the coefficient

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[31]We found that the selected instruments in this section are the same as the instruments in Section 3.6.2.

Table 3.7: Partial Correlations

Variables	Variable Labels	$gQNX_{iT}$	gK_{iT}	gH_{iT}	$D^{80}gsX_{1i}$	$D^{85}gsX_{1i}$	$D^{90}gsX_{1i}$	$D^{95}gsX_{1i}$
Output-Net Export Growth Rate	$gQNX_{iT}$	1.0000						
Capital Growth Rate in sector *i*	gK_{iT}	0.4257	1.0000					
Labour Growth Rate in sector *i*	gH_{iT}	0.2464	-0.0315	1.0000				
The First Lag of Sectoral Export Growth Rate X D^{80}	$D^{80}gsX_{1i}$	0.0153	-0.0593	0.0468	1.0000			
The First Lag of Sectoral Export Growth Rate X D^{85}	$D^{85}gsX_{1i}$	-0.0047	-0.0224	-0.0076	-0.0436	1.0000		
The First Lag of Sectoral Export Growth Rate X D^{90}	$D^{90}gsX_{1i}$	0.0544	-0.0061	-0.0854	-0.0360	-0.0356	1.0000	
The First Lag of Sectoral Export Growth Rate X D^{95}	$D^{95}gsX_{1i}$	0.0606	0.0267	0.0173	-0.0540	-0.0534	-0.0442	1.0000
Sectoral Export Ratio X D^{80}	$D^{80}sTX_{iT}$	-0.0219	0.1075	-0.0370	-0.1264	0.0407	0.0336	0.0505
Sectoral Export Ratio X D^{85}	$D^{85}sTX_{iT}$	0.1903	0.0968	0.0427	0.0307	-0.0011	0.0251	0.0376
Sectoral Export Ratio X D^{90}	$D^{90}sTX_{iT}$	-0.0174	0.0227	0.0132	0.0497	0.0491	-0.0845	0.0609
Sectoral Export Ratio X D^{95}	$D^{95}sTX_{iT}$	0.0771	-0.0299	0.0518	0.0229	0.0226	0.0187	-0.0448
The Second Lag of Sectoral Export Growth Rate X D^{80}	$D^{80}gsX_{2i}$	0.0895	-0.0441	-0.0102	-0.1690	0.0319	0.0264	0.0395
The Second Lag of Sectoral Export Growth Rate X D^{85}	$D^{85}gsX_{2i}$	0.1020	0.0716	-0.0425	0.0342	-0.1599	0.0280	0.0420

Table 3.7: Partial Correlations (continued from previous page)

Variables	Variable Labels	$gQNX_{iT}$	gK_{iT}	gH_{iT}	$D^{80}gsX_{1i}$	$D^{85}gsX_{1i}$	$D^{90}gsX_{1i}$	$D^{95}gsX_{1i}$
The Second Lag of Sectoral Export Growth Rate X D^{90}	$D^{90}gsX_{2i}$	0.0228	0.0246	-0.0253	0.0371	0.0367	-0.0912	0.0455
The Second Lag of Sectoral Export Growth Rate X D^{95}	$D^{95}gsX_{2i}$	0.0040	-0.0084	-0.0135	0.0533	0.0527	0.0435	-0.2517
Sectoral Import Share	sM_{iT}	0.1169	-0.0582	-0.0200	-0.11440	0.0669	-0.1572	-0.0990
The Second Lag of gK_{iT}	gK_{2iT}	0.0424	0.0096	-0.0478	-0.0518	-0.0404	-0.1054	-0.0220
Japan's Growth Rate	$jpgr_T$	-0.1720	0.0052	0.0268	-0.1280	-0.1927	-0.1669	-0.0732
US Growth Rate	$usgr_T$	0.0986	0.3066	0.0097	-0.2109	-0.0736	-0.1788	-0.0992
Singapore's Growth Rate	$spgr_T$	0.0651	-0.1140	-0.0594	0.1910	0.0103	0.1927	0.0491
Growth Rate of The World Oil Prices	$grwoprp_T$	-0.1975	-0.3717	0.0363	0.1641	0.1195	0.1160	0.1149

Table 3.7: Partial Correlations (continued from previous page)

Variable Labels	$D^{80}sTX_{iT}$	$D^{85}sTX_{iT}$	$D^{90}sTX_{iT}$	$D^{95}sTX_{iT}$	$D^{80}gsX_{2i}$	$D^{85}gsX_{2i}$	$D^{90}gsX_{2i}$	$D^{95}gsX_{2i}$
$D^{80}sTX_{iT}$	1.0000							
$D^{85}sTX_{iT}$	-0.0286	1.0000						
$D^{90}sTX_{iT}$	-0.0464	-0.0345	1.0000					
$D^{95}sTX_{iT}$	-0.0214	-0.0159	-0.0258	1.0000				
$D^{80}gsX_{2i}$	0.1443	-0.0224	-0.0363	-0.0167	1.0000			
$D^{85}gsX_{2i}$	-0.0320	0.0318	-0.0386	-0.0178	-0.0257	1.0000		
$D^{90}gsX_{2i}$	-0.0346	-0.0258	0.1655	-0.0193	-0.0272	-0.0288	1.0000	
$D^{95}gsX_{2i}$	-0.0497	-0.0370	-0.0600	0.1044	-0.0390	-0.0414	-0.0448	1.0000
sM_{iT}	0.0266	0.0115	0.0082	0.2179	0.0267	0.1682	0.0317	-0.0095
gK_{2iT}	-0.0626	-0.0660	-0.0106	-0.0346	-0.0570	0.0569	0.0315	-0.0899
$jpgr_T$	0.0424	0.0555	-0.1137	-0.0351	-0.0400	0.0351	-0.0594	-0.0602
$usgr_T$	0.0410	0.1082	0.0353	-0.1022	-0.0194	0.0122	-0.0117	-0.0741
$spgr_T$	0.0396	-0.1318	0.0459	0.0581	0.1384	0.1033	0.1120	0.1502
$grwoprp_T$	-0.1023	-0.0529	-0.0870	0.1084	-0.0914	-0.1147	-0.0780	-0.0160

Source: Author's analysis.

estimates. For example, using two stage least squares with fixed effects (2SLS,FE), the coefficient of the sectoral export ratio as in Table 3.5 is around 0.45%, while in Table 3.8 this coefficient ranges from 0.13% to 0.87% depending on which dummy variables are used.

The dummy variables, which control for export variables, do not affect productivity. The contribution of productivity to growth is still around 8 - 9% depending on which method is used. As compared to the findings in Chapter 2, we found that the contribution of sectoral productivity to growth in this chapter is higher than the contribution of aggregate productivity as in Chapter 2. This means that sectoral disturbances tend to increase sectoral productivity in Indonesia to the extent that some sectors with high productivity tend to "comprehensively" raise overall productivity. Alternatively, the input output data which only covered the "good" years of Indonesia's economy, i.e. 1975, 1980, 1985, 1990 and 1995, could also lead to this sectoral productivity boost, i.e. from around 0.30% in Chapter 2 to 8% per year in Chapter 3.

In general, the model still performs well when D^{85}, D^{90} and D^{95} or D^{LIB} enter into the model. The significant impact of D^{LIB} on the first lag of the sectoral export share growth rate is similar to D^{90}, i.e. around 15%. This means that within our sample period, the trade liberalization has taken into an effect on Indonesia's economic growth in 1990.

Table 3.8: The Coefficient Estimates of Equation (3.8)

Dependent Variable: Sectoral Output-Net-Export Growth Rate (*gQNX*), number of observations = 264, number of sectors = 66				
Independent Variable	**Label**	**OLS**	**OLS,FE**	**2SLS,FE**
Constant		9.4017(0.8486)[a]	8.4916(1.3410)[a]	8.0512(1.4172)[a]
First Lag of Sectoral Export Share Growth Rate Times D^{85}	$D^{85}gsX_{1i}$	0.0186(0.0986)	0.0825(0.1133)	0.0820(0.1174)
Second Lag of Sectoral Export Share Growth Rate Times D^{85}	$D^{85}gsX_{2i}$	0.0698(0.0740)	0.0368(0.0844)	0.0091(0.0892)
Sectoral Export Ratio Times D^{85}	$D^{85}sTX_i$	0.5639(0.2278)[a]	0.8780(0.2929)[a]	0.8739(0.3034)[a]
First Lag of Sectoral Export Share Growth Rate Times D^{90}	$D^{90}gsX_{1i}$	0.1381(0.0743)[b]	0.1432(0.0848)[c]	0.1556(0.0882)[c]
Second Lag of Sectoral Export Share Growth Rate Times D^{90}	$D^{90}gsX_{2i}$	0.0485(0.0838)	0.0576(0.0986)	0.0402(0.1027)
Sectoral Export Ratio Times D^{90}	$D^{90}sTX_i$	-0.2730(0.6183)	0.1559(0.7687)	0.2676(0.7994)
First Lag of Sectoral Export Share Growth Rate Times D^{95}	$D^{95}gsX_{1i}$	0.0942(0.0784)	0.1384(0.0904)[c]	0.1291(0.0938)
Second Lag of Sectoral Export Share Growth Rate Times D^{95}	$D^{95}gsX_{2i}$	0.0370(0.0762)	0.0500(0.0880)	0.0483(0.0911)
Sectoral Export Ratio Times D^{95}	$D^{95}sTX_i$	0.1232(0.1492)	0.2639(0.1971)	0.1291(0.0938)
Sectoral Import Share	sM_i	0.0825(0.0314)[a]	0.1433(0.0768)[c]	0.1401(0.0796)[c]
Sectoral Capital Growth Rate	gK_i	0.3792(0.0472)[a]	0.3895(0.0517)[a]	0.5780(0.1331)[a]
Sectoral Labour Growth Rate	gH_i	0.1086(0.0216)[a]	0.0992(0.0252)[a]	0.1081(0.0267)[a]
Wald χ^2		112.13[a]		422.93[a]
F-Statistics			7.58[a]	
Correlation (τ_i,Xb)		0	-0.1964	-0.2385
R^2 within		0.3180	0.3285	0.2796
R^2 between		0.2839	0.2228	0.2403
R^2 overall		0.3088	0.2903	0.2946

Source: Author's analysis

Notes: See also notes to Table 3.5. Numbers in parentheses are standard errors; a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. The instruments for 2SLS, FE are *jpgr*, *grwoprp* and gK_{2i}. See also Appendix 3.7 for the first stage regression results of these instruments.

Table 3.9: The Coefficient Estimates of Equation (3.9)

Dependent Variable: Sectoral Output-Net-Export Growth Rate (*gQNX*), number of observations = 264, number of sectors = 66				
Independent Variable	**Label**	**OLS**	**OLS,FE**	**2SLS,FE**
Constant		9.5398 (0.8118)[a]	8.9691 (1.2798)[a]	8.5199 (1.3534)[a]
First Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{1i}$	0.1278 (0.0550)[b]	0.1430 (0.0615)[a]	0.1411 (0.0633)[b]
Second Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{2i}$	0.0357 (0.0568)	0.0562 (0.0643)	0.0488 (0.0664)
Sectoral Export Ratio Times D^{LIB}	$D^{LIB}sTX_i$	0.0867 (0.1456)	0.0512 (0.1870)	0.1164 (0.1977)
Sectoral Import Share	sM_i	0.0913 (0.0306)[a]	0.1357 (0.0764)[c]	0.1336 (0.0786)[c]
Sectoral Capital Growth Rate	gK_i	0.3930 (0.0469)[a]	0.3932 (0.0520)[a]	0.5683 (0.1326)[a]
Sectoral Labour Growth Rate	gH_i	0.1099 (0.0216)[a]	0.1036 (0.0251)[a]	0.1117 (0.0264)[a]
Wald χ^2		103.53[a]		406.24[a]
F-Statistics			13.06[a]	
Correlation (τ_i, Xb)		0	-0.0557	-0.1137
R^2 within		0.2878	0.2899	0.2480
R^2 between		0.2854	0.2583	0.2726
R^2 overall		0.2872	0.2812	0.2810

Source: Author'analysis

Notes: See also notes to Table 3.5. Numbers in parentheses are standard errors; a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. The instruments for 2SLS, FE are *jpgr*, *grwoprp* and gK_{2i}. See also Appendix 3.7 for the first stage regression results of these instruments. The estimation results without the second lagged specification are also reported in Appendix 3.11.

3.7.3 Robustness

Using the selected instruments shown in Tables 3.8 and 3.9, we employ an IV estimation technique to regress equations (3.8) and (3.9). To check on robustness, different sets of instruments are used. These instruments include 1) *usgr*, *spgr*, *jpgr* and the second lag of gK_i (as in Chapter 2), and 2) *usgr*, *jpgr*, *grwoprp*, and the second lag of gK_i. Tables 3.10 and 3.11 report these results for equations (3.8) and (3.9). Using the 2SLS and 2SLS, FE estimation procedures, the coefficient estimates in Tables 3.10 and 3.11 are similar to those in Tables 3.8 and 3.9. Thus, we may conclude our coefficients are robust estimators.

3.7.4. Discussion of The Results

Using OLS methods with and without sectoral fixed effects, the model performs well in the sense that our independent variables are jointly related with the dependent variable because either the Wald χ^2 (112.13) or the F-statistic (7.58) is quite high, depending on which method is used, and significant at the one per cent level. The sectoral fixed effects, which allow the intercept and slopes to vary, improve the model performance. As in Table 3.8, the existence of sectoral fixed effects mostly increases the coefficient estimates. All the signs are now positive. In general, most variables are significant. Thus, using the standard OLS with fixed effects model, we find that the coefficient estimates for the trade variables and

Table 3.10: The Robust Estimation Results of Equation (3.8)

Dependent Variable: Sectoral Output-Net-Export Growth Rate (*gQNX*), number of observations = 264, number of sectors = 66					
Independent Variable	**Label**	**2SLS**		**2SLS,FE**	
		Coeff.	**S.E.**	**Coeff.**	**S.E.**
Constant		8.1000	5.7381	8.0512[a]	1.4172[a]
First Lag of Sectoral Export Share Growth Rate Times D^{85}	$D^{85}gsX_{1i}$	0.0808	0.1010	0.0820	0.1174
Second Lag of Sectoral Export Share Growth Rate Times D^{85}	$D^{85}gsX_{2i}$	0.0094	0.0768	0.0091	0.0892
Sectoral Export Ratio Times D^{85}	$D^{85}sTX_i$	0.8635[a]	0.2604	0.8739[a]	0.3034
First Lag of Sectoral Export Share Growth Rate Times D^{90}	$D^{90}gsX_{1i}$	0.1554[b]	0.0759	0.1556[c]	0.0882
Second Lag of Sectoral Export Share Growth Rate Times D^{90}	$D^{90}gsX_{2i}$	0.0403	0.0884	0.0402	0.1027
Sectoral Export Ratio Times D^{90}	$D^{90}sTX_i$	0.2483	0.6864	0.2676	0.7994
First Lag of Sectoral Export Share Growth Rate Times D^{95}	$D^{95}gsX_{1i}$	0.1289[c]	0.0807	0.1291	0.0938
Second Lag of Sectoral Export Share Growth Rate Times D^{95}	$D^{95}gsX_{2i}$	0.0486	0.0784	0.0483	0.0911
Sectoral Export Ratio Times D^{95}	$D^{95}sTX_i$	0.3287[c]	0.1787	0.1291	0.0938
Sectoral Import Share	sM_i	0.1372[b]	0.0668	0.1401[c]	0.0796
Sectoral Capital Growth Rate	gK_i	0.5797[a]	0.1148	0.5780[a]	0.1331
Sectoral Labour Growth Rate	gH_i	0.1082[a]	0.0230	0.1081[a]	0.0267
Wald χ^2		68.55[a]		422.93[a]	
Correlation (τ_i,Xb)		0		-0.2385	
R^2 within		0.3178		0.2796	
R^2 between		0.2414		0.2403	
R^2 overall		0.2951		0.2946	

Source: Author's analysis

Notes: See also notes to Table 3.5. Numbers in parentheses are standard errors; a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. The instruments are *jpgr*, *grwoprp* and *gK2i*.

Table 3.11: The Robust Estimation Results of Equation (3.9)

Dependent Variable: Sectoral Output-Net-Export Growth Rate (*gQNX*), number of observations = 264, number of sectors = 66					
Independent Variable	Label	2SLS		2SLS,FE	
		Coeff.	**S.E.**	**Coeff.**	**S.E.**
Constant		8.7862[a]	1.6855	8.5199[a]	1.3534[a]
First Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{1i}$	0.1398[a]	0.0549	0.1411[b]	0.0633
Second Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{2i}$	0.0467	0.0575	0.0488	0.0664
Sectoral Export Ratio Times D^{LIB}	$D^{LIB}sTX_i$	0.1207	0.1630	0.1164	0.1977
Sectoral Import Share	sM_i	0.1150[b]	0.0517	0.1336[c]	0.0786
Sectoral Capital Growth Rate	gK_i	0.5671[a]	0.1168	0.5683[a]	0.1326
Sectoral Labour Growth Rate	gH_i	0.1119[a]	0.0227	0.1117[a]	0.0264
Wald χ^2		50.73[a]		406.24[a]	
Correlation (τ_i,Xb)		0		-0.0557	-0.1137
R^2 within		0.2827		0.2899	0.2480
R^2 between		0.2766		0.2583	0.2726
R^2 overall		0.2813		0.2812	0.2810

Source: Author's analysis

Notes: See also notes on Table 3.5. Numbers in parentheses are standard errors; a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. The instruments are *jpgr*, *grwoprp* and gK_{2i}.

factor inputs are quite significant.[32]

If there is an endogeneity problem, we need to use an instrumental variable (IV) estimation technique with sectoral effects. Overall, using the IV estimation with fixed effects, the model is significant at the one per cent level as shown by the Wald χ^2. The Wald χ^2 is similar to the F statistic which is a test that the coefficients on the regressors are jointly zero. So our model is significant.[33] Also,

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[32]We also treat the three dummy variables as a single independent variable. The regression results of an OLS method with sectoral effects are as follows:

$$gQNX_i = \underset{(1.67)^a}{8.6956} + \underset{(0.05)^a}{0.3915}\, gK_i + \underset{(0.03)^a}{0.0998}\, gH_i + \underset{(1.80)}{0.40}\, D^{85} + \underset{(1.81)}{0.2827}\, D^{90}$$

$$- \underset{(1.80)}{1.4080}\, D^{95} + \underset{(0.07)^b}{0.1504} sM_i$$

F-Statistics = 12.03[a] Correlation (τ_i, Xb) = -0.1086

R^2 within = 0.2732 R^2 between = 0.2397 R^2 overall = 0.2610

Numbers in parentheses are standard errors. a and b denote 1 % and 5 % level of significance (z-score).

[33]Using the IV estimation with fixed effects technique gives results as follows:

$$gNXQ_i = \underset{(1.79)^a}{8.0841} + \underset{(0.13)^a}{0.5334}\, gK_i + \underset{(0.03)^a}{0.1064}\, gH_i + \underset{(1.83)}{0.4649}\, D^{85} + \underset{(1.86)}{0.5351}\, D^{90}$$

$$- \underset{(1.56)}{1.0912}\, D^{95} + \underset{(0.07)^b}{0.1564}\, sM_i$$

Wald χ^2 = 398.46 Correlation (τ_i, Xb) = -0.1460

R^2 within = 0.2455 R^2 between = 0.2558 R^2 overall=0.2653

Numbers in parentheses are standard errors. a and b indicate 1 % and 5 % level of significance (z-score).

the correlation of the fixed effects and the regressors in the system is quite low with a value of 0.24. Although the results are better, i.e. the R^2s and F-statistics are slightly higher, than those in Table 3.5., the inclusion of the dummy variables to indicate oil dependence generally decreases the model's performance.[34] Most coefficient estimates are not significant at the conventional level except for $D^{85}sTX_i$ and $D^{90}gsX_{1i}$. In general, the inclusion of the dummy variables reduces the coefficient estimates of the trade variables. Because the dummy variables indicate trade policy for non-oil exports, this means that a higher non-oil dependence alone may not be enough to stimulate higher productivity growth in Indonesia. The trade policy in 1985 indeed affects the export ratio, although it influences the export share growth rate in 1990. Stated differently, a structural shift in exports plays an important role in productivity growth but its role varies over time. Thus, the development of the non-oil sector alone is not sufficient for technological progress and economic growth in Indonesia. As a matter of fact, the expansion of the oil sector together with the non-oil sector is required to raise productivity and economic growth.[35] This is because oil exports are an important source of foreign exchange, which would allow intermediate inputs and capital goods to be

[34]But, note that a higher R^2 does not necessarily mean a better model.

[35]In some cases, as in Table 3.8, the 1985 and 1990 dummies indicate a significant effect on the export ratio and the first lagged sectoral exports. This means the magnitude of these dummies is sensitive to the inclusion of the export ratio in 1985 and the first lagged sectoral exports in 1990, respectively.

imported. These imported inputs, which could embody more advanced technology to domestic producers, would then lead to improved productivity performance of the non-oil sector.

Note that the dummies are also useful to reflect the "lesser dependence" of the economy on oil exports. As in Tables 3.8 and 3.9, the effects of the oil dependence on productivity and economic growth are mostly positive and significant, except for the second lagged specification. From an economic point of view, the oil export expansion may earn foreign exchange which can be used to increase imports of equipment and intermediate goods. That is why the existence of the dummy variables for the oil dependence is expected to have a positive impact on the productivity level and its growth. However, because the coefficient estimates of the second lagged export share variables are not statistically significant, this indicates that these variables may be a poor measure of oil dependence on sectoral productivity. Thus, we may conclude that productivity and economic growth in Indonesia are sensitive to the inclusion of oil exports mainly in the short run. In other words, an increase in oil revenue might not be necessary to produce a direct impact on Indonesian development in the long-run.[36]

Of all the dummy variables, the inclusion of the 1985 dummy on the export ratio and that of the 1990 dummy on the first lagged sectoral exports indicate a

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[36]In fact, Woo *et al.*(1994) noted that the government was often obliged to take responsibility for Pertamina's debts.

significant relationship to productivity. This means these variables are correlated with productivity growth and significant at the one per cent level and the ten per cent level, respectively. The coefficient estimates of these variables are smaller when the dummy variables are not introduced into the model, i.e. from 0.87 to 0.45 for the export ratio and from 0.16 to 0.12 for the first lagged sectoral exports. (See also Table 3.5.) This indicates that the existence of the 1985 and 1990 dummy variables changes the magnitude of the export ratio and the first lagged sectoral export variables *ceteris paribus*.[37] This means that a full percentage point increase of oil exports is likely to contribute a 0.04 (from 0.16 - 0.12) to 0.42 (from 0.87 - 0.45) per cent increase to productivity growth at the one and ten per cent levels of significance via the (sectoral) export ratio and the first lagged sectoral exports. This contribution is slightly bigger than the increase in total sectoral exports, as in Table 3.5. Consequently, these findings show that the oil dependence has been a significant variable affecting sectoral productivity growth via the short-run export variables, namely the export ratio and the first lagged sectoral exports.

With regard to the productivity level effects of trade liberalization, only the

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[37]Indeed, when oil exports increase, Indonesia's income increases. This will also raise domestic demand for all products. Thus, exports can also be a strategic decision to improve greater capacity utilization of domestic firms. In this chapter, however, the model is not intended to explore this capacity utilization issue. We will deal with this capacity utilization issue in Chapter 4.

inclusion of the 1990 dummy on the first lagged sectoral exports variable is significant at the ten per cent level. In other words, most lagged export variables do not have a significant coefficient estimate when the export dummy is introduced. Thus, this indicates that if the economy is less dependent on oil exports, trade liberalization can be significant in its effect on the productivity level.

As seen in Table 3.8, the inclusion of the dummy variable for oil export dependence increases the import share variable and is significant at a ten per cent level. Its impact slightly increases from 0.12 to 0.14 per cent. This means that a higher dependence on oil exports induces significant foreign competition effects in the Indonesian economy. This finding is consistent with the results reported before.

Further, we also attempt to test the dummy variable as a separate independent variable. In this context, using the IV estimation with sectoral fixed effects, we find that the coefficients of D^{85}, D^{90}, and D^{95} are 0.47, 0.54 and -1.09, respectively. None of these dummy variables have a coefficient estimate that is significant at the ten per cent level. This indicates that our construction of the dummy variables in equation (3.8) performs better than treating the dummy variable as a separate independent variable. This is not to say that this variable is not important in affecting productivity but rather, that the nature of data in this variable may ultimately cause an insignificant impact on productivity level and growth.

Further, the introduction of D^{LIB} as an indicator of trade reforms also supports the argument that trade reform policy yields a significant impact on productivity growth via the short-term export share. The interaction of this dummy with the first lagged sectoral export share variable is statistically significant at the one per cent level for OLS and at the five per cent level for 2SLS, FE.

3.8. An Analysis of the Results

Economic growth is the result of a variety of influences. Although growth theorists have long debated extensively these influencing factors, they generally underline three major factors affecting economic growth. These are total factor productivity growth, capital stock growth and employment growth. In the previous chapter, we have examined the sources of output growth using aggregate data. Meanwhile, in this chapter, we apply sectoral data to further investigate the sources of growth. In addition, this chapter is designed to extend our discussion by relating productivity to foreign trade variables.

Our findings show that the sources of Indonesia's sectoral output growth are the growth in factor inputs and sectoral productivity. These findings are consistent with the previous results reported in Chapter 2, although the coefficient estimates of capital and labour growth in this chapter are slightly higher than those in the previous chapter.[38] This indicates that our cross section-time series data gives different results than our aggregate data. The sectoral data allow us to capture cross section and fixed effects in the model. Thus, the changes of the coefficient estimates for the factor inputs from the results in Chapter 2 and those in Chapter 3 show that the cross sectional and time series effects cause the slopes to vary over time within subjects.

In particular, although the sectoral data provides higher results, the coefficient estimate for labour is still lower than that of capital. The coefficient estimate for labour is approximately 0.10 per cent. In this context, Gollin (2002) has proposed a new methodology to improve the computation of the labour share. This methodology will be discussed in Chapter 4. Regardless of data limitations, from our findings, the higher coefficient estimate of capital versus labour indicates that the capital share has a greater impact on economic growth than the labour share. On the other hand, the low skilled and poorly educated labour force in Indonesia causes labour productivity to be low.

Factor inputs are not the only variables affecting productivity. In recent times, as explained before, productivity has been linked to international trade. In this study, a significant relationship is found between trade liberalization and the productivity level and its growth in the short-run. Unfortunately, we cannot prove

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[38]It is important to note that the higher estimates may also be interpreted as meaning that exports also induce greater capacity utilization by domestic firms.

that trade liberalization also supports long-run productivity growth in Indonesia. This may be due to data problems or to sectoral disturbances. Exports in Indonesia are primarily intended to boost production techniques and capacity of export-oriented firms by providing better products and/ or keeping production costs low. So domestic firms may experience higher economies of scale and/ or greater capacity utilization. Because domestic firms become more technically efficient, they can compete with foreign firms. Alternatively, higher capacity utilization reduces the average cost of production which, in turn, may result in a more competitive price.

Unfortunately, however, within the sample period, the Government kept the fuel cost low by granting subsidies on petroleum products in domestic markets. This subsidy certainly caused an allocative inefficiency. Therefore, "true" sectoral efficiency may ultimately disappear.

Given our empirical evidence, the export sector in Indonesia in the long-run may not play as big a role in development as has been generally believed by the government. At least, oil's role is not directly related to long-run domestic efficiency. In any case, Indonesia's competitive advantage in exported products may only last for the short-run, not for the long-run. Moreover, the notion of getting the "price right" is also not as simple as is often suggested. It seems that many factors determining comparative advantage have been distorted by historical and other forces. In this context, Krugman (1986) argues that a good deal of trade's impact, such as transitory advantages from innovation and large scale production, is more likely to appear in the more developed countries where it can be fostered by government policy. Thus, economic efficiency and competitiveness in the long run may not necessarily be the first priorities of trade liberalization.[39]

In Indonesia, this competitiveness argument regained momentum in the mid-1980s in response to the significant drop in international oil prices and the need to create an economic environment to stimulate growth in non-oil exports. Hobohm (1995) points out that a particular feature of this liberalization process in Indonesia is generally shown by the shift from the use of non-tariff barriers to more transparent tariffs. Under an international commitment such as the ASEAN Free Trade Area (AFTA) and the Asia Pacific Economic Cooperation (APEC), however, trade barriers cease to be a competitive weapon. Consequently, marketing strategies entailing assessment of market potential for exports appear to take on a central importance in offering Indonesian products in international markets.

The positive and significant relationship between the export variables and sectoral productivity and growth in the short-run indicates support for the export-led growth theory. This means that countries which do not encourage their export-oriented sectors through competitive economic policies are likely to have lower

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[39]The first priority is just to meet government revenues in dollar terms due to the fluctuations of oil prices in the world market.

economic growth.

Export growth is also often seen to have a stimulating effect on productivity in other sectors through externality effects (Bhagwati, 1978 and Piazolo, 1996). These effects ultimately lead to a reallocation of resources based on the comparative advantage of a country. But in Indonesia, although the subsidy gives export-oriented firms a cost advantage, the existence of subsidies on domestic oil prices may reduce the incentive to adopt better technology and/ or other cost-cutting measures. So the productivity effects are minimized. In addition, although the government keeps the fuel prices low, these low fuel prices will not reduce production costs if other "economic" costs, such as bribery and corruption, are still high. Hence, economic policies eliminating any price distortion (for export goods) are required to make export firms more competitive internationally, as long as they don't get hit with countervailing duties/ tariffs by their trade partners. These economic policies to reduce any price distortion will hopefully improve the technical efficiency of export-oriented firms and provide incentives for the development and production of new technologies. In turn, export-oriented firms (and local industries) in the long-run will be able to better cope with the pressure of international competition without government interference or intervention.

On the other hand, however, Bernard and Jensen (1999) argued about the causality of export and productivity. They stated that "the positive correlation between exporting and productivity levels appears to come from the fact that high productivity plants are more likely to enter foreign markets". If this is the case, factor inputs tends to play an important role in affecting technological progress. The reason is that if capital inputs vary across sectors due to different rates of capacity utilization, and these rates vary systematically with export demand, then the significance of this export variable on productivity and growth must be affected by this capacity variation. Alternatively, improvements in the quality of labour input may also affect labour productivity to the extent that more skilled labour input will result in higher productivity, and in turn, increased export growth. The study, however, finds a very small variation between factor inputs (i.e., capital and labour) and export variables. Thus, we assume that the variation in factor inputs does not directly produce a significant impact on productivity and output growth in Indonesia.

In fact, in the mid-1990s, most Indonesian manufactured exports were natural resources and unskilled labour based commodities (Wee, 2002). Table 3.12 presents Indonesian manufactured exports broken down by factor intensity. As in Table 3.12, although Indonesian exports are already diversified, Indonesian exports were not heavily dependent on skill and technology intensive. If this is the case, improvements in capital and labour inputs tend to have a smaller effect on exports than changes in natural resources, which contributed more than half of the 1995 Indonesian manufactured exports. Given this situation, we hold to our "export led productivity" argument.

Table 3.12: Indonesian Manufactured Exports by Factor Intensity, 1995

No.	Factor Intensity Based Commodoties	Exports (%)
1.	Natural resource-intensive products	52.54
2.	Unskilled labour-intensive Products	31.65
3.	Skilled labour-intensive Products	11.12
4.	Capital-intensive Products	4.69

Sources: Wee (2002, p.225), and Author's analysis.

It is also useful to note that strong competition from other low wage industrializing countries such as China, Vietnam and Bangladesh tended to slow down Indonesian exports in the 1990s. See, for example, Wee (2002) and Rosser (2002). Therefore, to maintain its export performance, Indonesia's policy makers have to encourage exporters to improve their competitive advantage from natural-resources and unskilled labour intensive products to more technological and human capital intensive goods.

With regard to the import share variable, the coefficient estimate of the import share variable is positive and significant. This finding certainly suggests that foreign competition affects domestic industries. Although the share of imported consumer goods tends to decline (from approximately 15 per cent in 1975 to around 5% in 1990), the existence of the free trade agreement in 2003 may indeed accelerate the flows of foreign (consumer) products to the domestic market

(Poot *et al.*, 1992 and Piazolo, 1996). This certainly threatens the survival of some domestic industries.

In addition to foreign competition effects, the positive and significant impact of the import variable can also be interpreted as the success of the import strategy. It is useful to note that the import variable used in this study is total imports, which is the sum of imported inputs and finished goods. In this context, the share of imported consumer goods has been decreasing, while the share of imported capital goods shows an increasing trend, i.e. from 45 % in 1975 to 85% in 1990 (Poot *et al.*, 1992 and Piazolo, 1996). This means the importance of the import variable in the process of industrialization is determined by the switch from imported consumer goods to imported capital goods.

In addition, our findings also indicate that oil dependence has affected sectoral productivity and economic growth in Indonesia through trade orientation. Oil exports have certainly increased government revenues.[40] But international oil prices may be very unstable. The temporary increase of oil exports often produces another cost when the revenues from the oil boom go to the government rather than the private sector. This usually induces inefficiency in consumption and production (Woo *et al.*, 1994). This condition is known as Dutch Disease.[41]

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[40]In this context, Woo *et al.* (1994) states that "In Indonesia, however, all oil income net of payments to the foreign oil companies and net of the (insignificant) payments to domestic labor goes to the government"(p.76).

[41]For certain cases, this condition may also crowd out traditional exports.

In Indonesia, Dutch disease occurred in the mid-1970s after the tremendous oil price hikes as a result of the OPEC oil embargo. In this period, the price of Minas light crude (Indonesia's benchmark grade) in international markets jumped over 740%. In 1970, this oil was sold for an average price of US$ 1.64 a barrel, while by mid-1974, the price had risen to US$11.89 (The Embassy of the USA, 1991, p. 97). This increase, together with an expansion in production, caused the real values of Indonesian oil exports to rise from US$ 580 million in 1970 to US$ 5.13 billion in 1974 (The Embassy of the USA, 1991, p. 88). In this period, the inflow of foreign exchange from oil exports increased the government revenues but could not change the exchange rate because Indonesia's exchange rate was pegged at 415 rupiahs to the US dollar. In turn, this foreign exchange inflow caused a rapid inflation. As a result, traditional exporters, such as agriculture and labour-intensive manufactured goods, were faced with a double hit: rising domestic costs coupled with a constant nominal exchange rate. This made exporting quite unprofitable.

In addition to Dutch Disease, when the oil boom began and the government financed its spending by converting the dollar earnings from oil exports into rupiahs, the domestic money stock exploded. Because the government used a fixed exchange rate system, the domestic currency could not freely appreciate. This then added idle funds at the Central Bank of Indonesia.[42] This windfall then induced extra unplanned government expenditures. In this period, the main instrument of monetary control was the allocation of direct Central Bank credit to state and private enterprises. This credit mechanism, however, was ineffective in reducing the money supply. As a result, the inflation rate rose to around 41% (Woo *et al.*, 1994). But when international oil prices fell, the government lost significant earnings. The slowdown of international oil prices in 1977 and 1978 along with oil resource depletion meant the government had to seek alternatives to recover its losses from oil exports. Therefore, in November 1978, the government changed its exchange rate system from a fixed rate to a managed floating rate and devalued the Rupiah by 50 percent. By depreciating its currency, the government expected to boost trade competitiveness of Indonesian products in international markets.

Given the fact that oil exports may create economic imbalance, it is not surprising that there is no significant relationship between oil exports and long-run productivity. It seems that the gain from oil exports is unlikely to improve economies of scale of Indonesian industries because Indonesia's oil industry is a

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[42]The Central Bank of Indonesia at this time was not operating as an independent central bank but rather, as an arm of the government. This permitted the government to dictate the surplus funds to be monetized and made available to the government. Under IMF pressure, the Central Bank of Indonesia has been made an independent central bank. This occurred when a new Central Bank Act (no. 23/ 1999) was issued in May 17, 1999. The Act confers the status and position as an independent state institution on the Bank and provides freedom from interference by the Government or any other external parties. See http://www.bi.go.id.

protected sector. It is also useful to note that the model [equation (3.8)] attempted to identify productivity growth caused by exploiting the variations in oil and non-oil dependence. Assuming that the oil and non-oil dependence can be measured by our dummy variables, the findings suggest that oil and non-oil export dependence causes no significant difference in productivity growth rates in the long-run. The results do indicate productivity level effects in the short-run.

Nevertheless, using the findings in Table 3.5, the real contribution of oil exports to growth can then be estimated. Since the real values of the sectoral export ratios for the oil sector are known, we can multiply these values by the respective parameter estimate (sTX_i) depending on which method is used, i.e. 0.1609 for OLS, 0.4072 for OLS, FE and 0.4492 for 2SLS, FE. This multiplication will give us the real contribution of oil exports to growth. (See Table 3.13.)

As shown in Table 3.13, the real contribution of oil exports (as represented by sectoral export ratios) has generally declined. In general, however, this contribution can be divided into two periods, i.e. "prior to 1985" and "after 1985". It seems that the contribution to growth is higher before 1985 than after. Using the findings from 2SLS, FE, in general, the contribution of oil exports to growth is above 25% per year before 1985 and is less than 17% per year after 1985. Meanwhile, despite its biasedness, if we use the coefficient estimate from OLS, FE, the contribution is above 20 % per year prior to 1985 and is below 16% per

Table 3.13: The Real Contribution of Oil Exports to Growth

Year	Contribution of Output Growth (%)		
	Estimated From OLS	Estimated From OLS, FE	Estimated From 2SLS, FE
1967	5.79	14.66	16.17
1968	6.55	16.58	18.29
1969	7.22	18.26	20.15
1970	6.48	16.40	18.09
1971	6.23	15.78	17.40
1972	8.26	20.92	23.03
1973	8.06	20.40	22.51
1974	11.29	28.58	31.52
1975	12.03	30.45	33.59
1976	11.30	28.61	31.56
1977	10.82	27.38	30.21
1978	10.28	26.01	28.70
1979	9.16	23.17	25.56
1980	10.48	26.51	29.25
1981	11.61	29.39	32.42
1982	11.16	28.26	31.17
1983	10.26	25.95	28.63
1984	9.15	23.16	25.54
1985	7.86	19.90	21.95
1986	5.98	15.13	16.69

Table 3.13: The Real Contribution of Oil Exports to Growth (continued)

Year	Contribution of Output Growth (%)		
	Estimated From OLS	Estimated From OLS, FE	Estimated From 2SLS, FE
1987	5.78	14.63	16.14
1988	4.34	10.99	12.13
1989	4.40	11.14	12.29
1990	4.64	11.74	12.95
1991	3.71	9.38	10.35
1992	3.14	7.93	8.75
1993	2.49	6.30	6.94
1994	2.41	3.10	6.73
1995	2.28	5.78	6.37
1996	2.33	5.91	6.52
1997	2.04	5.17	5.70
1998	1.34	3.38	3.73
1999	1.80	4.55	5.02
2000	1.81	4.59	5.06

Source: Author's Analysis

year after 1985. Using the estimates from OLS are even worse, i.e. it was around 10% per year before 1985 and around 3% per year after 1985. This decrease after 1985 means that either the government's focus on oil exports to support growth changed or it was reduced due to price fluctuations in the world oil market.

Table 3.13 also shows that in the 1970s and early-1980s, Indonesia seemed to enjoy high benefits from oil exports. This, of course, was a period of OPEC oil price increases. These high prices in the international market secured high revenues for the Government of Indonesia. As a result, oil exports served well as an engine of growth.

Finally, the new growth theorists such as Romer (1986) and Lucas (1990) argue that the spillover effects on labour productivity due to externalities generated by exports are an essential mechanism to promote growth. In this context, Piazolo (1996) also points out:

> the larger the volume of trade, e.g. of exports, the greater will be the number of personal contacts between domestic and foreign individuals. These contacts may ... cause the agents from the less developed country to acquire novel perspectives of technical problems.

This positive knowledge perhaps provides an answer to why the coefficient estimates of labour inputs are greater in Table 3.5 than in Table 2.5, i.e. when there were no trade variables in the model. The frequent contacts between domestic and foreign individuals ultimately increases labour productivity for Indonesians. If this is the case, we are likely underestimating the coefficient estimate for labour inputs shown in Table 3.5. Thus, we need a better estimate of the contribution of labour to output and productivity growth over time.

3.9. Concluding Remarks

In terms of methodology, this study has specified a determinant of productivity growth. In particular, relevant models have been developed to examine the causal relationship between trade variables and economic growth. The model is also useful to investigate the sources of productivity level and growth. The causal relationship of these variables is expected to have a positive sign implying that export performance supports economic growth and productivity growth. This relationship was estimated by applying equation (3.7). We found that the export variables have a positive impact on productivity and growth, although some variables are not statistically significant. The positive impact, however, indicates that exports are important to achieve efficiency in the Indonesian economy.

In addition to the export variables, dummy variables are also introduced to investigate the effect of oil dependence and trade policies on productivity and growth. These effects are predicted by employing equation (3.8). Although the dummy variables are not individually sensitive to growth, due to data limitations, the results of the model, as in Tables 3.5 and 3.8, show that trade variables and policies may have a positive effect on productivity and economic growth in Indonesia.

Further, the importance of imports was also investigated, as seen in equation (3.7). The import variable used is designed to capture the effect of foreign competition on growth. We found that importation of foreign products yields a significant effect on output growth in Indonesia.

Our findings conclude that foreign trade variables are likely to have a positive impact on productivity and economic growth. Although the oil sector has been the largest economic sector in Indonesia, the impact of oil exports on productivity and economic growth is not as high as the non-oil sectors.

Due to data limitations, the inclusion of dummy variables to capture the effect of oil dependence and trade liberalization policies in 1985 slightly changes the model's performance. This happens either because of data problems or because the dummy variables are a poor way to capture the dependence effect on productivity and growth.

In general, there are three things that need to be explained. First, we see that the coefficient estimates increase when we go from OLS to OLS with fixed effect. This means that sectoral disturbances seem to influence the performance of our model. In fact, by employing the fixed effect model, we obtain higher estimates. Second, the coefficients also increase when we go from OLS with fixed effect to 2SLS with fixed effect. This means that the endogeneity problem may also affect our model performance. When this endogeneity is considered, the coefficient estimates increase by around 11%. Third, by employing both OLS (with and without fixed effects) together with 2SLS (with and without fixed effects) procedures, we clearly provide a stepwise picture of the sources of growth in Indonesia rather than just simply using a 2SLS technique alone.

Our findings, as seen in Table 3.5, also show that sectoral capital and labour growth indicate significant influences on total or overall economic growth. As compared with the results in Chapter 2, our findings for factor inputs now look better. This means that employing a larger sectoral number of factor input effects will produce better results than using a two sector input approach. It is useful to note that the labour input of the oil sector in Chapter 2 is not significant. This is because the strength of labour growth in the non-oil sectors ultimately dominates the effect of labour input from the oil sector in the economy. This supports the argument that while oil is a capital-intensive sector, the non-oil sector in Indonesia is labour-intensive. If this is the case, there is no need to separate the labour growth by oil and non-oil sectors when investigating the impact of sectoral labour growth in the Indonesian economy.

To examine further the role of factor inputs in economic growth and to complete the results, the study now attempts to compute labour shares in Indonesia. Using a growth accounting method, we attempt to better account for output growth, factor accumulation and productivity growth.

CHAPTER 4

ACCOUNTING FOR LABOUR SHARES AND PRODUCTIVITY

4.1. Introduction

The small role indicated for labour shares in the previous chapters is somewhat troubling. It is commonly claimed in the literature that labour input is a prerequisite for development and most countries have government policies which encourage labour development (Gillis *et al.*, 1996). But such claims presume a bigger role for labour in the economy than our previous findings. There are at least two possible explanations for why our labour variables in the previous chapters are small. One possibility is that it shows a low ability of Indonesian labour. This may be caused by inadequate human skills and/ or lack of management of Indonesian labour. Another possibility is that our labour variable is a poor measure of labour input. This is because, for example, our labour accounting excludes the importance of self-employment.[1] This exclusion could certainly lead us to "mismeasure" the relationship between labour share and GDP. In some sectors, such as agriculture and trade, the self-employed may account for significant fractions of the workforce. Consequently, our previous factor input is likely to understate the

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[1]Indeed, output may include value-added by the self-employed. Unfortunately, the CBS does not explicitly report value-added by the self-employed.

implied labour variable.[2]

Due to this problem, this chapter is primarily designed to present an alternative approach to compute labour shares and productivity. In this context, a growth accounting framework is applied to provide alternative evidence on determinants of growth in Indonesia. Because we will use sectoral data, our basic growth model is equation (3.1) as specified in Chapter 3. Due to the use of the growth accounting method, error terms (ε_t), as in equation (3.1), will not be introduced. For convenience, it is useful to rewrite the standard growth accounting formula in the following form:

$$gQ_t = gTFP_t + \beta_K gK_t + \beta_H gH_t. \tag{4.1}$$

This growth accounting decomposes the growth in output (gQ) into growth in factor inputs (gK and gH) and growth in productivity ($gTFP$). The latter is often known as the Solow residual because it accounts for any residual output growth which is not explained by labour and capital inputs.

To estimate factor shares, defined as in Appendix 2.1, labour shares are initially calculated. To do so, labour shares are commonly computed as the ratio of labour income to the value of total output. A widely used strategy for labour

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[2]However, if output includes self-employed output and labour income does not include self-employed income, then we will overstate the returns to capital.

income is to use employee compensation which usually appears in the macro data sets such as the *United Nations National Accounts Statistics* (UNNAS). Then, under the assumption of perfect competition and constant returns to scale, capital shares are simply computed as one minus the estimated labour shares (see, for example, Young, 1995 and Yuen, 1998).

However, Gollin (2002) argues that "estimates of [labour] shares that do not account for self-employment income will be seriously flawed, especially in poor countries". This is due to the fact that the labour income of the self-employed is often treated incorrectly as capital income as a result of using the "one minus the estimated labour share" formula. (See, for example, Yuen, 1998.)

The main objective of this chapter is to compute labour shares for Indonesia. By using data from the *United Nations National Accounts Statistics* (1994), Gollin (2002) calculated these shares for 31 countries, but his study excludes Indonesia. This chapter also attempts to examine whether the labour shares in Indonesia have been constant over time and across sectors. To this end, we will first discuss Gollin's methodology which proposes a new accounting method for labour shares. We then use his method to estimate labour shares in Indonesia using input-output data. Finally, the study presents estimates of productivity growth in Indonesia using the relevant standard growth model.

Once the "true" size of the labour share is computed, we expect to find out the "true" size of productivity growth in Indonesia. In this context, Senhadji

(2000) notes that TFP as the source of growth needs to be computed precisely to explain long-term growth. If the labour share is not precisely computed, a decision on the long-term perspective of a country may be biased. In fact, the importance of productivity was noted again by, for example, Krugman (1994) and Young (1995) who argued that growth in the East Asian countries was only for the short period, because productivity only contributed a very small amount of growth in those countries. This small productivity growth, in turn, will not secure significant long-term growth.

The rest of this chapter is divided into seven sections. Section 4.2 develops the accounting method to measure factor shares. Section 4.3 presents the growth formula. Section 4.4 describes the data and methodology in this study. Section 4.5 reports the results. Section 4.6 provides an alternative measure of productivity. Section 4.7 analyzes the results and Section 4.8 presents concluding remarks.

4.2. Measuring Factor Shares

4.2.1. An Accounting Method for Labour Shares

In a neoclassical framework, labour share determines the contribution of labour input to economic growth. The concept of labour share has been long discussed since 1821. See, for example, Ricardo (1821), and Kang *et al.* (1998). In this context, Batini *et al.* (2000) define labour share as the share of value added (net of indirect tax) that accrues to workers from their supply of labour to firms. In practice, labour share is often computed as labour income divided by value of output (Gillis *et al.*, 1996).[3] This computation, however, is a "naive" calculation. Yuen (1998), on the other hand, uses the growth of labour income divided by the growth of output to compute labour share, while Young (1995) argues that accounting for labour share needs to include income of self-employed people. In his paper, he estimates wages of self-employed people on the basis of their sector, sex, age, and education. The difficulty with Young's approach is that it requires very detailed micro data which is not possible to replicate for Indonesia.

The discussion of accounting for labour shares in this chapter is mainly based on Gollin (2002). Relying on the work of Kravis (1962) on entrepreneurial income, Gollin (2002) proposed some adjustments to correct the standard accounting methodology for labour income. These adjustments are required because it is common to use compensation of employees as a measure of labour income. (See, for example, Yuen, 1998.) Theoretically, compensation of employees is different from labour income. In this context, Gollin (2002, p. 463) states that "employee compensation excludes some important forms of nonwage compensation and may include rents ... and omits the labour income of self-employed people who are not employees". Thus, these adjustments will be

[3]In this context, labour income is considered to be employee compensation.

necessary if and only if the actual labour income excluded incomes of the self-employed. If labour income already includes incomes of the self-employed, employing Gollin's adjustments will produce a double accounting. Yet data on the total income of the self-employed do not exist for most developing countries. Therefore, Gollin (2002) suggested adjusting the National Income and Product Accounts (*NIPA*) in one of three different ways to remedy this problem. (See also Krueger, 1999, and Bernanke and Gürkaynak, 2001.)

Gollin's adjustments for self-employment income involve three alternative methods. In the first, all the operating surplus of private unincorporated enterprises (*OSPUE*) is treated as labour income. This treatment overstates the labour share of national income, however, because the self-employed tend to have substantial amounts of capital in their businesses (Gollin, 2002, p. 468).[4] The labour share (*LS*) computed using this adjustment is

$$LS1 = \frac{EC + OSPUE}{GDP - IT}, \tag{4.2}$$

where *LS1* is labour share with the first adjustment, *EC* is employee compensation, *OSPUE* is the operating surplus of private unincorporated enterprises, *GDP* is

[4]It is useful to note that according to UNNAS, *OSPUE* is combined into the overall operating surplus in the system of national accounts which also consists of property and entrepreneurial income. The property income is basically a capital income because it includes payments of interest, dividends, land rents and royalties.

gross domestic product, and *IT* is indirect taxes.[5]

The second alternative is to assume that "labour and capital shares are approximately the same in private unincorporated enterprises (*PUEs*) as they are in large corporations and the government sector" (Gollin, 2002, p.468).[6] Though this assumption is simple and transparent, it has to assume the same labour shares of establishments regardless of their size, structure and labour intensity. The formula for labour share (*LS2*) in this adjustment will be

$$LS2 = \frac{EC}{GDP - IT - OSPUE}. \qquad (4.3)$$

Finally, the third adjustment computes employee compensation (*EC*) for workers in the economy by measuring the average employee compensation and scaling up for the entire workforce. This adjustment essentially assumes that the self-employed people have the same average wage rate as hired workers. The disadvantage of this third adjustment is that all the workforce is assumed to have the same average income, though some sectors such as agriculture and mining may yield different earnings. Another disadvantage of this approach is the assumption

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[5]Because *EC* together with operating surplus is calculated as the amount by which GDP exceeds the sum of consumption of fixed capital and indirect taxes, it is useful to remove the taxes from GDP when computing labour shares.

[6]One weakness of this method is to assume labour share in the government sector, although it does not report profits, is the same as for large corporations.

that all people in the labour force have income. When the unemployment rate is high, the third adjustment may be very imprecise. Nevertheless, this approach has an advantage to the extent that it provides more reliable estimates of income shares in the economy than guessing how to divide up *OSPUE* between labour and capital.

In this computation, the labour share (*LS3*) formula is constructed as

$$LS3 = \frac{\left(\frac{EC}{NoE}\right) \times WF}{GDP}, \tag{4.4}$$

where *EC* and *NoE* are NIPA employee compensation and number of employees and *WF* is workforce.[7]

All three options tend to overstate the labour share of national income. However, since labour incomes of the self-employed are now explicitly recognized, they are preferable to the usual "naive" calculation in computing labour income.

From his findings, Gollin (2002) concludes that these three adjustment options provide higher estimates of labour shares. Table 4.1 reports the descriptive

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[7]NIPA stands for the National Income and Product Accounts. Unfortunately, NIPA does not report Indonesian data on employee compensation and the number of employees. So, we need to modify equation (4.4). Because we will use IO data, *EC* and *NoE* in equation (4.4) will be employee compensation and number of employees from the IO table, respectively. In the Indonesian IO table, *NoE* equals *WF*. As a result, we do not use workforce (*WF*), but labour force (*LF*) data in applying equation (4.4).

statistics of Gollin's calculation for labour shares, and that adjustments increased the size and reduced the variation (from 16 % to 11 %) of labour shares. In any case, the adjusted calculations yield higher estimates and smaller variation than the naive calculation. This implies that labour shares are quite stable across countries, regardless of the levels of income per capita (Gollin, 2002, p. 470).

Table 4.1 also indicates that there is no statistically different among these three adjustment methods. On average, the labour share in Gollin's findings is about 69% (with approximately 10 % error). And the use of any of the adjustments gives relatively similar results. In general, this means that we can legitimately employ any of the adjustments to recalculate labour shares because we are likely to obtain similar results, though some countries, such as Bolivia, the Philippines, and Vietnam, do show larger variations across methods.

Table 4.1: Mean and Standard Deviation of The Labour Shares Calculation

Description	Naive Calc.	First Adj.	Second Adj.	Third Adj.
Mean	.472	.745	.675	.654
Std. Dev.	.157	.110	.107	.109

Sources: Gollin (2002).

Notes:

Calc. stands for calculation and Adj. is for adjustment. The number of observations is 31 countries, except for the third adjustment which was computed only for 19 countries because of data limitations. The naive calculation is employee compensation as a fraction of GDP.

Unfortunately, Gollin's formulas, as in equations (4.2), (4.3) and (4.4), are not easily applicable to Indonesia. This is because the required data are not readily available. An adjustment is required to employ Gollin's formulas. This adjustment is discussed in Section 4.4.

4.2.2. An Accounting Method for Capital Shares

As previously mentioned, under the assumption of perfect competition and constant returns to scale, capital shares are calculated as one minus the estimated labour shares. This is the standard assumption in accounting for sources of growth. It is not the purpose of this study to alter this assumption.[8]

4.3. Measuring Growth

As seen in equation (4.1), our analysis focuses on two inputs, i.e. capital and labour, in the aggregate economy. Because the input-output tables will be used to compute the model, our growth rate formula can be defined as

$$gV_T = \left(\frac{V_T - V_{(T-j)}}{V_{(T-j)}}\right) \times \frac{1}{d(T-j)} \times 100$$

[8]With increasing returns to scale, observed factor shares are likely to overestimate the true total factor productivity growth.

where V denotes respective variables such as Q, K, and H, while j is the previous time period.

4.4. Data and Methodology

As mentioned earlier, the main problem using Gollin's adjustment formulas for Indonesia is data availability. For example, until recently, the United Nations National Account Statistics (UNNAS) and the Central Board of Statistics of Indonesia (CBS) did not publish data on the operating surplus of private unincorporated enterprises (*OSPUE*).[9] The CBS even reports that self-employed people in Indonesia have never been surveyed systematically.[10] So no adequate information on *OSPUE* is likely to be available. Therefore, we need to modify the operating surplus data to get *OSPUE* to fully use the first and/ or second adjustments. This modification judges sectoral data to be broken into low and high-self employment units. This judgment will be explained later.

Meanwhile, the third adjustment is also problematic for Indonesia. This is because the third adjustment requires NIPA's number of employees which are also not available for Indonesia. Nevertheless, although the third formula may slightly

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[9]This information was obtained from Ms. Puji Handayani, an officer in Dissemination Services of the CBS.

[10]The questionnaires for economic surveys have never specifically included any salary information on self-employed people.

overstate labour's share of national income because we treat self-employed people as having the same income as workers in large corporations and government, this formula is more rational and transparent than guessing *OSPUE* as in the first and second adjustments if such NIPA data were available (Gollin, 2002).[11]

Despite the fact that the inclusion of the operating surplus of private unincorporated enterprises under employee compensation may slightly uncover the "true" condition of employee compensation as previously presented in Table 4.1, the end result from the first formula, we know from Gollin's work, will be approximately the same as it would be for the other adjustment formulas if they could be used.[12] Based on this condition and because NIPA does not provide the number of employees in Indonesia, *LS1* [equation (4.2)] is perhaps more practical than *LS3* [equation (4.4)].[13] This is because *OSPUE* can be obtained by modifying operating surplus data, while we don't have adequate information to predict NIPA's number of employees. Indeed, the operating surplus is reported in the IO

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[11]As seen in Table 4.1, the mean of the labour share estimate is 0.654 using the third adjustment, while it is 0.745 and 0.675 using the first and second adjustment, respectively.

[12]Corruption and bribery are common practices in Indonesia. Hence, the "true" employee compensation will never be computed precisely, especially for the government sector. This study will not discuss these practices further because not only is no adequate data on corruption available but also it is not the purpose of the study to examine corruption.

[13]Equations (4.2) and (4.3) have the same problem to the extent that *OSPUE* is required. In this study, we use equation (4.2) to compute labour share in Indonesia.

table, but it is not divided into *OSPUE* and others.

In this study, there are three options to compute labour shares in Indonesia by employing equation (4.2). First, following Gollin (2002), we can use data on employee compensation taken from the United Nations National Accounts Statistics (UNNAS) for various years. To my knowledge, prior to 1993, UNNAS published employee compensation data for Indonesia, although operating surplus was also included in employee compensation. Unfortunately, there is no information about *OSPUE*. So, we cannot split *OSPUE* from the operating surplus. The inclusion of the operating surplus in the employee compensation certainly raises the figure for employee compensation. Yet, we cannot split the operating surplus from the employee compensation because no symmetrical information source is adequate to do so.[14] In fact, UNNAS (2000) defined the operating surplus together with the compensation of employees in Indonesia as a residual by which the gross domestic product exceeds the sum of consumption of fixed capital and indirect taxes. The operating surplus itself is defined as "the surplus (or deficit) accruing from production before taking account of any interest, rent or similar charges payable and/ or receipts receivable on financial or tangible non-produced assets borrowed or rented and/ or owned by the enterprise" (UNNAS, 2000). The enterprise includes any corporate, quasi-corporate, unincorporated, public and

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[14] Alternatively, we can use operating surplus provided in the input-output table.

private unit. Stated differently, the operating surplus persons, contains a remuneration for work done by the owner, or other self-employed, and any rents or return to capital. Thus, *OSPUE* is apparently part of the operating surplus.[15]

In the first option, the nominator of equation (4.2) is treated by using employee compensation plus operating surplus. We denote this first option as the "First UNNAS Labour Share" (*LSUNNAS1*).

The second option is to employ data taken from the input-output table. Unlike the UNNAS data, employee compensation in the input-output table is separated from the operating surplus.[16] In this study, we will therefore compute the employee compensation in two ways. First, we combine the employee compensation and the operating surplus in the IO data to obtain results consistent with the UNNAS data. We denote this result as the "First IO Labour Share" (*LSIO1*). This also allows a comparison of the results from the input-output (IO) data and the UNNAS data. Second, we do not combine employee compensation

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[15]The CBS also uses the same definition of operating surplus as UNNAS. See the CBS (1998, p. 15). Due to round up, we found that there is around 10% difference between the UNNAS data and the IO data.

[16]Employee compensation can be seen in "row 201" of the IO table, i.e. wages and salary. The wages and salary definition from the IO table is similar to the employee compensation definition from the UNNAS reports. The CBS as in The 1995 Input-Output Table of Indonesia Volume II (1998, p.15) defines wages and salary as all employee compensation, cash and in-kind.

from the IO data with the operating surplus.[17] Thus, the numerator of equation (4.2) is only employee compensation. We denote the result of this second computation as the "Second IO Labour Share" (*LSIO2*). Using the operating surplus from the IO data, however, we may also split employee compensation in the UNNAS data.[18] We denote this result as the "Second UNNAS Labour Share" (*LSUNNAS2*).

From this computation, the labour income of the first approach, either *LSUNNAS1* or *LSIO1*, is likely to be too high because capital income was included while the second approach, either *LSUNNAS2* or *LSIO2*, may be too low since labour income of self-employed people is excluded. Therefore, we propose the third option which is a modification of the first and second option.

The third option is to apply the 19 sector data taken from the input-output table because these data are the only practical choice for our purpose. Then we use our judgement to split sectors into low and high self-employment, so we may obtain "adjusted" labour shares. In particular, the judgement is based on whether a sector is capital intensive and monopolistic. If a sector is capital intensive and

[17]The CBS (1998) stated that the input-output table is the most complete and comprehensive information for economic analysis in Indonesia. The main data sources are the same as those used in compiling gross domestic product of Indonesia. Additional data are obtained through a special IO survey to collect information on input structures, production and distribution of sectoral products.

[18]This is the only way to obtain a "pure" employee compensation in the UNNAS data.

monopolistic, we consider such a sector to have low self-employment. If not, it is considered high self-employment. Based on such judgements, some sectors may not be relevant to include in our accounting method. For example, sector 10 (oil refining) is dropped because self-employment in this sector is definitely zero. Sector 17, the general government and defense, is also dropped for the same reason.

Table 4.2 shows the sectors used in the analysis and the imputed degree of self-employment. The degree of self-employment in Indonesia using our judgement method allows sectors to be categorized as low self-employment sectors and high self-employment sectors. This sectoral classification can then be used to estimate incomes of the self-employed. Gollin (2002) used *OSPUE* as a proxy for incomes of the self-employed. In this study, we estimate incomes of the self-employed by calculating wages and labour compensation for private unincorporated enterprises (*PUE*), denoted as Employee Compensation for PUE (*ECPUE*). Thus, we treat *ECPUE* as equal to *Gollin's OSPUE,* which is a proxy for incomes of the self-employed.[19]

Table 4.2 indicates that sectors 8, 9, 11, 12 14, 15 and 16 are capital intensive and monopolistic units. So they are categorized as low self-employment sectors. Based on this categorization, we might assume that *ECPUE* in those

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[19]It is common that private uncorporated entrepreneurs treat their operating surplus as their employee compensation.

Table 4.2: The Degree of Self-Employment in Indonesia using A Judgment Method

Code	Name of Sector	Short Name	Capital Intensive	Degree of Self-Employment
1	Paddy	PDY	No	High
2	Other Food Crops	OFC	No	High
3	Other Agriculture	OAG	No	High
4	Livestock and Its Products	LSP	No	High
5	Forestry	FRS	No	High
6	Fishery	FSH	No	High
7	Mining and Quarrying	MIN	No	High
8	Manufacture of Food, Beverages and Tobacco	MFB	Yes	Low
9	Other Manufacturing	OMN	Yes	Low
10	Oil Refinery	ORY	Yes	Drop
11	Electricity, Gas and Water Supply	EGW	Yes	Low
12	Construction	CTN	Yes	Low
13	Trade	TRD	No	High
14	Restaurant and Hotel	RST	Yes	Low
15	Transportation and Communication	TCM	Yes	Low
16	Financial and Other Services	FIN	Yes	Low
17	General Government and Defense	GOV	No	Drop
18	Other Services	OSV	Undefined	Drop
19	Unspecified Sector	UCM	Undefined	Drop

Source: CBS(1998) and Author's analysis.

sectors is zero. Thus, labour shares of these sectors (*LS4*) are

$$LS4_{iT} = \frac{EC_{iT}}{GDP_{iT} - IT_{iT}}, \qquad (4.6)$$

where EC_i is sectoral employee compensation, GDP_i is sectoral output (value added)[20], IT_i is sectoral indirect tax, *i* denotes sectors 8, 9, 11, 12, 14, 15 and 16 respectively and T is the time period = 1971, 1975, 1980, 1985, 1990 and 1995. Equation (4.6) is the first adjusted labour share (*LS4*). The average of labour shares of these sectors, $\overline{LS4_T}$, denote the first estimate of labour share in Indonesia at the aggregate level.

Table 4.2 also indicates that sectors 1, 2, 3, 4, 5, 6, 7 and 13 are less capital intensive than other sectors. So these sectors are considered to be the high self-employed sectors. To get *ECPUE* for these sectors, we multiply $\overline{LS4_T}$ by their operating surplus (*OS*) such that $ECPUE_{iT} = \overline{LS4_T} \times OS_{iT}$ where i = 1, 2, 3, 4, 5, 6, 7, and 13 respectively. This provides an estimate of the earnings of the self-

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[20]Sectoral GDP is imputed as gross value added plus import sales tax and import duty (CBS, 1998). For our purpose, because sectoral GDP includes indirect taxes, we need to deduct the taxes from the output value as in equation (4.2).

employed. Thus, the labour shares of these sectors (*LS5*) are

$$LS5_{iT} = \frac{EC_{iT} + ECPUE_{iT}}{GDP_{iT} - IT_{iT}}. \quad (4.7)$$

Equation (4.7) is the second adjusted labour shares (*LS5*). The average of these sectors, $\overline{LS5_T}$, gives us the second estimate of labour share in Indonesia at the aggregate level. Thus, using the third option, we have two labour share estimates. The "true" value of labour shares in Indonesia perhaps lies between the two.

Finally, we multiply $\overline{LS4_T}$ by the operating surplus to obtain *ECPUE* at the aggregate level. Using the UNNAS data, the Indonesian labour share is then estimated by employing equation (4.2). We denote the results of this computation as the "Sixth Labour Share" (*LS6*).

Because of difficulties dividing *OSPUE* from the operating surplus, we also propose two other alternatives to determine a benchmark estimate of labour shares in Indonesia. The first alternative is to adopt Gollin's first adjustment mean labour shares to compute the factor shares and productivity. In this context, Gollin (2002) argued that "labour shares are quite stable across countries, regardless of the levels of income per capita". Thus, the use of Gollin's first adjustment finding is rational as a control between our findings and Gollin's findings.

The second alternative is to determine a benchmark country which is economically similar to Indonesia. Among 19 countries in Gollin's results, the Philippines is likely to be our best practical choice for such a benchmark country in providing an estimate of labour shares. This is because not only is the geographic location of the Philippines close to Indonesia, i.e. both are an ASEAN member[21] and have similar terrain, but also the economic structure of the Philippines is similar to that of Indonesia. For example, the agricultural sector, the most self-employed unit, in both countries contributed around 15 per cent of GDP in 2001 (The World Bank, 2002).

Therefore, in this study, eight alternatives will be applied to estimate labour shares in Indonesia: *LSUNNAS1*, *LSUNNAS2*, *LSIO1*, *LSIO2*, *LS4*, *LS5*, *LS6*, the Gollin's first adjustment and the Phillipines estimates. In short, Table 4.3 presents the summary of these alternative formulas.

After computing the factor shares, using equation (4.1), the study then attempts to compute productivity in Indonesia. To this end, the study will use capital stock and employment data developed in Chapter 2 and the input-output tables of Indonesia. Thus, we will have annual productivity growth and sectoral productivity growth broken into 19 sectors. The study also compares our results

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[21] ASEAN stands for the Association of South East Asian Nations. The members are, for example, Indonesia, Malaysia, The Philippines, Singapore, Thailand, Vietnam. Of the ASEAN members, in Gollin's paper, only the Phillippines and Vietnam were computed in his first method. Labour shares in both countries are around 80%.

Table 4.3: The Summary of Adjusted Labour Share Formulas

No.	Name of Formula	Formula	Explanations
1.	*LSUNNAS1*	$\frac{EC + OSPUE}{GDP - IT}$	*OSPUE* is treated to be equal *OS*. All data are taken from the *UNNAS* data.
2.	*LSUNNAS2*	$\frac{EC}{GDP - IT}$	*EC* from *UNNAS* data is deducted by *OS* from IO Tables. *GDP* and *IT* are taken from *UNNAS* data.
3.	*LSIO1*	$\frac{EC + OSPUE}{GDP - IT}$	*OSPUE* is treated to be equal *OS*. All data are taken from IO tables.
4.	*LSIO2*	$\frac{EC}{GDP - IT}$	All data are taken from IO tables.
5.	*LS4*	$\frac{EC_{iT}}{GDP_{iT} - IT_{iT}}$	All data are taken from IO tables. i refers to low-employment sectors (sectors 8, 9, 11, 12, 14 and 15).
6.	*LS5*	$\frac{EC_{iT} + ECPUE_{iT}}{GDP_{iT} - IT_{iT}}$	All sources are taken from IO tables. i refers to high-employment sectors (sectors 1, 2, 3, 4, 5, 6, 7 and 13). $ECPUE = \overline{LS4}_{iT} \times OS_{iT}$.
7.	*LS6*	$\frac{EC + ECPUE}{GDP - IT}$	*EC* from UNNAS minus *OS* from IO plus *ECPUE* which is calculated as in Formula 6. *GDP* and *IT* are taken from UNNAS data.
8.	Gollin's First Adjustment	$\frac{EC + OSPUE}{GDP - IT}$	Data are taken from the Penn World Tables, and for NIPA data from the United Nations (1994).

Notes: *EC* is employee compensation, *OS* is operating surplus and *OSPUE* is operating surplus of private unincorporated enterprises (*PUE*). *ECPUE* is employee compensation for *PUE*. For UNNAS data, *EC* includes *OS*, while in IO tables *OS* is reported separately from *EC*. *GDP* is gross domestic product and *IT* is indirect tax. The Philippines benchmark uses Gollin's First Adjustment formula. $\overline{LS4}$ is the average *LS4*.

with other studies of productivity growth for Indonesia.

The study finally tries to examine whether there is a correlation between labour shares and employment across sectors. To this end, we will employ the Spearman's rank correlation between sectoral weighted employment and sectoral labour shares. To compute sectoral labour shares, we employ the procedure in equations (4.6) and (4.7). The results are presented in Appendix 4.1.

4.5. Empirical Results

4.5.1. Accounting Labour Shares

Table 4.4 reports the labour shares in Indonesia as computed by equation (4.2). The time periods reported for the labour shares calculation correspond to the IO data period, i.e. 1971, 1975, 1980, 1985, 1990, and 1995. As seen in Table 4.4, the second column is the labour shares (*LSUNNAS1*) accounting from the UNNAS data, while the third column is from the Indonesian input-output (IO) table, i.e *LSIO1*. As Table 4.4 shows, the labour shares in Indonesia have similar results over time. On average, the share is 0.872 for the UNNAS data and 0.962 for the IO data. The difference between the two means is quite large, i.e. around ten per cent. However, although the labour shares are quite high, they are approximately consistent. The variation is relatively low, i.e. around 2% for both the UNNAS data and the IO data. This small variation suggests that the labour shares were approximately constant over time. The difference between our calculation and

Gollin's is that we computed the labour share over time while Gollin calculated it over countries.

Table 4.4: The Indonesian Labour Shares Using Equation (4.2)

Year	LSUNNAS1[1]	LSIO1[2]	LSUNNAS2[3]	LSIO2[4]
1971	0.857	0.968	0.145	0.315
1975	0.865	0.967	0.151	0.259
1980	0.855	0.988	0.135	0.250
1985	0.927	0.951	0.274	0.288
1990	0.860	0.943	0.230	0.293
1995	0.875[5]	0.953	0.140	0.325
Mean	0.873	0.962	0.179	0.288
Std. Dev.[6]	0.027	0.016	0.058	0.030

Sources: UNNAS (various years), CBS (various years), and author's calculation

Notes:

1. LSUNNAS1 is labour shares computed by using the First UNNAS Approach
2. LSIO1 is labour shares computed by using the First IO Approach
3. LSUNNAS2 is labour shares computed by using the Second UNNAS Approach
4. LSIO2 is labour shares computed by using the Second IO Approach
5. This is my estimate by using the 1993 data
6. Std. Dev. is standard deviation
7. The First (UNNAS and IO) Approach is Operating Surplus is included in Employee Compensation
8. The Second (UNNAS and IO) Approach is Operating Surplus is excluded in Employee Compensation.

As Table 4.4 shows, using this method the labour shares in Indonesia are likely to be grossly overestimated. This is due to the inclusion of the operating surplus in the compensation of employee data and to the fact that *OSPUE* covers both the returns to labour and capital of a private unincorporated enterprise. For this reason, it is very likely that the labour shares in Table 4.4 are too high.

Due to this capital returns counting problem, the next step tries to split the operating surplus from the employee compensation.

The fourth and fifth columns in Table 4.4 show the results.

The labour shares of Indonesia are now significantly smaller than those reported in the second and third columns. On average, the labour share in Indonesia, either *LSUNNAS2* or *LSIO2*, is around 0.2. This share is much lower than the mean value of Gollin's first adjustment findings (2002) of 0.745. However, despite its low estimate, the estimated shares (*LUNNAS2* and *LSIO2*) as seen in Table 4.4 are similar to Yuen's findings (1998) for China (i.e. around 0.26).

The 0.2 finding is indeed too low because we do not count the labour income of self-employed. Nevertheless, the results in Table 4.4 should be viewed as the upper and lower bounds of the labour shares in Indonesia. Also, using either the pooled cross-section and time series data (longitudinal data) or using the time series data, labour shares are mostly constant. For all observations and time periods available in the UNNAS and the input-output data, Table 4.4 shows low variances. The shares are approximately identical. See also Figure 4.1. The changes over time are very small. We deliberately drop some outliers, i.e. sector 10 (ORY), 17 (GOV), 18 (OSV), and 19 (UCM).

So far, we have computed the "rough" estimates of the Indonesian labour shares. The next step is to determine *OSPUE* by applying equations (4.6) and (4.7).

Table 4.5 reports the average value of labour shares of Indonesia broken into the low self-employed sector and the high self-employed sectors. As a comparison, we also compute the average value of the Indonesian labour shares by using the UNNAS data. The aggregate *ECPUE* is obtained by multiplying $\overline{LS4_T}$ with the aggregate operating surplus (OS) such that $ECPUE_T = \overline{LS4_T} \times OS_T$.

As in Table 4.5, the results are now suggestive. A quick look at the data in Table 4.5 reveals that our adjustments appear to change the results. On average, the labour share in Indonesia is around 40% of output value, ranging from 33% to 49%. As seen in Table 4.5, the average values of labour shares for any adjustment are almost identical to the weighted average values. However, the first adjusted labour share (*LS4*) is less reliable than the second adjusted labour share (*LS5*). This is because the operating surplus of private unincorporated enterprises (*OSPUE*) is only included in the *LS5* method. This implies that the labour income of self-employed is likely to be correctly estimated. Therefore, sectors 1 (PDY), 2

Figure 4.1: The Labour Shares in Indonesia, 1971-1995

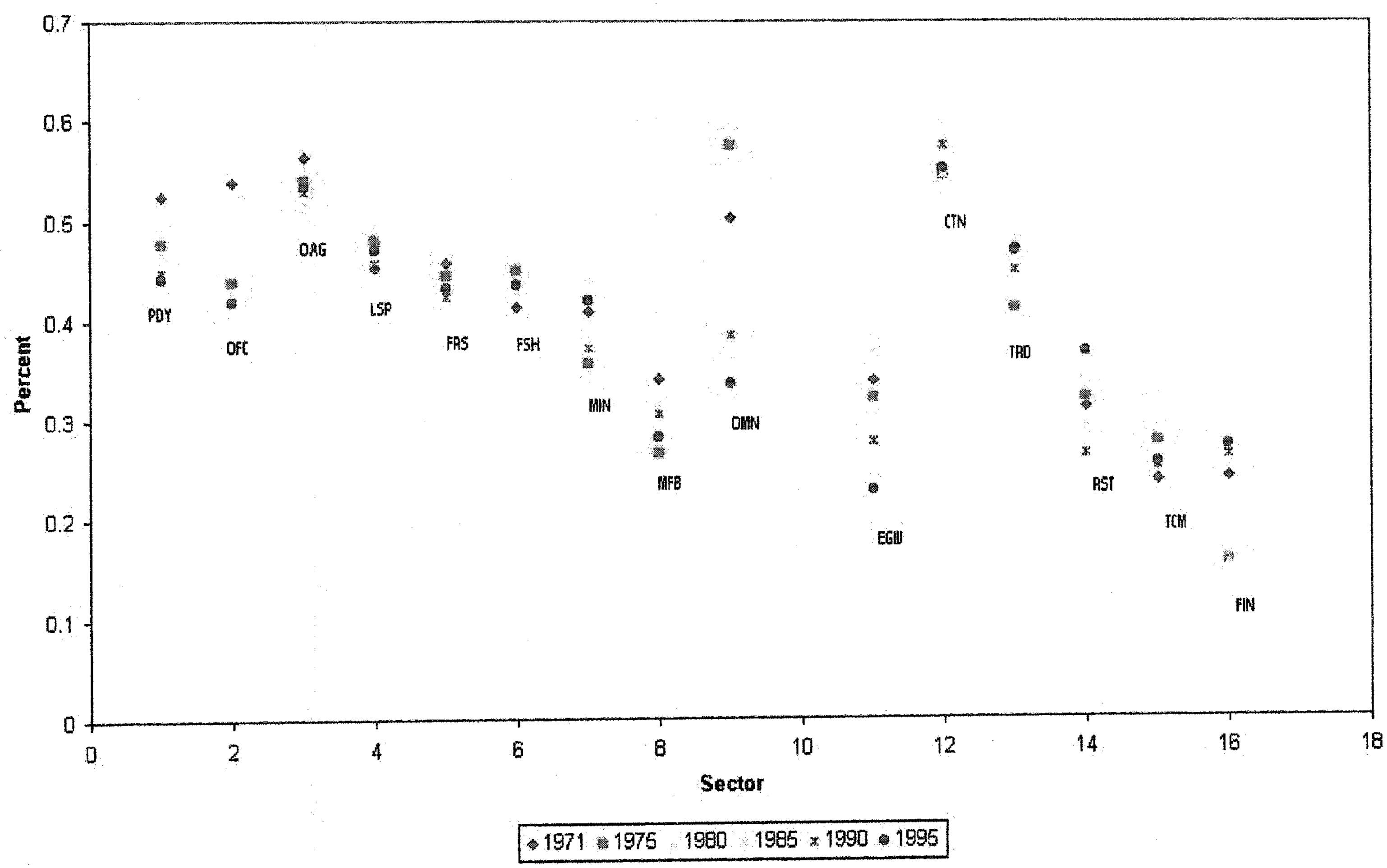

Table 4.5: The Labour Shares in Indonesia, 1971-1995

Period	LS4[1]		LS5[2]		LS6[3]	
	AV[5]	WAV[6]	AV	WAV	AV	WAV
1971	0.360	0.362	0.479	0.488	0.401	0.403
1975	0.352	0.365	0.450	0.423	0.403	0.412
1980	0.341	0.346	0.451	0.421	0.380	0.384
1985	0.327	0.328	0.440	0.422	0.488	0.489
1990	0.333	0.343	0.443	0.429	0.440	0.446
1995	0.328	0.334	0.453	0.452	0.381	0.385
Mean	0.340	0.346	0.453	0.439	0.416	0.420
Std.Dev.[7]	0.014	0.015	0.014	0.027	0.042	0.041

Sources: Author's calculations based on CBS and UNNAS data.

Notes:

1. *LS4* is the labour share based on low self-employment
2. *LS5* is the labour share based on high self-employment
3. *LS6* is similar to *LS5* but using aggregate data (UNNAS)
4. AV is an average value of labour shares
5. WAV is average value of labour share which is weighted by respective sectoral output
6. Std. Dev. is standard deviation.

(OFC), 3 (OAG), 4 (LSP), 5 (FRS), 6 (FSH), 7 (MIN), 8 (MFB), 9 (OMN), 11 (EGW), 12 (CTN), 13 (TRD), 14 (RST), 15 (TCM) and 16 (FIN) are important units in computing labour shares in Indonesia. The low self-employment sectors provide a starting point to estimate the income of the self-employed. By using this estimate, a "more credible" labour share is obtained from the high self-employment sectors.

These findings indicate that some data modification is required to fully employ Gollin's adjustment formulas. This modification is useful to overcome the lack of *OSPUE* data which is a common problem of developing countries. Without any loss of generality, our findings are likely to further complete the application of Gollin's adjustments.

As Table 4.5 shows, on average, the labour share in Indonesia using the *LS5* method is around 45%, ranging from 44% to 48%. This estimate is almost similar to Young's estimate for Singapore (i.e.,0.509). However, our labour estimates in Table 4.5 are much lower than our benchmark country, the Philippines. Gollin (2002) computed the labour share of the Philippines using the first adjustment as 0.800. These differences show that different measures will give different results.

Nonetheless, our methodology has at least two advantages. First, we use detailed information to separate a zero self-employment sector from the data. It is evident that some sectors may contribute high employee compensation but those sectors may have zero self-employed people. Sector 19 (GOV) is an example of this. The employee compensation of this sector certainly reflects the labour income of employed people with no income of self-employed.[22] Thus, the inclusion of this

[22]The employee compensation in this sector contributes approximately 95 per cent of output. The operating surplus in this sector is zero. This implies that most returns to labour are already recorded. This is because GDP in the government sector is just measured by wages.

sector in applying equation (4.2), Gollin's first adjustment, will indeed increase the labour share. Because Gollin's argument is to recalculate labour share by adding the income of the self-employed, it is necessary to exclude a zero self-employment sector from the data.

Another example is sector 10 (ORY). The data of Sector 10 (ORY) is also required to be pulled out. This is because the oil refinery sector also has a zero self-employment component. No one in Indonesia refines oil on their own and sells it for themselves. Oil refining is monopolized by Pertamina, a state owned oil company. Thus, the use of sectoral data is more credible in computing the labour income of the self-employed in Indonesia than the aggregate data.

Second, most of Gollin's sample are classified as developed countries. Although Gollin (2002) argues that labour shares are quite stable across countries, regardless of the levels of income per capita, they certainly decline if a country has very low educated labour. It is evident that, as in Gollin's (2002) findings, Bostwana, a country with low educated labour though rich in minerals (e.g. diamond and gold), has a small labour share (i.e. its first adjustment value is only 0.368). Because Indonesia's labour skills are also very low, it is rational to expect a smaller labour share than Gollin's findings.

Nonetheless, as in Table 4.5, the variation of average values of labour shares in Indonesia is also relatively low, i.e. less than 5 per cent regardless of which adjustment method is used. The results in Table 4.5 also show that there is no significant difference of labour shares between the sectoral data and the aggregate data. This implies that the average values of the Indonesian labour share estimates are fairly constant across sectors and over time.

A quick glance at the scatter plot in Figure 4.1 reveals that the first adjusted labour shares and the second adjusted labour shares across sectors are relatively flat and quite stable. It shows that a low self-employed sector tends to have a lower labour share, while a high self-employed sector has a higher labour share. On a sectoral level, the high self-employed sectors tend to be more stable than the low self-employed sectors. On average, the variance of the high self-employed sectors is below 6%, while that of the low self-employed sectors is over 10%.

4.5.2. Productivity

Using the results reported in Table 4.5, we then attempt to estimate total factor productivity growth in Indonesia. We do not use the results in Table 4.4 because those labour shares are not adequate, i.e they are either too high or too low. The estimates of total productivity growth in Indonesia are reported in Table 4.6. The productivity growth is computed by using equation (4.1). It is also useful to note that because the outcome of the weighted average value and the simple average is almost identical, we will use the simple average of labour shares to employ equation (4.1). Thus, there are three scenarios introduced to compute productivity growth. These are to use *LS6* as the First Scenario, to use *LS4* as the

Table 4.6: Total Factor Productivity Growth Estimates Using Annual Periods (%)

Year	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1983	0.27	-0.40	0.59	3.16	3.65
1984	-0.25	-0.80	0.02	2.12	2.52
1985	-2.02	-1.77	-2.15	-3.13	-3.31
1986	0.74	0.31	0.95	2.62	2.93
1987	-2.91	-2.84	-2.94	-3.18	-3.23
1988	-0.56	-0.97	-0.37	1.18	1.47
1989	-0.18	-0.71	0.08	2.11	2.49
1990	2.12	1.59	2.38	4.42	4.81
1991	1.81	1.28	2.06	4.09	4.47
1992	1.00	0.55	1.22	2.95	3.27
1993	2.75	2.03	3.10	5.85	6.37
1994	1.70	1.31	1.88	3.35	3.63
1995	2.15	1.71	2.37	4.07	4.39
1996	1.55	1.09	1.77	3.51	3.83
1997	0.19	-0.42	0.49	2.86	3.30
1998	-18.14	-18.51	-17.96	-16.53	-16.26
1999	-2.84	-3.08	-2.72	-1.79	-1.61
2000	7.39	7.21	7.48	8.16	8.29

Source: Author's analysis.

Notes:

1. TFP growth in the First Scenario is computed by using *LS6*; the Second Scenario is by using *LS4*; the Third Scenario is by using *LS5*; the Fourth Scenario is by using Gollin's mean value of the first adjustment; and the Fifth Scenario is by using the Philippines Labour Share taken from Gollin's findings (2002). See also Table 4.3
2. The labour shares used in the First, Second, and Third scenarios are the average values
3. TFP growth is computed from equation (4.1).

Second Scenario, and to use *LS5* as the Third Scenario of the labour share estimates.[23] Table 4.6. shows the productivity estimates using the annual growth data as in Chapter 2. However, we deliberately streamline the periods of 1983-2000 so that they are comparable with our alternative productivity estimates which will be discussed in Section 4.6. The complete results for total factor productivity growth estimates using annual data (i.e. from 1968 to 2000) are provided in Appendix 4.2. As seen in Table 4.6, the productivity estimate lies between approximately -18% in 1998 to 8% in 2000, depending on which scenario is used. Meanwhile, Table 4.7 reports the average estimates results of sectoral productivity using the IO data span from 1980-1995. The complete estimates of sectoral productivity growth (for 19 sectors) are presented in Appendix 4.3.

In general, the results of aggregate estimates in Table 4.6 are smaller than sectoral productivity using the 19 sectors data as in Table 4.7. This occurs for at least two reasons. First, it is important to note that the IO data are a quinquennial period. This means that we may not get an actual growth rate when calculating an "annual" sectoral output growth rate. In this context, an "annual" sectoral growth rate from the IO data is simply computed by taking an average between the current IO data period and its previous time period. This average computation certainly yields a discrepancy to the extent that the "annual" sectoral output growth rate

[23]As a supplement, we will also compute TFP growth by using Gollin's mean labour share value of his first adjustment and by using Gollin's labour share estimate of the Philippines.

Table 4.7: Average Estimates of Sectoral Productivity Growth Using Quinquennial Periods and Equation (4.1) for 19 Sectors in %

Time Period	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1980-1985	6.61	6.25	6.82	8.46	8.77
1985-1990	3.46	3.84	3.28	1.85	1.58
1990-1995	10.02	10.15	9.97	9.61	9.54
1980-1995	6.70	6.75	6.69	6.64	6.63

Sources: CBS (various years), Gollin (2002) and author's calculation

Notes:

1. TFP growth in the First Scenario is computed by using *LS6*; the Second Scenario is by using *LS4*; and the Third Scenario is by using *LS5*; the Fourth Scenario is by using Gollin's mean value of the first adjustment; and the Fifth Scenario is by using the Philippines Labour Share taken from Gollin's findings (2002). See also Table 4.3
2. The labour shares used in the First, Second, and Third scenarios are the average values
3. TFP growth is computed from the standard growth model as in equation (4.1).

from the IO data tends to be larger/ smaller than the actual annual output growth rate. In 1995, for example, the Indonesian economy, on average, grew around 14.51% as compared to 1990, while it was only 5.84% as compared to 1994. This means that our annual sectoral growth rate calculated from the IO data tends to be larger than that computed from actual annual data. Second, the IO tables actually cover the "good" business cycle in the Indonesian economy. Thus, it is rational to have a high output growth rate within our sample period. That is why because our "annual" sectoral growth rate is higher than our actual annual growth rate, our average productivity estimates in Table 4.7, which use the IO data, are much larger than our aggregate estimates in Table 4.6, which use the annual data.

The positive sign of productivity growth simply indicates that output is increasing faster than predicted by the growth of inputs. Hence, technical progress is a source of growth. As seen in Table 4.6, on average, TFP growth computed by using the *LS5* indicates a positive productivity growth in Indonesia. Using the *LS5*, productivity appears to have improved over time with the 0.65 per cent growth per year, ranging from -17.96% to 7.48%. It is also useful to note that the second adjusted labour share (*LS5*) is perhaps a more credible labour share estimate than the first adjusted labour share (*LS4*). This is because we include the labour income of self-employed in the model as suggested by Gollin (2002). Hence, the productivity growth in the third scenario is more credible than the second scenario.

Further, using Gollin's first adjustment result, we also found a positive productivity growth of, on average, 1.43 % in Table 4.6 and 6.64 per cent in Table 4.7. If, however, the Indonesian labour share is estimated to be similar to the Philippines, our benchmark country, the productivity growth in Indonesia will be, on average, 6.63 per cent, as in Table 4.7. Of the first, second, and third scenarios in Table 4.6, the highest productivity growth in Indonesia is around 7 per cent in 2000, while the smallest growth in total factor productivity will be around -18 per cent in 1998. The negative sign clearly indicates that the predicted growth of inputs is greater than output growth. This is perhaps because capacity is not fully utilized or the market is not fully served. In 1998, for example, it is clear that an economic crisis occurred which caused a significant capital flight and a significant fall in economic growth. This crisis ultimately eliminates the positive productivity growth achieved prior to 1997. That is why there is a difference between the mean values of productivity growth in Tables 4.6 and 4.7. In other words, the negative productivity result in 1998 had decreased the average estimates of productivity growth.

Another example is 1985, which has around a -2% productivity growth. It is evident that through the banking deregulation program which stimulated investment, factor inputs grew very fast that year, producing a negative productivity growth. In this period, it seems that the growth in output can be reasonably explained by the increase in factor inputs.

In general, from the third scenario which uses a "more credible" labour share, our findings show that Indonesia has recorded consistently a positive TFP growth except in 1980 and 1985. The average 0.65 per cent productivity growth in the third scenario is somewhat smaller than the findings of Abimanyu and Xie (1994) as well as Hill and Aswicahyono (1994) who found a 1 per cent productivity growth in Indonesia, focusing on the manufacturing sector only. It is, however, useful to note that their time period was only five years, i.e. 1985-1990. Our growth accounting formula is also different from Abimanyu and Xie (1994), who used a log linear method, and from Hill and Aswicahyono (1994), who used a translog method.[24]

The standard error of productivity growth is in general higher when using a quinquennial period (around 10%) than when using an annual period (around 4%). This happens because the annual data period is more stable than the quinquennial data period, which shows the fluctuations across sectors. Meanwhile, the use of operating surplus in equation (4.1) seems to scale up the labour shares approximately tenfold, which means that there may well be systematic differences between wages and operating surplus.

On average, the difference between the means is 5.23 percent. The complete results for the means are provided in Appendices 4.2 and 4.3. This shows that the estimate results between the quinquennial data period and the annual data period yield, on average, a 5 per cent difference. Thus, those results are fairly constant.

4.6. Alternative Measure of Productivity

So far, we have used the growth of capital stock and labour to measure productivity. Burnside *et al.* (1995) argue that overhead costs in capital and the existence of nonproduction labour may affect the interpretation of such results. They state that overhead costs of labour may be around 35% of total labour cost.

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[24]Using the manufacturing data, we found the productivity growth in 1980-1985 to be around 10%.

The existence of overhead capital and labour will ultimately induce a bias in our estimate. In addition, economists such as Lucas (1970) and Bernanke and Parkinson (1991) argued that capital tends to play no role in explaining cyclical movements in output. In other words, the relationship between capital and output is often not very clear because capital may relate to an estimated production function either with the wrong sign or not at all. Hence, a better measure of capital services is required. To remedy this problem, some authors such as Baker and Blundell (1991) and Burnside *et al.* (1995) proposed using energy consumption as a proxy for capacity utilization. In this context, they stated that energy consumption is a good measure for capital services because it is significant to the production function. It is highly correlated with both the real output growth rates and economy-wide hours worked. Thus, using energy consumption as a measure of capital services has an important implication to the extent that capital utilization rates are procyclical (Burnside *et al.*, 1995). In this study, data on energy consumption along with educational attainment are presented in Table 4.8.

Meanwhile, Benhabib and Spiegel (1994) and Barro and Lee (2000) used educational attainment as a proxy for labour input. They contended that human capital, particularly that attained through education, has been emphasized as a critical determinant of economic progress. There are at least two approaches to measure educational attainment. The first approach, applied, for example, by Nehru *et al.* (1995), uses school enrollment rates. But this approach is claimed not to adequately measure the aggregate stock of human capital (see, for example, Barro and Lee, 2000).

Another approach to measure educational attainment is by estimating average years of schooling of the labour force. In this context, Barro and Lee (2000) estimated average years of schooling by taking account of a given level of schooling, say primary, secondary and tertiary. The rationale is that the percentage of the population who have successfully completed a given level of schooling is a good measure to indicate the population's skill and knowledge attainment related with a particular level of education (Barro and Lee, 1993, 1996, and 2000).

Because we have data on population educational attainment at a given level of schooling, the average years of schooling in the labour force is calculated as

$$AYS = \frac{(PRI * 6 + SEC * 10.5 + HIGH * 16)}{POPLF}, \qquad (4.9)$$

where *AYS* is average years of schooling of the labour force; *PRI* is the number of persons graduated from Elementary School; *SEC* is the number of persons graduated from High School; *HIGH* is the number of persons graduated from university; 6 denotes years of schooling in elementary; 10.5 is years of schooling in junior (9 years of schooling) and senior high schools (12 years of schooling), so years of schooling of *SEC* is (9+12) / 2 = 10.5; 16 is years of schooling in university; and *POPLF* is population in the labour force. [See Jorgenson *et al.* (1987) and Barro and Lee (1993 and 2000)].[25] Table 4.8 shows the results.

As in Table 4.8, on average, around 3.6 million Terajoule of energy were consumed in Indonesia from 1982 to 2000. In 1998, for example, this energy was produced from coal (4%), petroleum (45%), gas (21%), electricity (8%) and other energy sources (22%). This shows that petroleum products are the main source of energy in Indonesia. On average, the energy consumption grew by 3 per cent per year.

In Indonesia, as in Table 4.8, the average years of schooling is very low. It is only 4.41 years. This finding is almost similar to Barro and Lee's (2000) estimate of 4 years of schooling for Indonesia in 1995. For the same year, Indonesia's average year of schooling is, however, lower than Malaysia, (7.7 years) and Thailand (5.7 years) (Barro and Lee, 2000). This means that Indonesia's labour tends to have lower skills than other ASEAN countries. In turn, this may result in lower productivity than other ASEAN countries.

In general, the average years of schooling in Indonesia has been growing. It was around 3 years in 1982, and around 6.6 years in 2000. Though Indonesia's labour may have lower skills, their skills may be slightly improved due to the increase in years of schooling.

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[25]There is no significant difference whether we split Junior and Senior High School at the Secondary level or not. The difference is very small (i.e. - 0.26 %).

Table 4.8: Energy Consumption and Educational Attainment, 1982-2000

Year	Encon	gEncon	AYS	gAYS
1982	2968000	n.a	3.024579	5.97
1983	2894694	-2.47	3.067567	1.42
1984	3163041	9.27	3.108642	1.34
1985	3210779	1.51	3.539347	13.86
1986	3679560	14.60	3.995153	12.88
1987	3762352	2.25	4.088947	2.35
1988	3876575	3.04	4.156774	1.66
1989	3965476	2.29	4.22143	1.56
1990	4168948	5.13	4.574601	8.37
1991	2999926	-28.04	4.911764	7.37
1992	3160189	5.34	4.907441	-0.09
1993	3327435	5.29	5.06131	3.14
1994	3498647	5.15	5.354734	5.80
1995	3587912	2.55	5.79698	8.26
1996	4082332	13.78	5.822695	0.44
1997	4104974	0.55	6.086705	4.53
1998	4439858	8.16	6.343805	4.22
1999	4574173	3.03	6.509575	2.61
2000	4712551	3.03	6.574954	1.00
Average	3581805.76	3.03	4.41	4.56

Sources: CBS (various years) and Author's Analysis

Notes:

1. Encon is Energy Consumption in Terajoule
2. gEncon is the growth rate of Energy Consumption in %
3. AYS is Average Years of Schooling
4. gAYS is the growth rate of Average Years Schooling
5. n.a is not applicable
6. The actual educational attainment data are provided in Appendix 4.4.

Based on these results, we may now provide an alternative measure of productivity in Indonesia. As in Table 4.9, from 1983-2000, on average, using the third scenario, productivity growth in Indonesia is estimated around 3.57 per cent.

Table 4.9: Alternative Total Factor Productivity Growth Estimates Using Equation (4.1) in %

Year	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1983	7.69	7.77	7.65	7.34	7.29
1984	-0.41	-1.22	-0.02	3.08	3.66
1985	5.74	4.57	6.31	10.80	11.64
1986	-0.08	-2.17	0.94	8.96	10.47
1987	2.15	1.80	2.32	3.67	3.92
1988	2.46	2.10	2.63	4.00	4.26
1989	5.51	5.21	5.65	6.77	6.99
1990	6.58	5.56	7.08	11.03	11.77
1991	25.82	27.39	25.06	19.02	17.89
1992	1.60	1.20	1.79	3.33	3.62
1993	3.04	2.40	3.35	5.81	6.27
1994	4.55	3.72	4.96	8.15	8.75
1995	7.79	6.96	8.19	11.34	11.94
1996	-2.66	-3.74	-2.13	2.02	2.80
1997	3.73	3.34	3.91	5.40	5.68
1998	-18.12	-19.06	-17.66	-14.04	-13.36
1999	-2.79	-3.22	-2.58	-0.94	-0.63
2000	6.63	6.32	6.78	7.96	8.18
Average	**3.29**	**2.72**	**3.57**	**5.76**	**6.17**

Source: Author's Calculation Based on Table 4.8

Notes:

1. TFP growth in the First Scenario is computed by using *LS6*; the Second Scenario is by using *LS4*; and the Third Scenario is by using *LS5*; the Fourth Scenario is by using Gollin's mean value of the first adjustment; and the Fifth Scenario is by using the Philippines Labour Share taken from Gollin's findings (2002). See also Tables 4.6 and 4.7
2. The labour shares used in the First, Second, and Third scenarios are the average values
3. TFP growth is computed from the standard growth model as in equation (4.1).

This result is higher than the finding in Table 4.6 (i.e.-0.10%). However, if we streamline our data point, i.e. from 1985 to 1995, to compare with our findings in Tables 4.7, using the third scenario, productivity growth in Table 4.9 (6.21%) is similar to the finding in Table 4.7 (6.69%). Thus, we take this fact to be supportive of the argument that movements in capital indeed affect cyclical productivity fluctuations. In fact, an economic crisis in 1998, for example, produced a significant impact on productivity growth when capital enters the estimated production function. Thus, we argue that productivity growth in Indonesia ranges from -0.10 % per year to 6.69 % using the third scenario, the most credible scenario, depending on which data sets are used. Alternatively, using a different set of information, i.e. from 1968-2000, productivity growth is estimated around 0.65%, with around a 4 % standard error, which is almost twice as large as the finding in Chapter 2.

Finally, we show that different data and different methods may yield different estimates. It is clear that differences in coverage, as in Tables 4.6, 4.7 and 4.9, produce different estimates of productivity growth. The IO data sets which cover the good years of the economy in Indonesia evidently give larger estimates than the annual data set which covers most of the entire economic period. For example, the IO data includes Indonesia's 1975 first oil boom which ultimately significantly increased economic growth and capital stock, but it excludes the economic crisis in 1997/ 1998 which caused the economy to fall substantially.

Thus, the high productivity sector in the IO data may ultimately affect sectoral productivity in general. In addition, it is also useful to note that we use a regression technique to estimate productivity in Chapters 2 and 3, while in Chapter 4 we compute productivity growth using an accounting method. Thus, different techniques seem to yield different results.[26]

4.7. An Analysis of The Results

The estimate of labour's share is now greater (0.45) than that reported in Chapter 3 (0.11) and much higher than the estimate reported in Chapter 2. The sign of the labour variable is positive, which is consistent with the labour variable in Chapter 3. This means that the use of Gollin's methodology to estimate the labour share is valid.

In general, we need sectoral data to compute the Indonesian labour shares in ways that take into account the labour income of employed people and the earnings of the self-employed. In addition, we also need to pull out some economic sectors which become outliers. For example, a monopolistic sector tends to have no self-employment. The existence of this monopolistic sector certainly raises labour income but it does not provide any additional information on the

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[26]We do not run the regression on the annual data by focusing on 1983 - 2000 only. This is because running a regression on the 1983-2000 data will not have enough degrees of freedom.

earnings of the self-employed. Gollin's formula is mainly intended to correct labour share estimates by accounting for the income of the self-employed. Therefore, we should drop a monopolistic sector. So, if *ECPUE* (or even *OSPUE*) data do not exist, sectoral data is required to apply Gollin's methodology.[27]

Although our labour share estimate now looks higher, it is smaller than any other Asian countries such as Singapore (0.509), Hongkong (0.628), South Korea (0.703) and Taiwan (0.743) (Young, 1995). The low labour shares in Indonesia are, however, not very surprising for two reasons. First, it has become widely accepted in recent years that labour shares in poor countries are lower than in rich countries, mainly due to a difference in technology (Gollin, 2002). In addition, the characteristics of employed (and self-employed) people in poor countries are mostly unskilled and low education. This discrepancy induces lower wages in poor countries than in rich countries. Second, accounting for labour shares certainly requires consistent and detailed micro data. For poor countries, such as Indonesia, such consistent data may be very difficult to obtain. That is why, because the information is not identical, the results of labour shares between poor and rich countries may also differ. For example, Young's approach of imputing wages of the self-employed is very innovative and stimulative. But his approach is not

[27]Because of this reason, we have to drop the oil sector when computing labour shares in Indonesia. Since we do not include the oil sector as having a zero self-employment, we may treat *LS4* as a lower bound of the Indonesian labour share.

practical for Indonesia because neither the Indonesian economic census nor the labour force survey explore specifically information on self-employment. Hence, because we use a different angle to account for labour shares in Indonesia, the results may not be the same as for other countries.

Using *LS5*, productivity growth is indeed a determinant of growth. It contributes 0.65% to sectoral growth. (See Appendix 4.2.) This finding is higher than our previous productivity variable, which was around 0.31% in Chapter 2. The positive sign indicates technical progress that created by the diversion of resources from current productive activity evidently advances economic activities in Indonesia. This progress may take the form of the introduction of new products or new methods or even the technological transfer from the outside world to Indonesia.

The trend of productivity growth in Indonesia declined from 1971 to 1985, then increased from 1990 to 1995. This clearly implies that oil exports may also affect productivity growth. It is useful to note that in the 1970s, oil exports contributed significantly (on average around 50 per cent) to government revenues. Oil exports are likely to have a positive impact on productivity growth. In the mid-1980s, the decline in oil exports which resulted in negative productivity growth encouraged the Government to switch its policy from oil export dependence to non-oil export development. This switching policy, in fact, was successful in boosting economic and productivity growth. Since 1985, productivity growth has increased from -2% in 1985 to 2.4% in 1995. This implies both oil and non-oil exports are important ingredients of productivity growth.

Using a new method, the study found that economic growth can be attributed mainly to the accumulation of capital and labour. It appears that Indonesia has grown rapidly, but it grew through an extraordinary process in improvement of the factor accumulation (capital and labour). To briefly figure out the growth rates of factor inputs in Indonesia, we can summarize these growth rates from 1983-2000.

Table 4.10: The Growth Rates of Factor Input in Indonesia, 1983-2000

Variables	Variable Label	Growth Rate (%)
Capital Stock	*gK*	5.72
Labour	*gH*	0.48
Energy Consumption	*gEncon*	3.03
Educational Attainment	*gAYS*	4.56

Source: Author's analysis.

Table 4.10 shows that capital services grew, on average, by 3.03% or 5.72% while human capital increased, on average, by 0.48% or 4.56%, depending on which data sets are used. It is evident that technological improvement is not the most important factor. This simply means that different factors, data and methodologies can affect the computation of TFP growth. Gollin's method has indeed corrected the labour shares and TFP growth computation, but the weakness of this method is that it assumes a zero variance in the model. Therefore, it is indeed questionable which measure is best. However, it is not the purpose of the study to judge which method provides better results. It is sufficient for us to note that different measures give different results.

Finally, we found that employment is likely to have a strong relationship with labour shares. A sector with higher employment tends to have increased its labour share. This is rational because given their its low skill, Indonesians tend to work in labour intensive sectors which may be affected by their relatives. It is widely known that Indonesians are socially characterized by having strong family ties and connections. In this context, Kuntowijoyo (1985) states that members of a family are often considered to be a valuable resource for household economic activities.[28] It is not surprising then that, based on their previous work experiences, family members establish their own activities, including economic activities, similar to their parents. For example, people who have worked in the agricultural sector are likely to train their offspring or siblings in the same sector. So, their offspring or siblings may be self-employed in the agricultural sector.

In addition, recently, many young rural people have become less willing to

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[28]They are usually unpaid workers.

work in the agricultural sector. They want to be "city workers", no matter what, although their income in the city may be lower than in the village. However, they will not migrate to the city unless they have friends, siblings or relatives who already work in the city. Given the fact that family ties and connections are certainly significant factors for self-employment in Indonesia, a sector with higher employment would be likely to increase its labour share. This argument seems to be similar to our findings that labour share and employment across sectors are significantly related. This study suggests that it is reasonable to categorize sectors into low employment and high employment to compute labour shares.

The lesson in this study is that factors of productive activity must be taken into account very carefully before we pass judgement on technical progress and factor inputs in growth. In particular, we need to make sure that we precisely compute input growth. For example, we need to recognize that the growth rate of labour inputs is not just the employment growth rate: income of self-employed, as well as the magnitude of the self-employment sector, need to also be taken into account. Otherwise, policy prescriptions may not be well applied.

4.8. Concluding Remarks

Gollin (2002) proposed a new method to compute labour shares. His method is used here because the normal labour share calculation is perhaps not appropriate. His claim was motivated by the fact that employee compensation excludes income from self-employment. To this end, he postulated three alternative adjustments. Of these three adjustments, the first formula seems to be the most practical for Indonesia. The formula uses employee compensation plus the operating surplus of private unincorporated enterprises (*OSPUE*) as the numerator and GDP minus indirect taxes as the denominator. In this study, instead of estimating *OSPUE*, we compute the employee compensation of private unincorporated enterprises (*ECPUE*). To employ this formula, we need to categorize low self-employed sectors and high self-employed sectors. Based on the formula and a sectoral categorization of low and high self-employment, we can then calculate labour shares of Indonesia.

Our primary concern in this chapter has been to compute labour shares as in equation (4.2) and hence, productivity in Indonesia. Given the data availability, we found that labour shares in Indonesia vary from 0.327 to 0.479 depending on which information is used, the *LS4* or the *LS5*. This is the range which Young (1995), Yuen (1998) and Gollin (2002) find. Using the difference between two means, we also found that the cross-section and time-series labour shares are fairly constant.

The study ultimately extends the application of the labour share to examine whether there is a relationship between labour share and employment across sectors. To do this , we use Spearman's rank-order correlation. The study concludes that the Indonesian labour shares and employment across sectors are strongly correlated. On average, the correlation is around 70 per percent.

Using five alternatives of the labour share estimates including *LS4*, *LS5* and *LS6*, Gollin's third adjustment and the benchmark country (the Philippines) estimates, the study computes productivity in Indonesia. Depending on which alternatives are used, total factor productivity growth in Indonesia using equation (4.1) varies. Using the third scenario, for example, it lies between - 17.96 per cent in 1998 and 7.48 per cent in 2000.[29] The negative estimate is clearly indicative of the essence of sectoral factor input growth in the model and is meant to show what can be accomplished at the sectoral level given the current state of Indonesian data.

Finally, further studies on self-employment such as country- informal sector surveys are required to provide an empirical analysis of the "true" pattern of self-employment. This pattern is useful to categorize economic activity units into low self-employed and high self-employed sectors. In addition, to reduce over-interpretation of the results for the capital stock, an energy consumption computation is required to be extended to cover the entire economic period of 1968 - 2000. This assumes the returns to scale of energy consumption to be roughly constant. Hence, energy consumption data may yield a better measure of capital services than capital stock data.

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[29]This wide variance suggests the economic crisis in 1998 contributed a large negative impact of productivity growth to economic growth in Indonesia.

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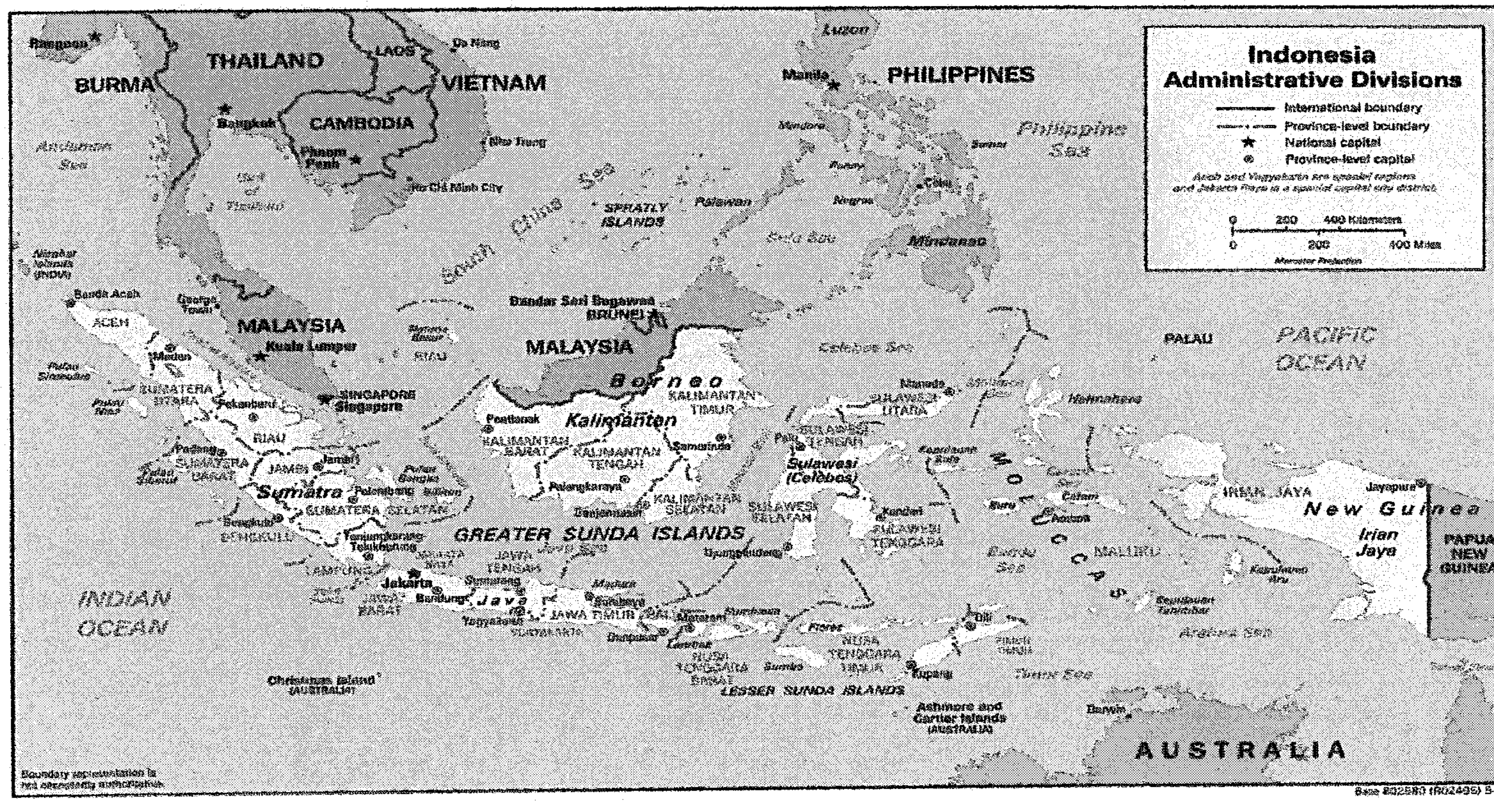
APPENDIX 1: THE INDONESIAN OIL PRODUCTION

Appendix 1.1: Map Of Indonesia



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Appendix 1.2: An Overview of Indonesian Oil Production

1.2.1. Introduction

The purpose of this section is to introduce the settings and the underlying regulations on Indonesia's oil production. The discussion of oil production development in Indonesia in this section is primarily based on Pertamina: Dedicated to the Country (1996) and Barlett III *et al.*(1972). This Pertamina manuscript briefly provides a historical overview of Indonesian oil production since the colonial era.

1.2.2. Historical Settings

The discovery of commercially exploitable oil in the Netherlands East Indies (N.E.I)[1], now Indonesia, was accidentally made by a Dutchman, Aeilko Jans Zijker, in 1883, although oil from natural seepages had been used by local people for many centuries. At that time, Zijker's curiosity was aroused upon seeing a watchman light a bamboo torch that had been dipped in a nearby pond, after he had been overtaken by heavy rains as he was inspecting the tobacco fields that he managed near Langkat, North Sumatra. When he inspected the pond the next morning, he recognized the smell of lamp oil. Then in June 1885, the first

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[1]The Dutch name was the Netherlands Oost Indie.

commercial volumes of oil were exploited in Telaga Tunggal (Pertamina, 1995).[2] With interest in the region's oil increasing rapidly, the Royal Dutch Company was formed on 16 June 1890 to produce and refine oil (Barnes, 1995, p.4).

Another early company was Shell Transport and Trading Company, which found oil in East Kalimantan and set up a small refinery in Balikpapan in 1894. Oil was also found, produced, and refined in other regions of Indonesia such as South Sumatra, Central and East Java, and other parts of Kalimantan by the early 1900s. By 1907, the two companies, Royal Dutch, as the leader in production and refining, and Shell, as the leader in transportation and marketing, had merged into the Royal Dutch/ Shell group of companies, now known as "Shell" (Pertamina, 1995). In 1910, Shell's domination of the oil industry in N.E.I. was completed with the purchase of all remaining independent producers.

In 1907, after the official reception of the East Indies Mining Law of 1899 by the Governor General, the first general mining legislation was introduced into the Netherlands East Indies. Its provisions paralleled the contractual principles then governing petroleum concessions in the Middle East. All mineral rights were vested in the N.E.I government, which was authorized to grant full ownership rights to foreign companies. The 1907 concessions had evidently persuaded the US companies to obtain concessions from the very early days and eventually, after

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[2]The official name is Telaga Tunggal no. 1 (the Lake of Tunggal no. 1).

threats of counter action against Dutch companies in the United States, these restrictions were relaxed. Hence, California Texas Oil Company, then known as Caltex, jointly owned by Standard Oil of California and Texaco, and Standard Vacuum Petroleum, then known as Stanvac, jointly owned by Standard of New Jersey and Socony Vacuum (later known as Mobil), were firmly established in Indonesia as producers and refiners well before the Second World War.

During World War II, most of the N.E.I. oil facilities were destroyed by the Dutch to prevent the facilities from being used by the Japanese. Indeed, the Second World War and the Japanese occupation took a heavy toll. By 1946, for example, crude oil production had fallen to a low point of 5,700 barrels per day (bpd) and the refineries were in chaos (Barnes, 1995, p.5).

The Japanese occupation, though costly in human terms and in damage to the oil industry, was a benefit for Indonesians in terms of obtaining valuable experience. When the Japanese invaded the N.E.I, they tried to rehabilitate the oil fields and refineries because Indonesia's oil was vital to the Japanese war effort and Japan's fighting equipment. During the war, the Japanese operated the refineries at full capacity and drilled many development wells in known oil fields to get the oil out faster. They also drilled the discovery well of the giant Minas oil field in Riau whose location had been prepared by Caltex in late 1941. Since they did not have adequate experience in the oil business, they made maximum use of the few well-trained Indonesians, as well as Dutch prisoners. They also established two oil training schools for Indonesians. These schools ultimately had the beneficial effect of enabling many Indonesians to gain experience in oil field and refining operations, which subsequently helped lay the foundation for the post-war national oil industry.

Prior to 1945, Indonesia dominated oil exploration in the Far East, where 75 per cent of crude oil supply came from Indonesian wells. By 1939, for example, crude oil production in Indonesia had reached 170,000 bpd and total refining capacity was about 180,000 bpd (Barnes, 1995).[3] But, because of over-exploitation by the Japanese, along with their lack of good practices in drilling, the country's oil reserves were drastically depleted. This condition, together with the discovery of oil fields in other countries, changed the Indonesian domination of oil in Asia. In 1993, for example, Indonesia ranked only fifteenth among world oil producers with 2.3 per cent of the world's daily production. Then, in 2000, Indonesia's rank dropped to seventeenth with 1.9 per cent of the world's production (Embassy of the USA, 1998 and 2001). Recently, Indonesia's oil reserves have been estimated at approximately 9.6 billion and its production capacity at around 1.4 million bpd (Embassy of the USA, 2001).[4]

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[3]On average, in 1940s the oil production was 62 million barrels per year (Pertamina, 1996).

[4]Indonesian oilfields are mainly characterized by small but numerous fields requiring a large number of wells to be drilled to get oil. There are well over 300 fields producing oil in Indonesia. From all fields, only 28 fields have a production of over 10,000 bpd, which together make around 80 per cent of total production (Barnes, 1995).

1.2.3. The Underlying Policies

After the successful commercial exploration in North Sumatra, oil was mined in other areas such as South Sumatra, Central Java, East Java and Northeast Kalimantan[5] by three multinational companies- Caltex, Shell and Stanvac, later known as the "Big Three" multinational companies. These "Big Three" companies signed "let alone" agreements on oil exploitation with the Dutch colonial government which gave them exclusive rights to explore, develop, process and market N.E.I.'s oil, in return for less than 50 per cent of their profits. Such an agreement later became known as a concession (Woo *et al.*, 1994, p.55).

After 1945, the Government of Indonesia attempted to annul the existing concession agreements and the East Indies Mining Law, both of which were said to conflict with the new state constitution, known as *Undang-Undang Dasar 1945* (the 1945 Constitution) of the Republic of Indonesia.[6] Sections 2 and 3 of Article 33 of the 1945 Constitution clearly stated that:[7]

> Branches of production which are important to the state and which affect the life of most people, shall be controlled by the state. (Section 2)

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[5]For the location of regions, a map of Indonesia is provided in Appendix 1.1.

[6]Indonesia declared its independence on 17 August, 1945.

[7]In August 2002, the People's Consultative Assembly completely revised the 1945 constitution.

and,

> Land and water and the natural resources therein shall be controlled by the state and shall be exploited for the greatest welfare of the people. (Section 3)

In other words, the new constitution made the state the sole owner of all natural resources in the country, with full control over their exploitation and development. Hence, the oil reserves became government property, to be exploited for the greatest welfare of Indonesians.[8] Indeed, Article 33 of the 1945 Constitution of the Republic of Indonesia was interpreted by many as having annulled all the agreements made by the Dutch colonial Government.

However, the Netherlands government refused to recognize the new state with its own constitution. In 1947 and 1949, the Netherlands armed forces launched a full-scale military offensive against this new government. The offensive, however, was not successful.

In the 1950s, foreign exploitation was eliminated by nationalizing all foreign, particularly Dutch, enterprises. This "anti- foreign exploitation" was certainly destabilizing to the economy (Woo *et al.*, 1994). Many foreign companies stopped their operations and moved out of Indonesia because the

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[8]Although since 1999 the People's Consultative Assembly (Majelis Permusyawaratan Rakyat) of the Republic of Indonesia has attempted to modify the 1945 Constitution, Sections 2 and 3 of Article 33 have not been changed.

Government of Indonesia revoked all prior agreements/contracts with the Dutch colonial government. This withdrawal of businesses ultimately forced the Government of Indonesia to honor the existing contracts of the colonial government. This "honor" policy eventually attracted the Big Three companies to return, continuing the exploitation of oil in the country.

Nevertheless, these colonial contracts, or concessions, contained some flaws. Many Indonesians even accused the oil companies of exaggerating their costs in order to keep profits low, since the Government shared in profits not revenues. Reportedly, the Big Three were actually earning up to five times as much as they reported. In the 1950s, a Japanese group offered to pay Rp 950 per ton of crude oil, while the Big Three was paying only Rp 100 per ton (Barlett III *et al.*, 1972). Therefore, on 2 August 1951, the Indonesian parliament passed a motion to urge the Government to form a commission to scrutinize oil and mining problems. In addition, the parliament also asked the Government to postpone the granting of any new concessions and exploration permits until the newly established state commission on mining could formulate a new national oil policy.

Prolonged debate within the commission over the role of foreign capital delayed the submission of a draft of the mining bill to the Indonesian parliament for ten years. President Soekarno, the first Indonesian president, using his emergency powers, signed the Oil and Mining Law no. 44 in 1960 (Carlson, 1977, pp. 12-14). The law stated that oil and natural gas mining is to be conducted by the state and a company may be authorized to engage in oil mining on behalf of the state. The introduction of the Oil Mining Law no. 44/1960 actually specified unambiguously that the mining of oil and gas resources should be undertaken by the state and carried out solely by a state enterprise. This principle, together with the revoking of the concession rights of foreign oil companies, was a major milestone in the policy of state control in the oil (and gas) industry in Indonesia. The foreign oil companies were then told, although with difficulty, to adjust their operations to the terms and conditions of this Law in a short period of time.

To avoid stagnation in the exploration and development of oil reserves, as well as to meet the new regulation, the Government took over three existing, small, indigenous private oil companies, P.T. Permina (P.T. Perusahaan Minyak Nasional or National Oil Incorporated), P.T. Nglobo and P.T. Permindo (P.T. Perusahaan Minyak Indonesia or Indonesian Oil Incorporated) in 1961.[9] Then, in August 1968, by Law no. 28/ 1968, P.N. Permina and P.N. Pertamin were merged into one national oil company, i.e., P.N. Pertamina (P.N. Pertambangan Minyak dan Gas Bumi Nasional or the National Oil and Gas Mining State Company). Later, the

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[9]P.T. stands for Perseroan Terbatas (incorporated company). The majority (51% of total shares) of the shareholders determine who is the owner of the company, i.e., either private or government (state). The Government took over P.T. Permina to be P.N. Permina and P.T. Permindo became P.N. Pertamin (P.N. Perusahaan Tambang Minyak or the Oil Mining State Company). The GOI also changed P.T. Nglobo to become P.N. Permigan (the National Oil and Gas State Company). P.N. stands for Perusahaan Negara or the State Company.

Pertamina Law no. 8/ 1971 was passed in 1971, effective January 1, 1972; this established a new incorporated company, "Pertamina", i.e., P.T. Pertamina (P.T. Pertambangan Minyak dan Gas Bumi Negara, or the State Oil and Natural Gas Incorporated Company).[10]

The functions of Pertamina, according to Article 6 of Law no. 8/ 1971, are

1. the enterprise operates in the field of oil and natural gas exploration which covers exploration, exploitation, refining and processing, transportation and marketing

2. with the approval of the President of the Republic of Indonesia, expansion of the fields of operations may be undertaken, insofar as they are still related to the oil and natural gas exploitation as referred to in paragraph (1) of this article, and are based on the budget, annual working program, and investment plan.

This Pertamina Law clearly specified that Pertamina would become the sole supplier in the Indonesian oil industry. In practice, the new law also showed the central role of the state in the contractual arrangements for oil and gas

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[10]From now on, P.T. Pertamina shall be referred to as Pertamina.

development and the activities of Pertamina to be very clear (Barnes, 1995, pp. 143-145).

As the new law was issued, it took three years of negotiation before the Big Three (i.e. Caltex, Shell and Stanvac) relinquished their rights under the "let alone" agreements and became contractors to Pertamina; the contractors received thirty- year work contracts on the former concessions and on the new exploration areas (Woo *et al.*, 1994, p. 56). The profit split was changed from 50-50 to 60-40 in the government's favor, and the Big Three agreed to withdraw from refining and marketing activities. In addition, although the work contracts had a shorter duration than the concession agreements, and the geographic areas they covered were not large, the foreign contractors still retained management control and control of technical decisions (Carlson, 1977, pp. 14-17). Indeed, this was an important effort by Pertamina to modernize the agreements with its counterparts, as opposed to directly revoking the "let alone" agreements which were imposed by the Dutch colonial government.

In 1966, the government set up a type of agreement between Pertamina and its contractors known as a Production Sharing Contract (PSC). In a production sharing contract, Pertamina has management control (if it chooses to exercise it) and the split in profits between the state and the foreign companies is based on production output.[11] This type of PSC agreement seemed much fairer than a concession agreement, since it avoids a "mark-up" of the cost of production or a "lowering" of profits as in concessions. With this radical departure from the contractual arrangements existing in other parts of the world, PSC agreements gave a shared responsibility to both parties, i.e., Pertamina and its foreign partners.[12]

Further, since 2001, Pertamina's roles in managing Production Sharing Contracts (PSC) with its counterparts and any other type of oil arrangements have been replaced by an Oil and Gas Implementation Agency (Badan Pelaksana Minyak dan Gas), while its role in regulating oil prices in the domestic market has been taken over by an Oil and Gas Regulatory Agency (Badan Peraturan Minyak dan Gas). In this respect, the Indonesian Parliament issued the new Oil and Gas Law no. 22/ 2001 on October 23, 2001. The new law replaces the Oil Law no. 44/ 1960 and the Pertamina Law no. 8/ 1971. Though the new law revokes some of Pertamina's controls in the oil industry, Article 33 of the 1945 Constitution still requires the GOI to continue its role in the management of Indonesia's energy sector (Embassy of the USA, 2001).

In this study, there will be no further discussion of the institutional

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[11]PSC allows for 30 years exploration and production of oil. Under PSC, the profit-sharing split is on a net income basis of 85/15 in favor of the Government of Indonesia.

[12]This PSC agreement was then adopted by OPEC.

framework for oil because our focus is on how oil stimulates growth and this is largely unrelated to the organization and structure of the industry. In addition, the new agencies, i.e., the Oil and Gas Implementation Agency (Badan Pelaksana Minyak dan Gas) and the Oil and Gas Regulatory Agency (Badan Peraturan Minyak dan Gas) which will replace Pertamina's roles in managing oil resources and regulating oil prices in the domestic market, have not been completely set up.[13] Though the oil authority has changed from Pertamina to the new oil agencies, existing PSC's will be grandfathered and remain in effect until the originally scheduled expiration of the contract (Embassy of the USA, 2001).

1.2.4. Indonesia and OPEC

No discussion of Indonesian oil can be separated from the importance of international markets. In the 1990s, there was a buyer's market for oil in international markets. For an oil producer, one practical marketing strategy to overcome this problem is to cut production to maintain stable and fair prices. However, such action from Indonesia alone, for example, would have virtually no effect on international supply because of Indonesia's small share (around 2%) in the world market.

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[13]Under Goverment Regulation number 31/ 2003, Pertamina becomes a new state owned company which only focuses on supplying oil, not on regulating oil prices or setting up oil contracts. See http://www.pertamina.co.id.

A buyer's market usually keeps the international prices of oil unstable and low. These unstable and low prices certainly do not yield any economic advantage for the exporting countries. For this reason, in September 1960, in Baghdad, Iraq, some exporting countries such as Iran, Iraq, Kuwait, Saudi Arabia and Venezuela founded an organization known as the Organization of Petroleum Exporting Countries (OPEC). OPEC is a permanent, intergovernmental organization. Indonesia joined OPEC in 1962.[14] Other OPEC members are Qatar (joined in 1961), Socialist Peoples Libyan Arab Jamahiriya (in 1962), the United Arab Emirates (in 1967), Algeria (in 1969), and Nigeria (in 1971).[15] Equador and Gabon which became OPEC members in 1973 and 1975, respectively, had their membership suspended in 1992 (for Equador) and in 1995 (for Gabon) because of economic and production constraints.

The reasons for being OPEC members are[16]

A. the need to secure revenues from oil exports

OPEC was initially established in response to declining oil prices in international markets. OPEC's objective is to co-ordinate and unify

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[14]These five countries were then also known as the Five Founding Members.

[15]Though the lower bounded concept in oil production is nebulous, a country is eligible to be an OPEC member if its oil production accounts for at least 1 per cent of the total world production.

[16]See Carlson (1977), Grayson (1980) and http://www.opec.org.

petroleum policies among member countries in order to secure fair and stable prices for petroleum producers, an efficient, economic and regular supply of petroleum products to consuming nations, and a fair return on capital to those investing in the industry. To do so, OPEC utilizes a production quota to arrange international supply. This quota strategy was successful in the 1970s when the international price of oil jumped over 600%, from US$1.70 to US$ 12.60 a barrel. The increase of international prices has indeed benefitted the oil producing countries. With almost 40% of the world market, the OPEC strategy is also supported by IPEC, the Independent Petroleum Exporting Countries[17], which includes Mexico, the Russian Federation and the Sultanate of Oman.[18]

B. the need to protect producing countries from multinational oil firms

When OPEC was founded by the Five Founding members, it was also intended to counter the power of multinational firms that enjoyed concessions given by previous regimes within their territories. Thus, the common interest among the members is the necessity of protecting themselves when exploiting their national resources in order to maximize

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[17]IPEC is a "group" of individual petroleum exporting countries. This group is not formally structured.

[18]The quota strategy was effectively imposed in the 1970s, 10 years after OPEC was founded.

their gains.

C. the need to share experience

All OPEC members are unlikely to be able to exploit their oil resources without the assistance of foreigners and accordingly, their oil industry is usually in the hands of large, foreign oil companies. In this context, the cartel sprang up in reaction not only to price manipulation by multinational corporations but also the high dependence of OPEC members on the same companies for exploration, transportation and marketing of their hydrocarbons.[19] Therefore, OPEC members need to share their experiences when engaging in agreements with any multinational firms to avoid repeating mistakes. For example, prior to 1970, the agreements between OPEC members and their foreign partners were usually based on concessions. Then, post-1970, OPEC adopted Indonesia's experience with the contractual agreements known as Production Sharing Contracts (PSC). This sharing of experience can be used in the case of oil because the operation of the oil industry is basically similar everywhere. Consequently,

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[19]Mexico refused to join OPEC because not only has this country relied less on oil revenues for its development programs but also it has been gaining experience and know-how since the late 1930s (Grayson, 1980). It is also important to note that the US Trade Act of 1974 awarded preferential tariff and special treatment on exports to some non-OPEC producers when they sold oil to the US market as a partial retaliation against the 1973-1974 oil embargo from OPEC.

the problems dealt with or the disputes that have arisen between a host country and a foreign operator are often identical across OPEC member nations.

D. the need to reduce price differences

It is reasonable for OPEC members to want to reduce the problem of price differences. To do so, there is a coherent price structure for OPEC members. With such a price structure, it was expected that there would no longer be any incentive for buyers to shift from one source of supply to another. In other words, no one country could be adversely affected relatively more or less than any other country by short-term shifts in the demand for total OPEC crude.

From these four common interests, joining OPEC is likely to give the member a better bargaining position and a wider knowledge transfer when negotiating oil production and marketing with its partners.

Although OPEC in some cases has been successful in maintaining fair and stable prices in international markets, the survival of this cartel is indeed questionable because assigned quotas have been frequently ignored by members. Nevertheless, to stabilize the oil market, almost every three months, OPEC's

Ministerial Monitoring Committee (MMC) has a meeting to determine the appropriate production ceiling. This OPEC production ceiling is then broken down into members' production ceilings known as production quotas. The decision on the amount of a member's quota in terms of relative share of the overall production ceiling is mainly based on proven reserves reported by each member. The member's production is then monitored by the representatives of MMC.[20]

Recognizing that market stability is a joint responsibility of all producers, the MMC often requests individual IPEC members, such as Mexico and the Russian Federation, to participate in its production quota system, particularly if it wishes to achieve a cut-back in supply. Therefore, it is quite often the case that the MMC and individual IPEC members schedule a meeting to review the oil market.[21]

With its small market share (e.g., 1.9% of the world market in 2001), Indonesia gains some benefits from being an OPEC member. As a member with little oil to export but with major reliance on oil revenues for its development programs, Indonesia needs the price in the world market to be stable and high. Therefore, as far as OPEC is able to determine fair and stable prices, the Government of Indonesia (GOI) has always been supportive of OPEC policies.

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[20]See http://www.opec.org.

[21]This can be categorized as collusion. This is "misconduct" which may be a target of US antitrust law. Theoretically, through the potential implementation of extra-territorial antitrust, the US Government may retaliate against OPEC members who depend on the US economy for other goods or markets.

The GOI is likely to obey OPEC's quota because of the fast depletion of its oil reserves, its own production capacity restrictions and its position in the world market.

In terms of oil prices, the GOI faces a dilemma, because oil prices in the Indonesian domestic market are subsidized. This means that as the international price of oil rises, the implicit subsidy for domestic oil rises, i.e., the foregone revenue, from smaller international sales, gets larger. Meanwhile, if the prices in international markets are low, this will directly decrease government revenues from oil exports. Therefore, both high and low world market prices may restrict net oil revenue flows to the government.[22]

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[22]In 2001, the Government decided to change the subsidy program. Prior to 2001, the Government gave subsidies for oil to Pertamina to keep domestic prices low. Since 2001, the monies have been allocated directly to the poor via village heads. But, these monies have been the target of corruption. Up to now, the Government still seeks a sound alternative for this subsidy program.

APPENDIX 2: ALTERNATIVE RESULTS FROM TIME SERIES DATA SET

Appendix 2.1: The Construction of Social Marginal Productivities

This section will figure out social marginal productivities in capital and labour inputs as mentioned in the main chapter. To do so, we need to derive the growth in the Indonesian economy. Consider the following production function

$$Q = f_s(K, H, A) \qquad (2.1.1)$$

where:

1. Q is real GDP
2. f_s is a gross output function, which is homogenous of degree κ in capital (K) and labour (L), and of degree one in productivity (A)
3. K is physical capital services, such that $K = K_w + K_o$

4. H is total employment, such that $H = H_w + H_o$

5. A is a measure of productivity (TFP).

Equation (2.1.1) simply means that real output is a function of factors of production K, H and A respectively.

To estimate social marginal productivities in K and H, we need to set up a model specification. In doing so, we begin with taking a total derivative of equation (2.1.1) with respect to time, to yield

$$\frac{dQ}{dt} = \frac{\partial f_s}{\partial K}\frac{dK}{dt} + \frac{\partial f_s}{\partial H}\frac{dH}{dt} + \frac{\partial f_s}{\partial A}\frac{dA}{dt} \qquad (2.1.2)$$

This means that the change in real output is a function of social marginal productivities with respect to capital (K) and employment (H), multiplied respectively by the change in capital and by the change in employment. Equation (2.1.2) also shows productivity shift factors, namely marginal productivities of TFP multiplied by the change in TFP.

When perfect competition and constant returns to scale prevail, all factors of production are paid their marginal products. Under these circumstances, factor shares can then be defined as

$$\beta_K = \left(\frac{\partial f_s}{\partial K}\right) \left(\frac{K}{Q}\right) \quad (2.1.3)$$

$$\beta_H = \left(\frac{\partial f_s}{\partial H}\right) \left(\frac{H}{Q}\right) \quad (2.1.4)$$

After dividing both sides of equation (2.1.2) by Q and inserting K/K and H/H, denoting $[(dQ/dt)/Q] = gQ_t$, and introducing an error term (ε_{st}), we get

$$gQ_t = gTFP + \beta_K\, gK_t + \beta_H\, gH_t + \varepsilon_{st} \quad (2.1.5)$$

where:

1. gQ_t is real output time
2. $gK_t = [(dK/dt)/K]$ is the growth rate of capital stock
3. $gH_t = [(dH/dt)/H]$ is employment growth
4. $gTFP$ is constant as a measure of productivity growth
5. t is time period of sample, such that $t = 1967, \ldots, 2000$

Equation (2.1.5) shows that the causes of economic growth in Indonesia have three input elements, namely, capital growth, employment growth and technical change. Once we run the estimation of equation (2.1.5), factor shares are observable.

The findings of these social marginal productivities are useful to estimate the efficiency and externality effects of the oil sector as discussed in the main text. In this context, Caballero and Lyons (1992) suggested regressing the aggregate and sectoral data of the growth model to examine variation of the growth in inputs. The difference of parameters in the aggregate and sectoral results indicates the externality effects.

Appendix 2.2: The Complete Data for Growth

Year	gQ	gK	gK_o	gK_w	gH	gH_o	gH_w	gq	gk	gk_o	gk_w	gh	gh_o	gh_w	gP_{1w}	gP_{2o}
1968	12.03	0.31	8.51	0.21	2.10	2.10	2.10	9.69	-1.79	6.24	-1.89	-0.04	-0.04	-0.04	0.14	0.72
1969	7.48	3.80	27.01	3.49	2.12	2.12	2.12	5.21	1.61	24.33	1.30	-0.04	-0.04	-0.04	-0.01	-0.18
1970	8.15	5.79	34.49	5.32	2.13	2.14	2.13	5.85	3.54	31.63	3.08	-0.04	-0.04	-0.04	0.01	0.42
1971	7.00	8.60	65.00	7.42	2.70	2.70	2.70	4.40	5.96	60.99	4.81	0.20	0.20	0.20	0.35	0.00
1972	7.88	9.40	78.87	7.16	0.06	3.00	0.06	5.22	6.70	74.46	4.52	-2.40	0.46	-2.42	-0.03	0.01
1973	9.78	10.35	47.64	8.35	2.74	2.74	2.74	7.06	7.63	43.99	5.68	0.20	0.20	0.20	-0.01	-0.25
1974	8.26	11.05	31.21	9.57	2.98	2.98	2.98	5.61	8.33	28.00	6.90	0.46	0.46	0.46	-0.13	-0.24
1975	6.18	12.36	26.05	11.16	2.65	2.65	2.65	3.65	9.68	23.04	8.51	0.20	0.20	0.19	0.04	0.15
1976	5.99	12.28	23.92	11.12	3.03	3.03	3.03	3.10	9.21	20.54	8.09	0.22	0.22	0.22	0.03	0.06
1977	8.64	10.34	8.05	10.59	2.61	2.61	2.61	5.83	7.49	5.26	7.74	-0.04	-0.04	-0.04	0.00	-0.12
1978	9.21	12.24	3.74	13.16	2.76	2.76	2.76	6.51	9.47	1.18	10.36	0.22	0.22	0.22	0.00	-0.09
1979	7.09	12.62	5.73	13.31	2.41	2.41	2.41	4.53	9.93	3.20	10.60	-0.04	-0.04	-0.04	-0.29	0.58
1980	8.73	12.51	10.37	12.71	2.61	2.61	2.61	6.19	9.88	7.79	10.07	0.22	0.22	0.22	-0.08	0.83
1981	8.15	16.01	13.82	16.21	0.70	3.06	0.70	5.21	12.86	10.73	13.05	-2.04	0.26	-2.07	0.26	1.72
1982	1.10	13.91	18.97	13.46	3.22	3.22	3.22	-1.56	10.91	15.84	10.47	0.50	0.50	0.50	-0.21	1.23
1983	8.45	11.93	17.83	11.39	2.90	2.90	2.90	5.65	9.05	14.79	8.52	0.24	0.24	0.24	0.41	-0.24
1984	7.17	10.51	14.29	10.14	3.11	3.11	3.11	4.45	7.70	11.38	7.34	0.48	0.48	0.48	0.27	1.02
1985	3.48	7.20	10.28	6.88	10.64	2.84	10.65	0.86	4.49	7.49	4.18	7.84	0.23	7.82	0.18	0.70
1986	5.96	8.67	8.56	8.69	2.80	2.80	2.80	3.09	5.73	5.62	5.74	0.02	0.02	0.04	-4.43	-8.23
1987	5.30	8.95	7.80	9.07	9.82	3.00	9.83	2.49	6.05	4.92	6.16	6.89	0.25	6.90	-1.15	-1.04
1988	6.36	8.17	3.56	8.65	2.73	2.73	2.73	3.54	5.30	0.82	5.77	0.01	0.02	0.01	0.60	1.69
1989	9.08	9.15	3.56	9.71	2.02	2.97	2.02	6.20	6.26	0.82	6.80	-0.68	0.24	-0.68	-0.11	58.20
1990	9.00	9.81	4.91	10.27	2.63	2.75	2.63	6.10	6.89	2.12	7.33	-0.10	0.01	-0.13	-0.37	-0.99
1991	8.93	10.03	7.32	10.27	2.94	2.94	2.94	6.38	7.45	4.81	7.69	0.53	0.53	0.54	0.79	0.77
1992	7.22	8.72	7.02	8.87	2.66	2.66	2.66	4.75	6.22	4.56	6.37	0.30	0.30	0.30	0.01	0.76
1993	7.25	8.45	7.63	8.52	-1.19	2.84	-1.19	4.82	5.99	5.20	6.06	-3.43	0.51	-3.43	-0.15	1.70
1994	7.54	7.95	5.82	8.13	2.80	2.80	2.80	5.14	5.54	3.46	5.72	0.50	0.50	0.50	0.01	-0.07
1995	8.21	8.49	3.52	8.90	2.53	2.53	2.53	5.84	6.11	1.25	6.52	0.28	0.28	0.29	0.00	-0.08
1996	7.83	8.78	1.48	9.36	2.67	2.74	2.67	5.21	6.14	-0.99	6.70	0.18	0.24	0.18	-0.01	-0.09
1997	4.70	7.96	2.37	8.36	-0.34	2.51	-0.35	2.16	5.34	-0.11	5.74	-2.76	0.03	-2.76	0.00	-0.11
1998	-13.01	7.67	6.59	7.74	2.65	2.50	2.65	-15.11	5.06	4.02	5.14	0.17	0.03	0.17	-0.03	-0.07
1999	0.31	4.58	17.48	3.70	1.31	2.71	1.30	-2.11	2.06	14.65	1.20	-1.14	0.23	-1.14	0.02	-0.23
2000	10.07	3.53	4.98	3.42	1.13	1.97	1.13	7.98	1.57	2.99	1.46	-0.78	0.04	-0.78	-0.05	-0.10

Source: Author's Analysis

Notes: For the complete variable names, please see Table 2.1

Appendix 2.3: Stationary Test Results Using ADF Procedure

Variables	Variable Labels	ADF Statistics	Mac Kinnon	Explanation
Per Capita Output Growth Rate	grqpc	-4.6772	-4.2826[a]	Stationary
Output Growth Rate	grQ	-4.6363	-4.2826[a]	Stationary
Growth Rate of Per Capita Capital in non-oil sector (*w*)	grkwpc	-3.2124	-2.9665[b]	Stationary
Growth Rate of Capital in sector *w*	grKw	-3.2431	-2.9665[b]	Stationary
Growth Rate of Per Capita Capital in oil sector (*o*)	grkopc	-2.1169	-1.9521[b]	Stationary
Growth Rate of Capital in sector *o*	grKo	-2.0034	-1.9521[b]	Stationary
Capital Growth Rate	grK	-2.9549	-2.6164[c]	Stationary
Employment Growth Rate in sector *w*	ghwpc	-5.5174	-3.6496[a]	Stationary
Employment Growth Rate in sector *o*	ghopc	-7.4114	-3.6496[a]	Stationary
Employment Growth Rate	ghpc	-2.6022	-1.9521[b]	Stationary
Labour Growth Rate in sector *w*	gtwwork	-2.7132	-2.6369[a]	Stationary
Labour Growth Rate in sector *o*	gtowork	-3.1718	-2.9558[b]	Stationary
Labour Growth Rate	gtwork	-5.1925	-3.6496[a]	Stationary
Real Prices Growth in sector *w*	gP_{1W}	-5.6631	-3.6422[a]	Stationary
Real Prices Growth in sector *o*	grP_{2o}	-4.9429	-3.6422[a]	Stationary

Source: Author's Analysis

Notes: a, b, and c indicate 1%, 5% and 10% level of significance respectively. The tests include T (constant and trend) option.

Appendix 2.4: First Stage Regression

Table A.2.4.1: All Instrument Variables

Instruments Variables	Instruments Labels	Endogenous RHS Variables		
		gK_w	gK_o	gK
Labour Growth Rate in sector *w*	gH_w	0.0074 (0.1859)	-0.9332 (1.5583)	
Labour Growth Rate in sector *o*	gH_o	0.0392 (0.0450)	0.3020 (0.4164)	
Labour Growth Rate	gH			-0.0978 (0.1705)
Real Prices Growth in sector *w*	gP_{1w}	-0.0583(0.4455)	-0.6713(3.7517)	-0.1426(0.3676)
Real Prices Growth in sector *o*	gP_{2o}	0.0041(0.0311)	0.2575(0.2638)	-0.0069(0.0286)
A 1982 Dummy Variable	D^{82}	-0.6219 (2.1260)	6.5326 (16.8903)	-0.4771 (1.9510)
A 1998 Dummy Variable	D^{98}	4.3062 (2.2158)[c]	25.4746 (17.9049)	3.7224 (2.1080)[c]
US Growth Rate	usgr	-0.5098 (0.1808)[a]	-0.1800 (1.4230)	-0.5480 (0.1679)[a]
Singapore's Growth Rate	spgr	0.3218 (0.1448)[b]	1.7414 (1.1925)	0.2009 (0.1365)[c]
Japan's Growth Rate	jpgr	0.4003 (0.1623)[b]	2.0544 (1.299)[c]	0.4272 (0.14402)[a]
Political Uncertainty	RIOTS	-0.2402 (0.7125)	6.0262 (6.0801)	-0.6393 (0.6488)
Growth Rate of the World Oil Prices	grwoprp	0.0123 (0.0086)	-0.0458 (0.0763)	0.0106 (0.0078)
Second lag of gK_w	gK_{wt-2}	0.8997 (0.1463)[a]		
Second lag of gK_o	gK_{ot-2}		0.6268 (0.1642)[a]	
Second lag of gK	gK_{t-2}			0.8788 (0.1382)[a]
	Constant	-2.2276(1.8515)	-20.1861 (12.0531)[c]	-0.3234(1.8265)
R^2		0.7345	0.6056	0.7395
F-Statistics (Excluded Instruments)		6.53[a]	4.06[a]	7.45[a]

Source: Author's analysis.

Notes: a, b, and c indicate 1%, 5% and 10% level of significance. gK refers to a model for all sectors as in the appendix. Numbers in parentheses are standard errors.

Table A.2.4.2: The Instruments Without Riots

Instruments Variables	Instru-ments Labels	Endogenous RHS Variables		
		gK_w	gK_o	gK
Labour Growth Rate in sector *w*	gH_w	0.0057 (0.1775)	-0.6552 (1.5321)	
Labour Growth Rate in sector *o*	gH_o	0.0405 (0.0486)	0.2723 (0.4151)	
Labour Growth Rate	gH			-0.1232 (0.1672)
Real Prices Growth in sector *w*	gP_{1w}	-0.5786(0.4348)	-0.6918(3.7498)	-0.1229(0.3668)
Real Prices Growth in sector *o*	gP_{2o}	0.0018(0.0296)	-0.2067(0.2586)	-0.0131(0.0278)
A 1982 Dummy Variable	D^{82}	-0.6734 (2.0704)	8.4919 (16.7663)	-0.6995 (1.9365)
A 1998 Dummy Variable	D^{98}	4.2595 (2.1592)[c]	25.2876 (17.8955)	3.6647(2.1056)[c]
US Growth Rate	usgr	-0.5053 (0.1760)[a]	-0.2181 (1.4218)	-0.5435(0.1677)[a]
Singapore's Growth Rate	spgr	0.3227 (0.1413)[b]	1.6351 (1.1872)	0.2060 (0.1363)[c]
Japan's Growth Rate	jpgr	0.4099 (0.1560)[a]	1.8029 (1.2735)	0.4608 (0.1398)[a]
Growth Rate of the World Oil Prices	grwoprp	0.0122 (0.0084)	-0.0412 (0.0761)	0.0106 (0.0078)
Second lag of gK_w	gK_{wt-2}	0.8938 (0.1418)[a]		
Second lag of gK_o	gK_{ot-2}		0.5961 (0.1612)[a]	
Second lag of gK	gK_{t-2}			0.8782 (0.1381)[a]
	Constant	-2.3736(17576)	-14.6027 (10.6503)	-0.8234(1.7502)
R^2		0.7328	0.5841	0.7395
F-Statistics (Excluded Instruments)		8.20[a]	4.68[a]	8.76[a]

Source: Author's analysis.

Notes: a, b, and c indicate 1%, 5% and 10% level of significance. gK refers to a model for all sectors as in the appendix. Numbers in parentheses are standard errors.

Appendix 2.5: The OLS and 2SLS Results of Equation (2.33)

Dependent Variable: gQ, n=33 (1968-2000)					
Independent Variables	**Labels**	**OLS**		**2SLS**	
		Coefficient	**S.E.**	**Coefficient**	**S.E.**
	Constant	2.7729[c]	1.6026	0.3107	2.4641
Capital Growth Rate in sector *w*	gK_w	0.3219[c]	0.1963	0.6511[b]	0.2881
Capital Growth Rate in sector *o*	gK_o	0.0296[c]	0.0160	0.0506[b]	0.0298
Labour Growth Rate in sector *w*	gH_w	-0.0367	0.1458	0.0432	0.1728
Labour Growth Rate in sector *o*	gH_o	0.0119	0.0252	-0.0168	0.0350
A 1982 Dummy Variable	D^{82}	-8.1604[a]	0.7582	-9.5031[a]	1.0862
A 1998 Dummy Variable	D^{98}	-19.6493[a]	0.5830	-18.9755[a]	0.8796
F_Statistics		20.57[a]		20.95[a]	
Adjusted R^2		0.7858		0.7972	

Source: Author's analysis

Notes: S.E. is robust standard errors; a, b and c indicate 1%, 5% and 10% level of significance, respectively.

APPENDIX 3: ALTERNATIVE RESULTS FROM PANEL DATA SET

Appendix 3.1: The Share of Oil Revenues

Table A.3.1.1: The Share of Oil Revenues in GDP and in Non-Oil Revenues, 1987-2001

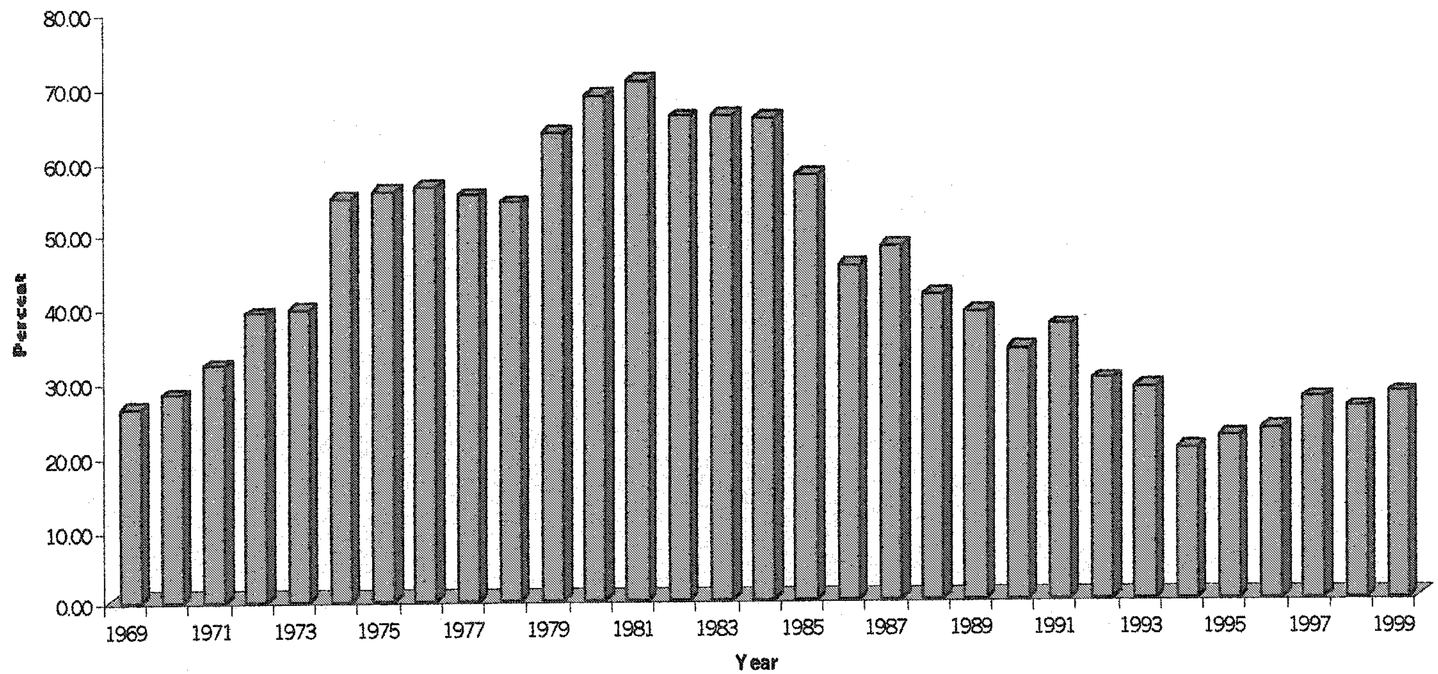
Year	SOGD	SON	GDP
1987	15.94	18.96	94,517.90
1988	13.87	16.11	99,981.40
1989	17.79	17.36	107,436.60
1990	14.87	17.46	115,217.40
1991	14.69	17.22	123,221.00
1992	12.35	14.09	131,184.70
1993	9.98	11.09	329,775.90
1994	8.77	9.61	354,640.90
1995	8.10	8.81	383,792.30
1996	7.95	8.63	413,797.90
1997	7.91	8.59	433,245.90
1998	11.29	12.73	376,892.50
1999	9.78	10.84	379,352.50
2000	14.37	16.79	397,934.40
2001	11.89	15.94	411,132.20

Sources: CBS (Various Years) and Author's analysis.

Notes:

1. SOGD is the ratio of oil revenues and GDP in %
2. SON is the ratio of Oil Revenues and Non-Oil Revenues in %
3. GDP is Gross Domestic Product in the 1993 constant prices.

Figure A3.1.1: The Share of Oil Revenues in Government Revenues



Appendix 3.2: Sectoral Data Conversion

In this study, due to similarities in data compilation, the study employs the 1985 IO table as the control table (or base year). Thus, we will convert sectors based on the 1985 table. This means, for example, five sectors have to be treated carefully in comparing sectoral data for 1980 and 1985. First, sector 07 (Rubber) which in the 1980 table consisted of latex, smoked rubber, and crumb rubber, was split into two sectors in the 1985 IO table. Latex and smoked rubber remained in sector 07 of the 1985 table, but crumb rubber was combined with sector 42. In the 1980 IO table, the latex and smoked rubber output had a 36% share of the whole output of sector 07. Thus, if we take the 1985 table as the base year, we need to reduce the output of sector 07 of the 1980 table by 64% and increase the output of sector 42 of the 1980 table by 64%. These changes also apply to capital, the number of workers and sectoral exports and imports.

Second, sector 15 (Fibre Crops) of the 1980 table contained nutmeg alone. In the 1985 table, sector 15 becomes nutmeg and pepper. In 1980, pepper belongs to sector 16 (Other Estate Crops) and contributed up to 65%. Third, bamboos items, contributing 77% of the whole output in sector 22 (Other Forest Products) in 1980, were reallocated to sector 21 (Wood) in 1985.

Fourth, sector 25(Crude Oil) of the 1980 table included petroleum and

Liquified Natural gas (LNG). In 1985, LNG was moved into sector 41 (Petroleum Refinery). In 1980, LNG contributed 13% of sectoral output. Fifth, sector 49 (Manufacture of Transport Equipment) in 1980 covered the manufacture of transport equipment and its repair. The repair items were transferred into sector 65 (Other Services) in the 1985 table. The contribution of the repair items in sector 49 of the 1980 table was 5%.

There are several sectors to be adjusted in comparing the 1985 and 1990 tables. Sector 2 (Nut Trees) in the 1990 table consists of groundnut, soy beans and other beans. Peeled groundnut, peeled soy beans, peeled and cleaned beans separated from the farm activity are not included in this sector, but in sector 32 (Manufacture of Other Food Products). The Nut Trees sector in 1985 was a part of the other farm food crops sector.

Sector 4 (Root Crops) in 1990 included only cassava and other root crops. Sago, dried cassava and all kind of palm flour were included in this sector in the 1985 table. By 1990 Sago is in sector 6 (Other Food Crops) for Sago and Manufacture of Flour, Dried cassava and all kind of Palm Flour are in sector 30.

Sector 8 (Sugarcane) in the 1990 table consisted only of sugarcane. White brown sugar, which was included in sector 8 of the 1985 table, it was included in sector 31 (Manufacture of Sugar) in 1990.

Sector 9 (Coconut) in 1990 was only for coconut, while in 1985 this sector was coconut and copra. In 1990, copra was included in sector 28 (Manufacture of

Animal/ Vegetable Oil and Grease).

Sector 10 in the 1990 table consisted of palm oil. Vegetable oil, crude palm oil, crude palm kernel oil, which were included in this sector in 1985, were moved into sector 28.

Sector 11 (Tobacco) in the 1990 table consisted of tobacco only. Tobacco leaf, which was included in this sector in 1985, was reallocated to sector 34 (Manufacture of Tobacco).

Sector 12 in 1985 consisted of coffee and peeled & cleaned coffee. But, in 1990, peeled & cleaned coffee was put in sector 32 (Manufacture of Other Food Products). This also applies to sector 13 (Tea).

Sector 15 in the 1990 table was Fibre Crop. Pepper and nutmeg which were included in this sector in 1985, were in the other estate crops sector in 1990.

The coverage of sector 17 (Other Agriculture) has changed. This sector in the 1990 table did not include pecking and cleaning of seeds other than coffee and unseeded kapok. The pecking and cleaning of seeds other than coffee was included in sector 32, while kapok was reallocated into sector 35 (Yarn Spinning).

Sector 44 (Manufacture of Cement) in 1990 only covered cement, while in 1985 this sector included cement and limestone. In 1990, the limestone was included in sector 43 (Manufacture of Non Metallic Mineral Product).

The same procedure also applies for the years 1971, 1975, and 1995. To this end, we use the information provided by the CBS as explained in the respective IO books. Most data (except the labour data) are deflated by the GDP deflator for a given time period.

Appendix 3.3: List of the 66 Sectors

Table A.3.3.1. Code of Sectors and Name of Sectors

Code	Name of Sector	Short Name
1	Paddy	PDY
2	Nut Trees	NUT
3	Corn	CON
4	Root Crops	RTC
5	Vegetable and Fruits	VFR
6	Other Food Crops	HFC
7	Rubber	RUB
8	Sugarcane	SGC
9	Coconut	CCN
10	Palm Oil	OPM
11	Tobacco	TBC
12	Coffee	COF
13	Tea	TEA
14	Cloves	CLV
15	Fibre Crops	FBC
16	Other Estate Crops	HEC
17	Other Agriculture	HAG
18	Livestock	LVS
19	Animal Slaughtering	ANS
20	Poultry and Its Products	PYP

Table A.3.3.1. Code of Sectors and Name of Sectors (continued)

Code	Name of Sector	Short Name
21	Woods	WOD
22	Other Forest Products	HFP
23	Fishery	FIS
24	Coal and Metal Ore Mining	CMM
25	Crude Oil	OIL
26	Other Mining and Quarrying	HMQ
27	Manufacture of Food Processing and Preserving	MFP
28	Manufacture of Animal/ Vegetable Oil and Grease	MVO
29	Rice Milling	RIC
30	Manufacture of Flour	MFL
31	Manufacture of Sugar	SGF
32	Manufacture of Other Food Products	MTF
33	Manufacture of Beverages	MBS
34	Manufacture of Tobacco	MTC
35	Yarn Spinning	YNS
36	Manufacture of Textile and Its Products	MTX
37	Manufacture of Bamboo and Rattans	MBR
38	Manufacture of Paper and Its Products	MPP
39	Manufacture of Fertilizer	MFR
40	Manufacture of Chemicals	MCL

Table A.3.3.1. Code of Sectors and Name of Sectors (continued)

Code	Name of Sector	Short Name
41	Petroleum Refinery	PRY
42	Manufacture of Rubber and Plastics Wares	MRP
43	Manufacture of Non Metallic Mineral Products	MNM
44	Manufacture of Cements	MCE
45	Manufacture of Basic Iron and Steel	MIS
46	Manufacture of Non Ferrous Basic Metal	MNF
47	Manufacture of Fabricated Metal Products	MFP
48	Machineries and Electrical Equipments	MMP
49	Manufacture of Transport Equipment	MTE
50	Manufacture of Other Products	MHP
51	Electricity, Gas and Water Supply	EGW
52	Construction	CTN
53	Trade	TRD
54	Restaurant and Hotel	RST
55	Railway Transport	AIL
56	Road Transport	ROD
57	Water Transport	WTR
58	Air Transport	AIR
59	Transport Supporting Services	TSS
60	Communication	COM

Table A.3.3.1. Code of Sectors and Name of Sectors (continued)

Code	Name of Sector	Short Name
61	Financial Services	FIN
62	Corporation Services	CPS
63	General Government and Defense	GOV
64	Social Community Services	SOC
65	Other Services	OSV
66	Unspecified Sector	UCM

Source: CBS (Various Years).

Table A.3.3.2. Mean and Standard Deviation of 66 Sectors, 1975 - 1995

Code	Short Name	gQNX		gsX	
		Mean	St.Dev.	Mean	St.Dev.
1	PDY	3.91	2.70	0.80	16.39
2	NUT	-2.71	4.13	-2.77	12.42
3	CON	9.50	9.82	-1.15	16.35
4	RTC	4.56	8.66	-2.42	8.39
5	VFR	7.75	4.84	17.48	19.54
6	HFC	7.92	14.42	8.30	25.54
7	RUB	12.01	23.80	-2.47	1.65
8	SGC	10.59	17.66	0.07	22.71
9	CCN	4.30	4.94	1.85	10.73
10	OPM	7.52	16.63	-0.84	12.78
11	TBC	0.91	9.79	0.87	6.53
12	COF	9.26	21.53	-1.07	11.45
13	TEA	4.82	19.91	-1.64	9.39
14	CLV	0.43	6.95	10.37	21.82
15	FBC	11.08	20.03	2.21	10.69
16	HEC	20.88	16.88	-1.85	3.89
17	HAG	9.86	10.51	-0.68	7.51
18	LVS	9.68	10.77	4.11	18.09
19	ANS	13.08	11.44	0.59	12.65
20	PYP	11.50	7.63	10.72	15.05
21	WOD	6.08	12.05	3.16	12.61
22	HFP	4.80	14.25	12.93	10.31

Table A.3.3.2. Mean and Standard Deviation of 66 Sectors, 1975 - 1995

(continued)

Code	Short Name	gQNX		gsX	
		Mean	St.Dev.	Mean	St.Dev.
23	FIS	4.61	9.12	7.50	15.01
24	CMM	15.50	15.43	0.44	3.17
25	OIL	14.64	22.39	0.32	5.34
26	HMQ	15.15	7.94	8.67	8.14
27	MFP	19.89	9.69	5.67	21.60
28	MVO	16.87	21.45	-0.22	12.82
29	RIC	9.71	8.94	10.99	11.02
30	MFL	21.70	18.32	8.97	13.44
31	SGF	12.21	19.55	6.00	13.25
32	MTF	15.93	11.97	4.98	23.49
33	MBS	9.73	14.03	4.38	16.47
34	MCS	12.19	3.65	8.33	20.62
35	YNS	15.56	15.43	12.35	16.99
36	MTX	7.39	14.01	20.45	13.20
37	MBR	14.89	7.30	19.10	16.39
38	MPP	12.53	12.70	10.36	10.19
39	MFR	12.43	9.94	6.53	15.13
40	MCL	14.41	5.19	9.03	7.27
41	PRY	10.26	13.91	3.82	9.80
42	MRP	21.49	13.26	12.77	17.93

Table A.3.3.2. Mean and Standard Deviation of 66 Sectors, 1975 - 1995

(continued)

Code	Short Name	gQNX		gsX	
		Mean	St.Dev.	Mean	St.Dev.
43	MNM	10.97	6.90	11.41	22.35
44	MCE	8.26	7.26	7.77	17.74
45	MIS	17.27	12.23	6.34	23.10
46	MNF	13.23	6.57	2.10	5.42
47	MFP	8.80	5.59	10.07	15.77
48	MMP	11.56	13.16	12.66	22.69
49	MTE	11.19	10.92	8.33	22.51
50	MHP	15.48	14.75	13.73	23.45
51	EGW	10.61	10.12	-1.18	11.65
52	CTN	11.36	2.76	-2.65	10.19
53	TRD	6.45	6.16	5.14	6.74
54	RST	11.16	8.62	15.55	21.07
55	AIL	3.93	9.50	3.27	7.00
56	ROD	5.78	7.44	5.87	9.70
57	WTR	18.71	20.32	-2.28	7.63
58	AIR	14.90	6.51	2.34	11.71
59	TSS	13.38	16.22	6.37	13.39
60	COM	16.70	11.66	11.47	27.45
61	FIN	18.86	7.53	4.77	9.30
62	CPS	14.63	13.31	1.04	13.13

Table A.3.3.2. Mean and Standard Deviation of 66 Sectors, 1975 - 1995

(continued)

Code	Short Name	gQNX		gsX	
		Mean	St.Dev.	Mean	St.Dev.
63	GOV	10.67	6.50	0.00	0.00
64	SOC	15.15	7.79	6.08	7.75
65	OSV	9.16	4.98	14.64	15.48
66	UCM	8.01	19.42	16.71	20.58
Mean		11.08	11.51	5.74	13.69

Source: CBS (Various Years) and Author's analysis.

Notes:

1. gQNX is the output-net-export growth rate (%)
2. gsX is the export share growth rate (%)
3. St.Dev. is standard deviation

Appendix 3.4: Stationarity Test Results Using ADF Procedure

Variable	Variable Label	ADF Statistics	Mac Kinnon	Explanation
Sectoral Output Net-Export Growth Rate	$gQNX_i$	-17.2898	-3.9871[a]	Stationary
Sectoral Capital Growth Rate	gK_i	-15.7214	-3.9871[a]	Stationary
Sectoral Labour Growth Rate	gH_i	-18.2571	-3.9871[a]	Stationary
First Lag of Sectoral Export Share Growth Rate	gsX_i	-14.9589	-3.9871[a]	Stationary
Sectoral Export Ratio	sTX_i	-19.7768	-3.9868[a]	Stationary
Sectoral Import Share	sM_i	-19.1937	-3.9868[a]	Stationary
Sectoral Output Growth Rate	gQ_i	-16.9340	-3.9871[a]	Stationary

Source: Author's analysis.

Notes: a indicates one percent level of significance. The ADF tests show the same results for T, C or N option. However, it is also useful to note that these ADF tests are perhaps not required since our data set is only six-5 year intervals.

Appendix 3.5: The First Stage Regression Results

Table A.3.5.1: The Instruments of Equation (3.7)

Instruments Variable	Label	Endogenous Variable (gK_i)	
		Coefficient	Standard Errors
Sectoral Labour Growth Rate	gH_i	-0.0093	0.0267
First Lagged Sectoral Exports	gsX_{1i}	0.0606	0.0595
Second Lagged Sectoral Exports	gsX_{2i}	-0.0329	0.0534
Sectoral Export Ratio	sTX_i	0.1970	0.1480
Sectoral Import Share	sM_i	-0.0296	0.0386
Second Lagged Capital Growth Rate	gK_{iT-2}	0.0231	0.0577
Japan's Growth Rate	jpgr	0.0987	0.5889
US Growth Rate	usgr	-0.4127	1.0753
Growth Rate of the World Oil Prices	grwoprp	-0.5335^a	0.1488
	Constant	4.7300^c	3.0281
R^2 within		0.1650	
R^2 between		0.0844	
R^2 overall		0.1526	
Wald $\chi^2(4)$ (Excluded Instruments)		41.60^a	

Source: Author's analysis.

Notes: Number of Observation is 264. a and c indicate 1% and 10% level of significance (Z-Score). This estimation is obtained by using OLS procedure without fixed effect.

Table A.3.5.2: The Instruments of Equation (3.8)

Instruments Variable	Label	Endogenous Variable (gK_i)
Sectoral Labour Growth Rate	gH_i	-0.0083 (0.0271)
First Lagged Sectoral Exports Times D^{85}	$D^{85}gsX_{1i}$	0.0808 (0.1272)
Second Lagged Sectoral Exports Times D^{85}	$D^{85}gsX_{2i}$	0.0476 (0.0944)
Sectoral Export Ratio Times D^{85}	$D^{85}sTX_i$	0.3758 (0.2875)
First Lagged Sectoral Exports Times D^{90}	$D^{90}gsX_{1i}$	0.0430 (0.0966)
Second Lagged Sectoral Exports Times D^{90}	$D^{90}gsX_{2i}$	-0.0083 (0.1065)
Sectoral Export Ratio Times D^{90}	$D^{90}sTX_iD$	-0.1190 (0.7826)
First Lagged Sectoral Exports Times D^{95}	$D^{95}gsX_{1i}$	0.1072 (0.0999)
Second Lagged Sectoral Exports Times D^{95}	$D^{95}gsX_{2i}$	-0.0041 (0.0975)
Sectoral Export Ratio Times D^{95}	$D^{95}sTX_i$	0.0850 (0.1877)
Sectoral Import Share	sM_i	-0.0329 (0.0396)
Second Lagged Capital Growth Rate	gK_{iT-2}	0.0212 (0.0585)
Japan's Growth Rate	jpgr	0.0342 (0.5983)
US Growth Rate	usgr	-0.3642 (1.080)
Growth Rate of the World Oil Prices	grwoprp	-0.5120 (0.1490)[a]
	Constant	4.7151 (3.0669)[c]
R^2 within		0.1741
R^2 between		0.0470
R^2 overall		0.1551
Wald χ^2 (4) (Excluded Instruments)		38.89

Source: Author's analysis.

Notes: Number of Observation is 264. a and c indicate 1% and 10% level of significance (Z-Score). Numbers in parentheses are standard errors. This estimation is obtained by using OLS procedure without fixed effect.

Table A.3.5.3: The Instruments of Equation (3.7)-All Instruments

Instruments Variable	Label	Endogenous Variable (gK_i)	
		Coefficient	**Standard Errors**
Sectoral Labour Growth Rate	gH_i	-0.0403	0.0328
First Lagged Sectoral Exports	gsX_{1i}	0.0832	0.0742
Second Lagged Sectoral Exports	gsX_{2i}	-0.0362	0.0647
Sectoral Export Ratio	sTX_i	-0.1790	0.2822
Sectoral Import Share	sM_i	-0.0312	0.0957
Second Lagged Capital Growth Rate	gK_{iT-2}	0.0073	0.0822
Japan's Growth Rate	jpgr	0.2033	0.6510
US Growth Rate	usgr	dropped	
Riots	Riots	dropped	
Singapore Growth Rate	spgr	0.0482	0.2172
Growth Rate of the World Oil Prices	grwoprp	-0.5003[a]	0.0898
	Constant	3.2306	3.2318
R^2 within		0.0216	
R^2 between		0.0879	
R^2 overall		0.0008	
F- Statistics (Excluded Instruments)		9.00[a]	

Source: Author's analysis.
Notes: a indicates one percent level of significance. This estimation is obtained by using OLS with fixed effect.

Table A.3.5.4: The Instruments of Equation (3.7)-Without *Usgr* and *Riots*

Instruments Variable	Label	Endogenous Variable (gK_i)	
		Coefficient	**Standard Errors**
Sectoral Labour Growth Rate	gH_i	-0.0403	0.0328
First Lagged Sectoral Exports	gsX_{1i}	0.0832	0.0742
Second Lagged Sectoral Exports	gsX_{2i}	-0.0362	0.0647
Sectoral Export Ratio	sTX_i	-0.1790	0.2822
Sectoral Import Share	sM_i	-0.0312	0.0957
Second Lagged Capital Growth Rate	gK_{iT-2}	0.0073	0.0822
Japan's Growth Rate	jpgr	0.2033	0.6510
Singapore Growth Rate	spgr	0.0482	0.2172
Growth Rate of the World Oil Prices	grwoprp	-0.5003[a]	0.0898
	Constant	3.2306	3.2318
R^2 within		0.1778	
R^2 between		0.0878	
R^2 overall		0.1237	
F- Statistics (Excluded Instruments)		9.00[a]	

Source: Author's analysis.

Notes: a indicates one percent level of significance. This estimation is obtained by using OLS with fixed effect.

Table A.3.5.5: The Instruments of Equation (3.7)-Without *Spgr* and *Riots*

Instruments Variable	Label	Endogenous Variable (gK_i)	
		Coefficient	Standard Errors
Sectoral Labour Growth Rate	gH_i	-0.0403	0.0328
First Lagged Sectoral Exports	gsX_{1i}	0.0832	0.0742
Second Lagged Sectoral Exports	gsX_{2i}	-0.0362	0.0647
Sectoral Export Ratio	sTX_i	-0.1790	0.2822
Sectoral Import Share	sM_i	-0.0312	0.0957
Second Lagged Capital Growth Rate	gK_{iT-2}	0.0073	0.0822
Japan's Growth Rate	jpgr	0.1895	0.6342
US Growth Rate	usgr	-0.2553	1.1502
Growth Rate of the World Oil Prices	grwoprp	-0.5232[a]	0.0822
	Constant	4.1459	3.5340
R^2 within		0.1778	
R^2 between		0.0878	
R^2 overall		0.1237	
F- Statistics (Excluded Instruments)		9.00[a]	

Source: Author's analysis

Notes: a indicates one percent level of significance. This estimation is obtained by using OLS with fixed effect.

Table A.3.5.6: The Instruments of Equation (3.7)-Without *Riots* and *Grwoprp*

Instruments Variable	Label	Endogenous Variable (gK_i)	
		Coefficient	Standard Errors
Sectoral Labour Growth Rate	gH_i	-0.0403	0.0328
First Lagged Sectoral Exports	gsX_{1i}	0.0832	0.0742
Second Lagged Sectoral Exports	gsX_{2i}	-0.0362	0.0647
Sectoral Export Ratio	sTX_i	-0.1790	0.2822
Sectoral Import Share	sM_i	-0.0312	0.0957
Second Lagged Capital Growth Rate	gK_{iT-2}	0.0073	0.0822
Japan's Growth Rate	jpgr	0.5036	0.6639
US Growth Rate	usgr	5.5738[a]	1.0008
Singapore Growth Rate	spgr	1.1009[a]	0.3406
	Constant	-16.7519[a]	5.2884
R^2 within		0.1778	
R^2 between		0.0878	
R^2 overall		0.1237	
F- Statistics (Excluded Instruments)		9.00[a]	

Source: Author's analysis

Notes: a indicates one percent level of significance. This estimation is obtained by using OLS with fixed effect.

Table A.3.5.7: The Instruments of Equation (3.7)-Without gsX_{2i} and gK_{iT-2}

Instruments Variable	Label	Endogenous Variable (gK_i)	
		Coefficient	Standard Errors
Sectoral Labour Growth Rate	gH_i	-0.0403	0.0328
First Lagged Sectoral Exports	gsX_{1i}	0.0753	0.0726
Sectoral Export Ratio	sTX_i	-0.1901	0.2803
Sectoral Import Share	sM_i	0.0298	0.0914
Japan's Growth Rate	jpgr	0.1614	0.6268
US Growth Rate	usgr	-0.0090	1.0622
Growth Rate of the World Oil Prices	grwoprp	-0.4831[a]	0.1451
	Constant	3.4141	3.2757
R^2 within		0.1763	
R^2 between		0.1270	
R^2 overall		0.1210	
F- Statistics (Excluded Instruments)		12.30[a]	

Source: Author's analysis.

Notes: a indicates one percent level of significance. This estimation is obtained by using OLS with fixed effect. The same F-statistic is also obtained when we include *spgr* and exclude *usgr*. The *riots* variable is dropped.

Appendix 3.6: The Estimation Results of Equation (3.7) Without Second Lag of Export Share Growth Variable

Table A.3.6.1: The Estimation Results

Dependent Variable: Sectoral Output-Net Export Growth Rate (*gQNX*), number of observation= 264, number of sectors= 66				
Independent Variable	**Label**	**OLS**	**OLS, FE**	**2SLS, FE**
		Coefficient	**Coefficient**	**Coefficient**
Constant		9.7520^{a} (0.8102)	9.2027^{a}(1.2357)	8.5868^{a}(1.3371)
The First Lag of Sectoral Export Share Growth Rate	gsX_{1i}	0.0943^{b}(0.0436)	0.1296^{a}(0.0496)	0.1431^{a}(0.0524)
The Sectoral Export Ratio	sTX_i	0.1599(0.1191)	0.4194^{b}(0.2168)	0.4616^{b}(0.2277)
The Sectoral Import Share	sM_i	0.0862^{a}(0.0304)	0.1175^{c}(0.0725)	0.1235^{c}(0.0759)
Sectoral Capital Growth Rate	gK_i	0.3925^{a}(0.0469)	0.4072^{a}(0.0512)	0.6220^{a}(0.1329)
Sectoral Labour Growth Rate	gH_i	0.1069^{a}(0.0215)	0.0985^{a}(0.0247)	0.1085^{a}(0.0264)
Wald χ^2		105.30^{a}		408.38^{a}
F-Statistics			16.96^{a}	
Correlation (τ_i,Xb)		0	-0.1884	-0.2569
R^2 within		0.2966	0.3053	0.2419
R^2 between		0.2737	0.2277	0.2364
R^2 overall		0.2898	0.2753	0.2784

Notes: Numbers in parentheses are standard errors. OLS is an ordinary Least Square without sectoral fixed effects, OLS, FE is an Ordinary Least Square with sectoral fixed effects, and 2SLS, FE is an instrumental variable with sectoral fixed effects. Coeff. is the coefficient estimate, S.E. is robust standard errors; a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. The first stage regression results for instruments selection are presented in Table 3.3.

Appendix 3.7: The First Stage Regression Results for Equations (3.8) and (3.9)

Table A.3.7.1: The Instruments of The 2SLS Estimation in Table 3.8

Independent Variable	Label	gK_i
Constant		4.0210 (2.2702)[b]
First Lag of Sectoral Export Share Growth Rate Times D^{85}	$D^{85}gsX_{1i}$	0.0768 (0.1265)
Second Lag of Sectoral Export Share Growth Rate Times D^{85}	$D^{85}gsX_{2i}$	0.0531 (0.0928)
Sectoral Export Ratio Times D^{85}	$D^{85}sTX_i$	0.3649 (0.2851)
First Lag of Sectoral Export Share Growth Rate Times D^{90}	$D^{90}gsX_{1i}$	0.0468 (0.0958)
Second Lag of Sectoral Export Share Growth Rate Times D^{90}	$D^{90}gsX_{2i}$	-0.0026 (0.1050)
Sectoral Export Ratio Times D^{90}	$D^{90}sTX_i$	-0.1052 (0.7802)
First Lag of Sectoral Export Share Growth Rate Times D^{95}	$D^{95}gsX_{1i}$	0.1077 (0.0997)
Second Lag of Sectoral Export Share Growth Rate Times D^{95}	$D^{95}gsX_{2i}$	0.0015 (0.0959)
Sectoral Export Ratio Times D^{95}	$D^{95}sTX_i$	0.0846 (0.1873)
Sectoral Import Share	sM_i	-0.0325 (0.0396)
Japan's Growth Rate	jpgr	-0.0132 (0.5805)
The Growth Rate of The World Oil Price	grwoprp	-0.4686 (0.0752)[a]
The Second Lag of gK_i	gK_{2i}	0.0203 (0.0583)
Sectoral Labour Growth Rate	gH_i	-0.0088 (0.0271)
F-Statistics (Excluded Instruments)		12.97[a]

Source: Author's analysis

Notes: Numbers in parentheses are standard errors; a and b indicate 1% and 5% level of significance (z-score), respectively. gK_i is the endogenous RHS variable.

Table A.3.7.2: The Instruments of The 2SLS Estimation in Table 3.9

Independent Variable	Label	gK_i
Constant		3.9184 (2.2059)[b]
First Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{1i}$	0.0821 (0.0704)
Second Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{2i}$	-0.0069 (0.0709)
Sectoral Export Ratio Times D^{LIB}	$D^{LIB}sTX_i$	0.0625 (0.1810)
Sectoral Import Share	sM_i	-0.0240 (0.0383)
Japan's Growth Rate	jpgr	0.0081 (0.5602)
The Growth Rate of The World Oil Price	grwoprp	-0.4727 (0.0729)[a]
The Second Lag of gK_i	gK_{2i}	0.0155 (0.0575)
Sectoral Labour Growth Rate	gH_i	-0.0070 (0.0268)
F-Statistics (Excluded Instruments)		14.96[a]

Source: Author's analysis.
Notes: Numbers in parentheses are standard errors; a and b indicate 1% and 5% level of significance (z-score), respectively. gK_i is the endogenous RHS variable.

Appendix 3.8: The Estimation Results of Equation (3.8) With Single Dummy Variables

Table A.3.8.1: The Estimation Results

Dependent Variable: Sectoral Output-Net Export Growth Rate (gQNX), number of observation= 264, number of sectors= 66				
Independent Variable	**Label**	**OLS**	**OLS,FE**	**2SLS,FE**
Constant		9.6505[a](1.3474)	9.0909[a](1.6753)	8.3872[a](1.7937)
The First Lag of Sectoral Export Share Growth Rate	gsX_{1i}	0.0935[a](0.0436)	0.1153[a](0.0507)	0.1305[a](0.0534)
The Second Lag of Sectoral Export Share Growth Rate	gsX_{2i}	0.0860[b](0.0398)	0.0534(0.0453)	0.0413(0.0476)
The Sectoral Export Ratio	sTX_i	0.1690(0.1190)	0.4271[b](0.2191)	0.4674[b](0.2287)
The Sectoral Import Share	sM_i	0.0786[a](0.0305)	0.1150[c](0.0730)	0.1214[c](0.0758)
The 1985 Dummy	D^{85}	0.1362(1.7408)	0.1124(1.7621)	0.1803(1.8280)
The 1990 Dummy	D^{90}	0.1345(1.7502)	0.3657(1.7745)	0.7260(1.8545)
The 1995 Dummy	D^{90}	-1.6040(1.7518)	-1.5546(1.7772)	-1.0666(1.8689)
Sectoral Capital Growth Rate	gK_i	0.3868[a](0.0469)	0.4005[a](0.0517)	0.5959[a](0.1348)
Sectoral Labour Growth Rate	gH_i	0.1077[a](0.0216)	0.0981[a](0.0250)	0.1064[a](0.0265)
Wald χ^2		111.67[a]		413.55[a]
F-Statistics			9.63[a]	
Correlation (τ_i,Xb)		0	-0.1717	-0.2417
R^2 within		0.3050	0.3145	0.2626
R^2 between		0.3074	0.2441	0.2470
R^2 overall		0.3054	0.2881	0.2876

Source: Author's analysis.

Notes: a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. Numbers in parentheses are standard errors.

Appendix 3.9: The Estimation Results of Equation (3.8) With Single Dummy Variables Without Second Lag Variable

Table A.3.9.1: The Estimation Results

Dependent Variable: Sectoral Output-Net Export Growth Rate (gQNX), number of observation= 264, number of sectors= 66				
Independent Variable	**Label**	**OLS**	**OLS,FE**	**2SLS,FE**
Constant		9.9709[a](1.3488)	9.3516[a](1.6624)	8.5166[a](1.8010)
The First Lag of Sectoral Export Share Growth Rate	gsX_{1i}	0.0905[b](0.0439)	0.1249[a](0.0501)	0.1392[a](0.0529)
The Sectoral Export Ratio	sTX_i	0.1667(0.1199)	0.4389[b](0.2191)	0.4801[b](0.2300)
The Sectoral Import Share	sM_i	0.0858[a](0.0306)	0.1188[c](0.0730)	0.1249[c](0.0762)
The 1985 Dummy	D^{85}	0.1958(1.7530)	0.1340(1.7638)	0.2029(1.8415)
The 1990 Dummy	D^{90}	0.1806(1.7626)	0.3997(1.7761)	0.7857(1.8690)
The 1995 Dummy	D^{90}	-1.3061(1.7589)	-1.3481(1.7704)	-0.8651(1.8689)
Sectoral Capital Growth Rate	gK_i	0.3902[a](0.0472)	0.4048[a](0.0516)	0.6176[a](0.1343)
Sectoral Labour Growth Rate	gH_i	0.1057[a](0.0217)	0.0964[a](0.0250)	0.1060[a](0.0267)
Wald χ^2		105.49[a]		406.61[a]
F-Statistics			9.63[a]	
Correlation (τ_i,Xb)		0	-0.1717	-0.2615
R^2 within		0.3001	0.3145	0.2476
R^2 between		0.2736	0.2441	0.2341
R^2 overall		0.2926	0.2881	0.2799

Source: Author's Analysis

Notes: a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. Numbers in parentheses are standard errors.

Appendix 3.10: The Estimation Results of Equation (3.10)

Table A.3.10.1: The Estimation Results

Dependent Variable: Sectoral Output-Net Export Growth Rate (gQNX), number of observation= 264, number of sectors= 66				
Independent Variable	**Label**	**OLS**	**OLS,FE**	**2SLS,FE**
Constant		9.7387[a](1.0214)	9.2213[a](1.3978)	8.5281[a](1.5138)
The First Lag of Sectoral Export Share Growth Rate	gsX_{1i}	0.0964[b](0.0434)	0.1197[a](0.0504)	0.1352[a](0.0532)
The Sectoral Export Ratio	sTX_i	0.1609(0.1185)	0.4047[b](0.2175)	0.4205[b](0.1907)
The Second Lag of Sectoral Export Share Growth Rate	gsX_{2i}	0.0835[b](0.0397)	0.0495(0.0450)	0.0373(0.0474)
The Sectoral Import Share	sM_i	0.0706[a](0.0305)	0.1138[c](0.0727)	0.1204[c](0.0757)
The Trade Liberalization Dummy	D^{LIB}	-0.8007(1.2356)	-0.6473(1.2524)	-0.2458(1.3246)
Sectoral Capital Growth Rate	gK_i	0.3876[a] (0.0468)	0.4015[a](0.0515)	0.6026[a](0.1348)
Sectoral Labour Growth Rate	gH_i	0.1097[a](0.0214)	0.1008[a](0.0249)	0.1093[a](0.0263)
Wald χ^2		113.13[a]		412.88[a]
F-Statistics			12.28[a]	
Correlation (τ_i,Xb)		0	-0.1627	-0.2380
R^2 within		0.3014	0.3103	0.2554
R^2 between		0.3078	0.2475	0.2488
R^2 overall		0.3027	0.2867	0.2855

Source: Author's analysis.

Notes: a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. Number in parentheses are standard errors.

Appendix 3.11: The Estimation Results of Equation (3.9)

Table A.3.11.1: The Estimation Results of Equation (3.9) Without Second Lag

Dependent Variable: Sectoral Output-Net Export Growth Rate (gQNX), number of observation= 264, number of sectors= 66				
Independent Variable	**Label**	**OLS**	**OLS,FE**	**2SLS,FE**
Constant		9.6531[a](0.7906)	9.1087[a](1.2691)	8.6262[a](1.3475)
The First Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{1i}$	0.1230[b](0.0544)	0.1369[b](0.0611)	0.1358[a]0.0630)
The Sectoral Export Ratio Times D^{LIB}	$D^{LIB}sTX_i$	0.0945(0.1449)	0.0658(0.1862)	0.1311(0.1968)
The Sectoral Import Share	sM_i	0.0908[a](0.0306)	0.1377[c](0.0763)	0.1352[c](0.0787)
Sectoral Capital Growth Rate	gK_i	0.3934[a](0.0469)	0.3948[a] (0.0520)	0.5752[a](0.1323)
Sectoral Labour Growth Rate	gH_i	0.1094[a](0.0216)	0.1027[a](0.0250)	0.1111[a](0.0264)
Wald χ^2		103.38[a]		404.77[a]
F-Statistics			15.54[a]	
Correlation (τ_i,Xb)		0	-0.0603	-0.1199
R^2 within		0.2852	0.2871	0.2425
R^2 between		0.2893	0.2622	0.2756
R^2 overall		0.2861	0.2797	0.2796

Source: Author's analysis.

Notes: a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. Numbers in parentheses are standard errors.

Table A.3.11.2: The Estimation Results of Equation (3.9) With Import Dummy Using 2SLS, FE

Dependent Variable: Sectoral Output-Net Export Growth Rate (gQNX), number of observation= 264, number of sectors= 66					
Independent Variable	Label	Scenario I		Scenario II	
		Coeff.	**S.E.**	**Coeff.**	**S.E.**
Constant		10.0073[a]	0.8905	10.1115[a]	0.8803
The First Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{1i}$	0.1730[a]	0.0687	0.1716[b]	0.0684
The Second Lag of Sectoral Export Share Growth Rate Times D^{LIB}	$D^{LIB}gsX_{2i}$	0.0363	0.0685	-	-
The Sectoral Export Ratio Times D^{LIB}	$D^{LIB}sTX_i$	0.1562	0.1985	0.1572	0.1975
The Sectoral Import Share Times D^{LIB}	$D^{LIB}sM_i$	0.0713	0.0602	0.0768	0.0588
Sectoral Capital Growth Rate	gK_i	0.5927[a]	0.1355	0.5867[a]	0.1346
Sectoral Labour Growth Rate	gH_i	0.1104[a]	0.0267	0.1093[a]	0.0266
Wald χ^2		395.12[a]		396.89[a]	
Correlation (τ_i,Xb)		-0.1013		-0.0976	
R^2 within		0.2300		0.2320	
R^2 between		0.2427		0.2485	
R^2 overall		0.2681		0.2685	

Source: Author's analysis.

Notes: a, b, and c indicate 1%, 5%, and 10% level of significance (z-score), respectively. Scenario I is with the second lag of sectoral export share variable, while scenario II is without second lag variable. The instruments are *jpgr*, *grwoprp* and gK_{2i}. These are similar to the instruments in Table 3.4.

Appendix 3.12: Wald χ^2 And F-Statistic

This section is to examine the biasedness of our instruments. As in Chapter 2, we use the procedure in Staiger and Stock (1997) and Bound *et al.* (1995) to check the validity of our instruments. Because Staiger and Stock (1997) and Bound *et al.* (1995) used F-statistics value, we need to convert our Wald χ^2 to F-Statistics. Theoretically, F-statistics and the Wald χ^2 are really the same thing to the extent that, after a normalization, the Wald χ^2 is the limiting distribution of F as the denominator degrees of freedom goes to infinity (Gould, 1999). The normalization formula is

$$\text{Wald } \chi^2 = \text{Numerator Degree of Freedom} * \text{F-Statistics}$$

Based on this formula, the Wald χ^2 values, for example, as in Tables 3.5.1 and 3.5.2 can be converted to the F-Statistics as 10.40 (i.e. 41.60/ 4) and 9.72 (i.e 38.89/4), respectively. Thus, we conclude that the F-statistic from the first stage regression is 10.40 for Table 3.5.1 and 9.72 for Table 3.5.2.

Following Staiger and Stock (1997), we argue that the instruments can be claimed weak because the first stage F-statistic is just around 10. This means we may have weak instruments. Because we obtain weak instruments, we need to check whether the bias is likely to be illegitimate. Using Bound's bias table, we conclude that the bias is quite small (around 0.03). This means that the bias of the IV estimator is around 3 per cent from the OLS estimator. From this finding, we conclude that although we may have weak instruments, the bias of the IV estimation is likely to be legitimately negligible. Therefore, our instruments variables in equations (3.7) and (3.8) are significantly valid and plausible.

APPENDIX 4: LABOUR SHARES AND THE COMPLETE PRODUCTIVITY GROWTH ESTIMATES

Appendix 4.1: Labour Shares Versus Weighted Employment

So far, we have categorized economic activities into high self-employment sectors and low self-employment sectors. We argue that a high self-employment sector which is a labour intensive unit tends to have a higher labour share than a low self-employment sector. The next step is to extend the application of labour shares by examining whether there is a correlation between labour shares across sectors and employment in Indonesia. This examination is essentially to analyze whether the labour share is also sensitive to total employment. To check the value of labour shares, we will use the average value of *LS4* and *LS5*. The null hypothesis is that there is no rank order relationship between labour shares and employment across sectors. The hypothesis is motivated by the fact that if labour shares are constant across time and space, they are expected to be consistent with employment in each sector. Thus, labour shares across sectors are parallel with employment across sectors. Stated differently, because the labour share has to account for the income of all employed people (self-employed and non self-employed), higher employment will mean an have increased labour share. This implies that the labour share of a transportation sector which is considered to be a capital intensive unit and that of an agricultural sector which is a labour intensive unit may be significantly different.

From this perspective, we may investigate whether there is any rank correlation between labour shares and employment. In this context, we will use the *LS4* and the *LS5* for labour shares computation and the sectoral employment ratio - sectoral number of workers as a fraction of total workers- for a full description and pattern of Indonesian labours. The next step is to use Spearman's Rank correlation to test whether the employment ratio has a strong correlation with labour shares. If the correlation value is not significant, we may conclude that there is no rank order relationship between employment ratio and labour shares, so that labour share is related to a labour-intensive sector, which is usually high self-employment. If the value is greater than the critical value, we conclude that there is a rank order relationship between the two variables; thus labour shares and employment across sectors have a strong relationship. Table 4.1.1 presents the results of Spearman's rank correlation between labour shares and weighted employment across sectors.

As shown in Table 4.1.1, the Spearman's rank correlations between labour shares and employment are quite strong (around 70%) and positive. With a 1 per cent critical value, in general, the results reject the null hypothesis. Thus, the study argues that there is a rank order relationship between labour shares and employment across sectors in Indonesia. This result supports the hypothesis that sectors with higher employment tend to have higher labour shares, whereas sectors with lower employment would be likely to have lower labour shares.

Table A.4.1.1: The Spearman's Rank-Order Correlation between the Labour Shares and the Weighted Employment in Indonesia 1971-1995

Year	Correlation Value
1971	0.779
1975	0.684
1980	0.714
1985	0.735
1990	0.763
1995	0.679

Sources: Author's Analysis
Notes: All values are significant at 1%.

These findings also support the argument that over a long period of time, subject to data availability, the labour shares appear to have a strong relationship with employment across sectors. Our findings suggest that we should take care to compute labour shares. Estimates of labour shares that do not account for employment (both non-self-employment and self-employment) will yield fairly inconsistent results. This concludes that our judgement approach to split the self-employment sectors is an important procedure to correctly compute labour shares.

Appendix 4.2: Productivity Growth Estimates Using Complete Annual Periods

Table A.4.2.1: Total Factor Productivity Growth Estimates (in %)

Year	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1968	5.75	5.88	5.68	5.17	5.08
1969	4.28	4.16	4.34	4.83	4.92
1970	3.80	3.53	3.93	4.98	5.17
1971	2.83	2.40	3.05	4.73	5.04
1972	3.81	3.12	4.15	6.81	7.31
1973	2.53	1.96	2.80	4.97	5.38
1974	0.55	-0.05	0.84	3.14	3.58
1975	-2.09	-2.81	-1.74	1.03	1.55
1976	-2.37	-3.06	-2.04	0.59	1.08
1977	1.47	0.90	1.75	3.95	4.36
1978	0.89	0.18	1.23	3.93	4.44
1979	1.75	0.99	2.12	5.03	5.58
1980	2.33	1.59	2.68	5.50	6.04
1981	1.55	0.42	2.10	6.45	7.27
1982	-8.14	-8.93	-7.75	-4.71	-4.14
1983	0.27	-0.40	0.59	3.16	3.65
1984	-0.25	-0.80	0.02	2.12	2.52
1985	-2.02	-1.77	-2.15	-3.13	-3.31
1986	0.74	0.31	0.95	2.62	2.93
1987	-2.91	-2.84	-2.94	-3.18	-3.23
1988	-0.56	-0.97	-0.37	1.18	1.47
1989	-0.18	-0.71	0.08	2.11	2.49
1990	2.12	1.59	2.38	4.42	4.81
1991	1.81	1.28	2.06	4.09	4.47
1992	1.00	0.55	1.22	2.95	3.27
1993	2.75	2.03	3.10	5.85	6.37
1994	1.70	1.31	1.88	3.35	3.63

Table A.4.2.1: Total Factor Productivity Growth Estimates (in %) (continued)

Year	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1995	2.15	1.71	2.37	4.07	4.39
1996	1.55	1.09	1.77	3.51	3.83
1997	0.19	-0.42	0.49	2.86	3.30
1998	-18.14	-18.51	-17.96	-16.53	-16.26
1999	-2.84	-3.08	-2.72	-1.79	-1.61
2000	7.39	7.21	7.48	8.16	8.29
Mean	**0.42**	**-0.06**	**0.65**	**2.49**	**2.84**
Std. Dev	**4.37**	**4.39**	**4.37**	**4.48**	**4.53**

Source: Author's analysis.

Notes:

1. TFP growth in the First Scenario is computed by using *LS6*; the Second Scenario is by using *LS4*; the Third Scenario is by using *LS5*; the Fourth Scenario is by using Gollin's mean value of the first adjustment; and the Fifth Scenario is by using the Philippines Labour Share taken from Gollin's findings (2002). See also Table 4.3
2. The labour shares used in the First, Second, and Third scenarios are the average values.
3. TFP growth is computed from the standard growth model as in equation (4.1).

Appendix 4.3: The Complete Results Of Sectoral Productivity Growth Estimates Using Quinquennial Data Periods

Table A.4.3.1: Sectoral Productivity Growth Estimates (19 Sectors) (%)

Year	Sector	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1975	1	24.23	25.19	23.74	19.81	19.07
1975	2	8.25	9.27	7.70	3.32	2.50
1975	3	2.62	3.90	1.92	-3.54	-4.57
1975	4	15.36	16.76	14.58	8.42	7.26
1975	5	-1.85	0.66	-3.15	-13.38	-15.31
1975	6	3.80	5.15	3.06	-2.79	-3.89
1975	7	56.38	57.97	55.55	48.96	47.72
1975	8	18.20	19.61	17.46	11.62	10.52
1975	9	9.88	11.03	9.27	4.46	3.56
1975	10	-10.97	-7.43	-12.76	-26.91	-29.57
1975	11	-2.17	-0.07	-3.26	-11.86	-13.48
1975	12	5.77	8.39	4.46	-5.92	-7.88
1975	13	1.84	3.44	1.00	-5.58	-6.82
1975	14	-2.14	-0.92	-2.77	-7.71	-8.64
1975	15	0.13	1.80	-0.73	-7.53	-8.81
1975	16	12.02	12.08	11.97	11.60	11.53
1975	17	15.73	16.68	15.24	11.31	10.57
1975	18	10.46	11.38	9.97	6.14	5.42
1975	19	-4.96	-2.52	-6.23	-16.22	-18.10
1980	1	-3.60	-2.77	-4.05	-7.62	-8.29
1980	2	5.79	6.80	5.24	0.87	0.04
1980	3	6.58	8.78	5.45	-3.43	-5.11
1980	4	17.44	20.03	16.11	5.63	3.66
1980	5	8.54	11.39	7.14	-3.94	-6.03
1980	6	3.45	5.26	2.50	-4.94	-6.34
1980	7	24.93	25.37	24.68	22.71	22.34
1980	8	8.24	9.59	7.53	1.93	0.88

Table A.4.3.1: Sectoral Productivity Growth Estimates (19 Sectors) (continued)

Year	Sector	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1980	9	9.21	9.38	9.13	8.51	8.40
1980	10	0.74	-0.15	1.30	5.71	6.54
1980	11	12.25	13.13	11.78	8.04	7.33
1980	12	16.08	16.90	15.65	12.26	11.62
1980	13	12.34	13.77	11.58	5.55	4.41
1980	14	18.25	18.85	17.93	15.37	14.89
1980	15	10.49	11.90	9.75	3.89	2.79
1980	16	11.30	13.07	10.39	3.25	1.90
1980	17	12.45	13.63	11.83	6.98	6.07
1980	18	15.96	17.20	15.33	10.35	9.42
1980	19	-16.40	-15.01	-17.07	-22.34	-23.33
1985	1	3.88	3.11	4.29	7.54	8.15
1985	2	7.56	8.00	7.33	5.55	5.21
1985	3	-1.53	-0.39	-2.11	-6.69	-7.56
1985	4	11.44	11.82	11.26	9.81	9.54
1985	5	0.11	0.33	-0.04	-1.21	-1.43
1985	6	10.53	11.42	10.06	6.34	5.64
1985	7	-7.29	-7.49	-7.17	-6.17	-5.99
1985	8	13.89	14.47	13.59	11.24	10.80
1985	9	15.65	16.37	15.26	12.17	11.59
1985	10	51.26	49.85	52.05	58.26	59.43
1985	11	12.58	12.56	12.64	13.17	13.27
1985	12	4.49	4.71	4.40	3.74	3.62
1985	13	-6.87	-7.10	-6.68	-5.20	-4.93
1985	14	20.86	19.96	21.28	24.58	25.21
1985	15	9.36	8.89	9.63	11.72	12.12
1985	16	11.46	11.12	11.66	13.26	13.56
1985	17	7.68	7.47	7.82	8.91	9.11
1985	18	-53.50	-59.80	-49.98	-22.17	-16.93
1985	19	14.02	13.48	14.23	15.85	16.15
1990	1	6.05	6.94	5.59	1.99	1.31
1990	2	5.15	5.32	5.06	4.29	4.14
1990	3	-1.31	-1.22	-1.36	-1.74	-1.81

Table A.4.3.1: Sectoral Productivity Growth Estimates (19 Sectors) (continued)

Year	Sector	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1990	4	-6.02	-5.27	-6.35	-9.01	-9.51
1990	5	5.42	6.50	4.87	0.60	-0.20
1990	6	4.12	3.57	4.43	6.86	7.32
1990	7	-10.97	-11.04	-10.87	-10.09	-9.95
1990	8	5.90	6.25	5.74	4.50	4.27
1990	9	14.65	14.67	14.68	14.89	14.93
1990	10	6.18	6.72	5.89	3.60	3.17
1990	11	6.56	6.78	6.48	5.82	5.70
1990	12	7.09	7.66	6.80	4.52	4.10
1990	13	7.24	7.25	7.24	7.28	7.29
1990	14	9.41	9.72	9.27	8.18	7.97
1990	15	5.35	5.44	5.32	5.09	5.05
1990	16	5.57	7.66	4.55	-3.56	-5.09
1990	17	3.89	4.54	3.54	0.81	0.29
1990	18	0.53	-0.32	1.00	4.71	5.41
1990	19	-9.14	-8.13	-9.64	-13.57	-14.32
1995	1	9.70	10.53	9.24	5.62	4.93
1995	2	4.97	5.07	4.91	4.46	4.37
1995	3	-2.47	-4.38	-1.41	7.04	8.63
1995	4	16.27	16.18	16.34	16.91	17.02
1995	5	12.11	11.78	12.30	13.85	14.14
1995	6	12.48	12.87	12.28	10.75	10.46
1995	7	-4.51	-4.84	-4.31	-2.72	-2.42
1995	8	10.32	10.43	10.30	10.17	10.14
1995	9	25.77	26.71	25.27	21.32	20.57
1995	10	2.19	2.69	1.91	-0.27	-0.68
1995	11	12.11	12.55	11.91	10.28	9.98
1995	12	9.43	9.45	9.45	9.63	9.67
1995	13	12.46	12.98	12.20	10.19	9.81
1995	14	14.73	15.25	14.49	12.68	12.33
1995	15	10.75	11.37	10.46	8.13	7.69
1995	16	6.73	7.16	6.61	5.68	5.50
1995	17	12.69	12.34	12.90	14.50	14.80

Table A.4.3.1: Sectoral Productivity Growth Estimates (19 Sectors) (continued)

Year	Sector	First Scenario	Second Scenario	Third Scenario	Fourth Scenario	Fifth Scenario
1995	18	12.94	13.21	12.82	11.81	11.62
1995	19	11.69	11.46	11.78	12.53	12.68
	Mean	**7.56**	**8.15**	**7.27**	**4.96**	**4.53**
	Std.Dev	**12.18**	**12.51**	**12.04**	**12.04**	**12.27**

Source: Author's analysis

Notes:

1. Sectoral Productivity Growth in the First Scenario is computed by using LS6; the Second Scenario is by using LS4; the Third Scenario is by using LS5; the the Fourth Scenario is by using Gollin's mean value of the first adjustment; and the Fifth Scenario is by using the Philippines Labour Share taken from Gollin's findings (2002). See also Table 4.3
2. The labour shares used in the First, Second and Third scenarios are the average values
3. Productivity growth is computed from the standard growth model as in equation (4.1).

Appendix 4.4: The Actual Data of Educational Attainment

Year	No School	Primary	Secondary	Higher
1978	35816481	11287828	4428707	247343
1979	35531707	12387751	5058411	306680
1980	35246932	13487674	5688114	366018
1981	34962158	14587596	6317818	425355
1982	34677383	15687519	6947521	484692
1983	34974588	15944499	7277626	497994
1984	35271793	16201478	7607730	511296
1985	35253516	17496160	10234723	841216
1986	33980236	23343179	11916292	953205
1987	33272779	24084989	11882336	1162339
1988	33362724	25130632	12567663	1067305
1989	33452669	26176275	13252989	972271
1990	31545893	27952189	14975805	1376693
1991	29049176	29008409	16823151	1542443
1992	30199017	29164168	17480680	1674507
1993	29278612	29746278	18259923	1915729
1994	29301627	26732284	21208009	2868140
1995	25820163	32946539	23968971	2966140
1996	27267359	30842824	25677436	3262137
1997	24589450	32860821	26742440	3479738
1998	23430834	32949814	29617747	3818464
1999	21529800	34290316	30039692	3977922
2000	21733717	33829887	30877403	4366410
Average	**30849940**	**24179961**	**15602225**	**1699306**

Source: CBS (various years).

Notes:

1. Primary is number of persons graduated from Elementary Schools
2. Secondary is number of persons graduated from Junior and Senior High Schools
3. Higher is number of persons graduated from University
4. Numbers are in persons.