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EAST ASIAN DEVELOPMENT NETWORK (EADN)

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THE IMPACT OF FISCAL POLICIES ON INCOME DISTRIBUTION AND POVERTY:

A Computable General Equilibrium Approach for Indonesia

THE EAST ASIAN DEVELOPMENT NETWORK

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SUMMARY

This research seeks to quantitatively measure the impact of fiscal policy on income distribution and poverty in Indonesia. This research is conducted using WAYANG, the CGE model for Indonesian economy. The crisis which struck in 1997 has affected the situation on poverty and income distribution through at least three channels. The first channel is the adjustment at the macro level at the output and input markets, especially labor market. The second category is the adjustment at the micro level, namely the changing patterns if household income and expenditure. And third, there is an indirect transmission through the government expenditure, namely the provision of public social services.

The research focus on fiscal policy as a means for the government intervention in poverty alleviation and income redistribution policy. Fiscal policy for the purpose of poverty alleviation and income redistribution actions are implemented most directly by three instruments by which the government could allocate budget. The first one is direct or personal subsidy, targeted on the low-income households. The second one is price subsidy, which is a subsidy allocated to commodities which are used chiefly by the low-income households, or specifically named as basic commodities. Due to the limitation of the model, we will only focus on these two areas of expenditure on this research. There is a third area of expenditure, which is the direct government spending on public services and infrastructures, especially on welfare, health and education, which particularly benefit low-income households. On the revenue side, financing can be obtained either domestically or from external funding. From the domestic side, we will be limiting our attention on income and commodity taxes. External funding can be in various forms, but will be limited on external (public) borrowings.

For the purpose of this research, we have made some amendments to the WAYANG original model by incorporating the parametric distribution and headcount poverty calculation. Using the amended model, we run four scenarios. Scenario 1 examines the effects 20% increase in government expenditure under the condition of government's budget deficit. Scenario 2 deals with a different way of tax financing to cover the increase in government expenditure. In the second scenario, income tax rate adjusts to ensure that the government borrowing is unaffected by the increase in the expenditure. Ini scenario 3, income tax rate adjustment is swapped to the adjustment of sales tax. Finally, scenario 4 is basically similar to the first one, but with fixed trade balance.

The research has shown that different schemes of fical expansion matter in affecting income distribution and poverty. The benefits from a fiscal expansion are mainly transferred to the urban households and non-labor rural households, which are basically the wealthiest segments of the society. There are several explanations on such phenomenon. First, those segments possess factors of production which are benefited most from the policy, i.e. skilled labor and fixed capital. Second, those types of household are not affected significantly by the increase in prices. This is due the structure of consumption of each households. Third, the data revealed that the tax system in Indonesia is regressive. That means rich households are taxed less than the poorer ones, in real term.

Fiscal expansion could also used as a policy instrument to reduce poverty incidence. But it does not always lead to poverty decline, as it depends on the source of financing. In the research, we find that if fiscal expansion is financed by increasing budget deficit (scenario 1), population under the poverty line is expected to decline by more than 9%. If increasing budget deficit is combined with a fixed trade balance, poverty incidence reduced only by 1.15% (scenario 2). Increasing taxes, either income or sales taxes, would result in higher population living below the poverty line. Higher income taxes (scenario 3) is associated to almost 13% increase in poor population, while higher sales taxes (scenario 4) increases poor population by more than 17%.

Keywords: income distribution; poverty; economic modeling; fiscal policy

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CHAPTER 1
INTRODUCTION

1.1. BACKGROUND

The Indonesian economic crisis that began in 1997 has been accompanied by widespread social distress in the country. A fall in output and incomes in these countries has been invariably accompanied by massive job losses as bankruptcies and cutbacks in production have multiplied. This has led to a sharp rise in open unemployment and underemployment. As the result, increasing number of people living below the poverty line and the deteriorating income distribution has been the concern of most. Unfortunately several studies on the social impact of the crisis failed to illustrate the exact impact on poverty and income distributions. Differences in assumptions and methodology have led to different figures. On the other hand, the Social Safety Net program that was implemented by the government has been considered as failure, do to the wrong design of the program which made the fund did not reach the poor people.

The failure of the Social Safety Net program does not necessarily wipe out the fact that there is still the need for a good government policy to alleviate poverty and redistribute income. While stimulating economic growth is considered a longer-term remedy, the government can directly intervene through fiscal policy instruments. However, such policy should be well-designed. It means that a policy implementation should be preceded by good cost-benefit analysis, calculating the positive as well as the adverse effect. In such case, policymakers need a tool which enables them to precisely measure the net effect of a possible fiscal policy instrument.

1.2. RESEARCH OBJECTIVES

The purpose of the research is to quantitatively measure the impact of fiscal policy on poverty alleviation and redistribution policy. We are interested in fiscal policy since it can play role as a direct intervention to poverty and income distribution. Fiscal policy can also be targeted on specific groups in the economy, which suffer most from an economic shock. In some conditions, especially during a crisis period where an economy may experience negative growth, a more immediate action is required. In such condition, there will be a need for a direct government intervention translated in fiscal policies.

The research is important to assist policy makers having a detailed policy orientation on poverty and income distribution. It seeks to provide both theoretical and empirical justification to seek and implement the "right" policy on poverty alleviation and redistribution. The term "detailed policy orientation" here means more than a simple, theoretical or intuitive consideration of fiscal policy (Francoins and Reinert 1997). It involves an analytical commitment to the details in the household and factor level as well as a commitment to be engaged in the policy-making process. A concern in the household and factor details forces the researcher into the realms of data on income distribution among and within households or income groups. It also concerns the way in which poverty or distribution measures are implemented.

1.3. TOOLS OF ANALYSIS

The study uses the Computable General Equilibrium (CGE) approach as the tool of analysis. The CGE model will be used here is called WAYANG, a CGE model designed for Indonesia. For the purpose of this research, we should first make some amendments to the original model by

incorporating the parametric distribution and headcount poverty calculation. Using the model, we run four scenarios.

- *Scenario 1* examines the effects 20% increase in government expenditure under the condition of government's budget deficit. In this scenario the government budget is allowed to change in response to the increase in the government expenditure, without having the revenue change sufficiently to cover the increase. Implicitly, this scenario ensures that the government can make borrowing to cover the increase in expenditure.

- *Scenario 2* deals with a different way of tax financing to cover the increase in government expenditure. In the second scenario, income tax rate adjusts to ensure that the government borrowing is unaffected by the increase in the expenditure. By having the income tax rate adjustment, the original deficit or surplus in the government budget will not change at all.

- *Scenario 3* is different in the way that income tax rate adjustment is swapped to the adjustment of sales tax. Through this swap, effects on different types of deficit financing can be examined in more detail.

- *Scenario 4* is basically similar to the first one, but with fixed trade balance. By having trade balance unchanged, there is no capital flow and foreign borrowing allowed to keep private investment unaffected. The increase of public investment pushes the interest rate to soar as no foreign borrowing take place. This in turn drives the private investment to adjust towards changing in the economy. In macroeconomic terms, the last scenario deals with a condition where private investment might be crowded out due to a shock in government expenditure and investment.

1.4. OUTLINE OF THE REPORT

The report is outlined as follows:

- ***Chapter 2 – The Economic Crisis, Poverty and Fiscal Policy.*** This chapter starts with the dicsussion of the transmission mechanism from economic crisis to poverty and the trend on poverty figures during the crisis. It then discusses the role of fiscal policy as an instrument for povery alleviation, and the current fiscal contstraints faced by the Indonesian government.

- ***Chapter 3 – WAYANG: A CGE Model for the Indonesian Economy.*** This chapter is a general description of WAYANG. It presents the basic feature of the original model, database and some amendments to the model for the purpose of this research.

- ***Chapter 4 – Simulation and Closure.*** Describes the simulation and closures of the model in detail. The focus of the simulation conducted in this study is to examine the implications of various fiscal policies on the Indonesian economy, including the distributional impacts on income and poverty.

- ***Chapter 5 – Simulation Results.*** This chapter presents the detailed results and findings of the simulation. This chapter presents the results of the simulations. The discussion starts with the impacts on macroeconomic variables. It is then followed by the impact on the sectoral and industrial level. The impact of various schemes of fiscal expansion on income distribution and poverty, which is the main part of this research, is presented in the final two sections.

- ***Chapter 6 – Concluding Remarks.*** This chapter summarizes and concludes the whole discussion, as well outlining some weaknesses of this research and providing some suggestions for further research.

CHAPTER 2
THE ECONOMIC CRISIS, POVERTY AND FISCAL POLICY

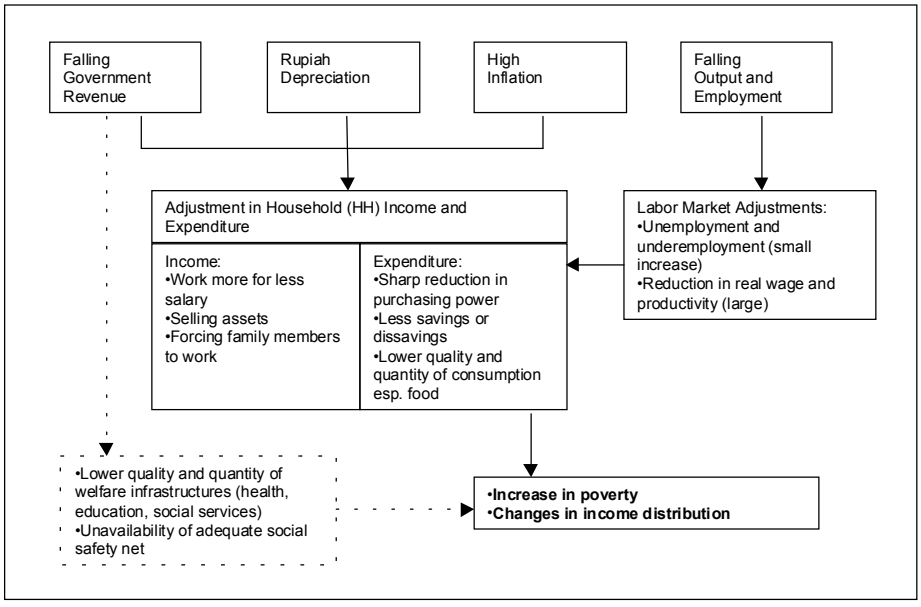
2.1. OVERVIEW

The discussion in this chapter is an introduction to the problem addressed in this research. In this chapter, we will discuss the issue of income distribution and poverty in the light of the economic crisis. We then relate the discussion with the issue on the role of fiscal policy, and the fiscal constraint faced by the government. This chapter starts with the dicsussion of the transmission mechanism from economic crisis to poverty and the trend on poverty figures during the crisis. It then discusses the role of fiscal policy as an instrument for povery alleviation, and the current fiscal contstraints faced by the Indonesian government.

2.2. THE TRANSMISSION

The transmission from the economic crisis – characterized by the sharp output contraction and currency depreciation, high inflation and banking system failure – to the social (more specifically, poverty and income distribution) impact of the crisis could be traced from adjustment mechanisms. Following Feridhanusetyawan (1999), there are three channels of transmission (see figure 2.1). First is the adjustment at the macro level at the output and input markets, especially labor market. The second category is the adjustment at the micro level, namely the changing patterns if household income and expenditure. Finally, there is an indirect transmission through the government expenditure, namely the provision of public social services.

Figure 2.1 Transmission from Economic Crisis to Poverty and Distributional Problem



The *first* channel of transmission at the macro-level consists of the adjustment in the output and input (labor) markets. In the output market, the changing structure in the economy has moved resources from one sector and industry to another. The crisis has shifted resources from the modern, non-traded and import-dependent sectors – such as construction and capital-intensive manufacturing – to traditional, traded and export-oriented sectors (agriculture, forestry, mining and labor-intensive manufacturing). In the shrinking sectors, market adjustments in the form of declining profit and real income, firm insolvency, company closing, has been more severe compared with the adjustment in the booming sectors. But the fact that not every industry or sector has been suffering from the crisis and even some sectors (such as the export-oriented manufacturing and agriculture, see Booth [1999]) have in fact benefited, has led to the complexity in assessing the social impact of the crisis.

The next macro-level adjustment takes place in the labor market, characterized by the fall in employment, real income and labor productivity. As a result of the flexible labor market in the naturally labor surplus economy, the increases in unemployment and underemployment rates have been relatively smaller than previously expected. But, on the other hand, the decrease in the real wage has been dramatic. Consistent with the changing structure of the economy in general, labor has moved from the formal to informal sectors, from modern to traditional sectors, and from urban to rural areas (see Feridhanusetyawan [1999], Manning [2000]).

The *second* channel of transmission is at the micro level, takes from in the changing patterns of household income expenditure. Sharp reduction in real income has forced people to work for relatively less income, to consume their savings or to sell their assets to cope with increasing expenditure. The increase in prices has been three or four times larger than the increase in nominal wages, such that the purchasing power of the family could decline by around a half. On the expenditure side, the doubling of prices, especially food prices, has forced people to reduce and substitute their spending on secondary and tertiary needs for basic needs. For low income families, for whom food consumption accounts for most of their expenditures, the sharp increase in food prices have significantly reduces their purchasing power, lowered their food consumption, and even led to starvation in some cases.

The *third* channel links the economic collapse and social problems through direct government expenditure. The government budgetary constraints during the crisis also led to smaller public spending for education, health and other services, as well as reducing the ability of government to maintain subsidies for fuel, electricity or basic food. Combined with the lack of capacity within the government in dealing with the crisis, the limited government budget has led to ineffective social safety net program.

2.3. POVERTY FIGURES SINCE THE CRISIS

The official poverty figure is the one published by the Central Board of Statistics (BPS). The poverty rate is calculated based on the *National Socio-Economic Survery* (SUSENAS). Table 2.1 presents the official poverty lines, headcount poverty rates and the number of people living below the poverty line.

According to the official BPS statistics, the crisis has increased the number of people living below poverty line from 34.5 million (17.7% of total population) in 1996 to 49.5 million (24.2%) in 1998. Poverty figure in 1996 was used as the benchmark since there is an absence of survey or estimation on poverty in 1997, when the crisis began. However, some opinions argued that the BPS calculation on poverty rate and incident in 1998 has been overestimated. Several studies has come up with lower numbers of the 1998 poverty rate, i.e. 14.1% (World Bank 1999), 11% (Frankenberg et al. 1999), or 14.4% (Poppele et al. 1999).

Small progress in the economy, especially lower inflation and return-to-positive GDP growth has reduced the poverty incidents in the subsequent years. In 1999, BPS calculated that poverty incident declined to 37.5 million (18.2% of total population). Poverty figures in the subsequent years are estimated based on SUSENAS Core data, excluding two troubled provinces of Aceh and Maluku. This explains why poor population declined to 37.3 million in 2001, but the poverty rate is higher, 18.9%. Poverty incident continued to decline, although not much, in 2001.

Table 2.1 Estimates of the headcount poverty rate

	Poverty line (Rp)		Headcount poverty rate (%)			Poor population (million)		
Year	Urban	Rural	Urban	Rural	Total	Urban	Rural	Total
1996 *	38,246	27,413	13.6	19.9	17.7	9.6	24.9	34.5
1998–December *	96,959	72,780	21.9	25.7	24.2	17.6	31.9	49.5
1999–December *	89,845	69,420	15.1	20.2	18.2	12.4	25.1	37.5
2000 **	91,632	73,648	14.6	22.1	18.9	12.1	25.2	37.3
2001 **	100,011	80,832	9.8	24.9	18.4	8.5	28.6	37.1

Source: BPS (various years)

Notes: * Based on SUSENAS full data, East Timor included
** Estimation based on SUSENAS Core data, East Timor, Aceh and Maluku exclued

Table 1.1 also suggests that in terms of increase in poverty, the crisis seems to be more an urban, rather than rural, phenomenon. This is illustrated by the increase in urban poverty by 88% from 1996-98, compared with 'only' 30% in the rural areas. Conversely, urban poverty also reduced faster (30%) than those in the rural areas (21%) following a relative improvement on the economic situation from 1998-99. However, the absolute number of rural poor is still higher than those in the urban areas in all years. This means that in absolute term, the level of deprivation is still higher in rural areas.

The sectoral analysis of poverty incidence is illustrated by table 2.2. The table presented the sectoral changes on headcount poverty and the contribution to total poor between February 1996 and 1999. During the crisis, all sectors have indicated increase in the poverty incidence. In absolute term, the agriculture sector had the highest poverty incidence before and after the crisis. It is also consistently has the highest share of poor people of total population. Pradhan et al. (2000:20) argued that this finding implies two things First, people in agriculture sector have always been the poorest among the other sectors. The poverty incidence is still high after the crisis, despite not being hit as hard as the modern sectors. However, this argument seemed to be rather weak. In fact, not all agriculture people or regions are poor (or being the poorest among the other regions or sectors). Second, agriculture sector is also the largest in terms of employment. Therefore, although the crisis seemed to hit the modern sectors more, the absolute poverty in agriculture sector remained to be the highest.

However, after the crisis the poor share of agriculture sector had declined. The declining trend of the poor share of total population had also happened in the mining and quarrying sector. On the other hand, relatively modern sectors had shown higher contribution of poor people after the crisis. Finance, leasing and insurance had experienced the highest relative increase in poverty incidence, as well as the contribution of the poor. This may be an illustration of the financial nature of the crisis.

Table 2.2. Sectoral Headcount Poverty and Contribution to Total Poor

Sectors	Feb '96		Feb '99		Changes in percentage point
	Sectoral headcount poverty	Share of sectoral poverty	Sectoral headcount poverty	Share of sectoral poverty	
Agriculture	26.29	68.54	39.69	58.38	13.40
Other	13.29	0.10	32.00	0.27	18.71
Mining and quarrying	15.34	1.01	29.81	1.00	14.47
Construction	14.04	5.42	28.97	5.52	14.93
Transport and communication	8.85	3.32	24.02	5.58	15.17
Manufacturing industry	10.69	5.71	22.92	7.71	12.23
Trade, hotel, restaurant	7.96	8.10	17.63	11.13	9.67
Receiving transfer	6.58	1.86	15.57	2.65	8.99
Electricity, gas, water	6.10	0.16	14.18	0.17	8.08
Civil, social, private services	5.73	5.72	13.13	7.36	7.40
Finance, insurance, leasing	1.24	0.06	5.23	0.23	3.99
Total	**9.75**	**100.00**	**16.27**	**100.00**	**6.52**

Source: Pradhan et al. (2000)

2.4. POLICY RESPONSE: THE SOCIAL SAFETY NET FAILURE

The role of the social safety net is crucial during the economic crisis to provide some protection for those who have to suffer from painful economic adjustments. Unfortunately, the social safety net in Indonesia, which was implemented between 1998-99 has not been effective. The implementation of the social safety net has not only been late, but also been in disarrays and full of controversy. However, to be fair, the failure of the Social Safety Net (SSN) programs was perhaps not too surprising. The worsening process of the crisis has been such that there was no warning system could be developed. Another reason was the lack of capacity within the bureaucracy in dealing with the program. The bureaucracy was not only demoralized during the rapid process of economic collapse and political turmoil, but also lacked the experience in designing and implementing the program. The problem was also complicated when the issues were politicized during the year of political turbulence in 1998.

Three months after the announcement of this SSN program, there were widespread criticisms that the program was a total failure. It was reported in various media that the program did not work nor reach the poor, and even the money was corrupted. In fact the World Bank had to delay the disbursement if the loan to Indonesia, partly due to some concern that the SSN fund was not properly used. Early 1999, The National Planning Board (BAPPENAS) admitted that the disbursement of the SSN fund had been very slow, and that the program had not run smoothly. It was also reported that only around 30-40% of the fund that was actually used.

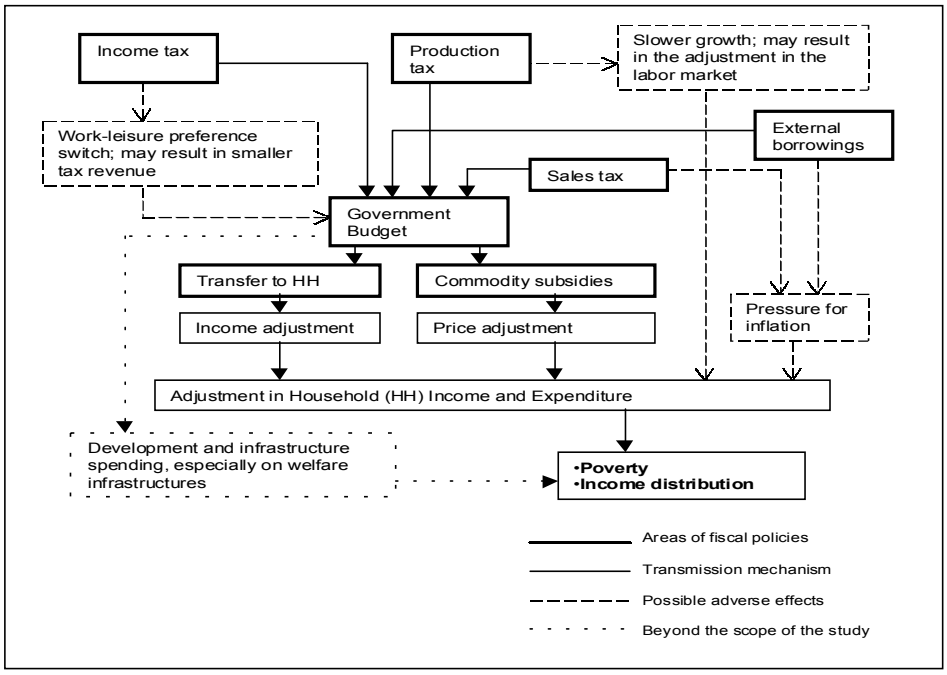
2.5. THE ROLE OF FISCAL POLICY IN POVERTY ALLEVIATION

2.5.1. Transmission Mechanism

This study aims to measure the net impact of different schemes of fiscal policy on the poverty incidence and income distribution in Indonesia. A fiscal scheme is any combination of fiscal instruments on the (government) revenue and expenditure. We underline the term "net impact" since

each fiscal instrument implies some adverse effects to the economy, which may lessen the effectiveness of its role. In the economic jargon, the adverse effect is more familiar as "efficiency cost". However, while poverty alleviation and redistribution policies inevitably involves efficiency cost, this consequence by itself establishes no conclusive case against such policies. It merely tells us that (1) any given distributional change should be accomplished at the least efficiency cost, and (2) a need exists for balancing conflicting equity and efficiency objectives. An optimally conducted policy must allow for both concerns. An illustration of the role of different fiscal instruments and their efficiency costs is summarized in figure 2.2.

Figure 2.2.Transmission Mechanism: The Effect of Fiscal Instruments on Poverty and Income Distribution



On the expenditure side, poverty alleviation and income redistribution are implemented most directly by three instruments by which the government could allocate budget. The *first* one is direct or personal subsidy, targeted on the low-income households. The *second* one is price subsidy, which is a subsidy allocated to commodities which are used chiefly by the low-income households, or specifically named as basic commodities. Due to the limitation of the model, we will only focus on these two areas of expenditure on this research. However, there is a *third* area of expenditure, which is the direct government spending on public services and infrastructures, especially on welfare, health and education, which particularly benefit low-income households. On the revenue side, financing can be obtained either domestically or from external funding. From the domestic side, we will be limiting our attention on income and commodity taxes. External funding can be in various forms, but will be limited on external (public) borrowings.

In choosing among alternative policy instruments, allowance must be made for resulting deadweight losses or efficiency cost, i.e., costs which arise as consumer or producer choice are interfered with. A direct subsidy has the advantage that it does not interfere with particular consumption or production choices. It also offers a more accurate result on improving the income distribution among households. However, this mechanism also requires some costs in the implementation. Firstly, there is an efficiency cost, since the choice between work and leisure will be distorted. There are also costs of targeting the "poor", including the administrative cost (Subbarao et al 1999), social cost and political

economy cost (Gelbach and Pritchett 1995, 1997).[1] In contrast, a commodity-specific subsidy requires lower administrative cost – since it does not require household targeting effort – and no work-leisure distortion. The disadvantage is that it implies distortions in the relative price between commodities.

Similar to direct subsidy, income tax implies less market distortions since it does not affect the relative prices and the production or consumption choices. But it also implies efficiency cost as it could switch the work-leisure preference of an individual subject to being taxed. In some cases, a higher income tax might reduce the overall individual working time. As the result, the tax revenue would be smaller, means lower available funding for subsidies.

Taxes could also be applied on commodities which are consumed largely by high-income consumers, or – in some cases – are relatively capital-intensive. The taxes can take form of production or consumption (sales) tax, with each has specific adverse microeconomic and macroeconomic (economywide) effects. At the micro level, these taxes create relative price distortions, the impact similar to commodity subsidies. At the macro level, both create inflationary effect since it increase the prices of the taxed commodities. Furthermore, production taxes create disincentive for producer and could result in lower production and slower economic growth. A slower economic growth will imply some adjustment in the labor market, a process similar to the discussion in previous section, which in the end affect the household income and expenditure.

Meanwhile, unlike the domestic taxes, external borrowings do not have direct microeconomic effect. The adjustment on domestic economy takes place only through macroeconomic variables. As a component of foreign assets, external borrowings create expansionary effect on the domestic money supply, which is a pressure for domestic inflation. This in turn creates a lower household real income and expenditure, although the result may not be clear and could be prevented by sterilization policy.

2.5.2. The Fiscal Policy Constraint

Deteriorating economic fundamentals and prolonging political uncertainty have made the Indonesian government facing a serious budgetary problem. As outlined by the IMF Letter of Intent (LoI), the government must gradually reduce its budget deficit. The government budget from 2000 to 2003 is presented in table 2.3. From the mentioned table, the government targets the budget deficit at 1.8% of GDP in 2003. This is a revised figure due to the Bali blast incident, from previosly 1.6%. The government also expects to have zero deficit in 2004.

However, given the fluctuation of Rupiah, slower-than-expected economic growth and the inflationary pressure which forced the interest rate to remain high, the government is facing a heavy task in managing its budget deficit. Financing the deficit is another difficult task, as the progress of privatization and asset sales, by which the government expects the revenue, is somewhat slow. Meanwhile, starting 2004 the government will also face a fiscal time bomb, the domestic interest payment burden.

To anticipate the exploding deficit, the government prepared to undertake several actions. The planned actions include squeezing development expenditure, which includes spending on welfare infrastructures, and reducing the allocation for subsidies. As the consequences, the most serious impact in the medium and longer run is the deterioration of public services in health and education. The provision of public services in education and heath for the poor has declined, and the long run adverse impact on poverty is very serious. The impact of the crisis on education and health in terms of quantity has been less severe than expected, but the impact on the quality in very serious. The low quality of health and education services is taking its toll, and the impact in the longer terms would be enormous.

[1] Without undermining the significance of such costs, however, this issue will not be addressed on this research.

This situation clearly suggests that the government is now having a heavy fiscal policy constrain. However, the prolonging crisis also means that the economic performance still does favor the poor and the relatively worse-off. Direct intervention on the poverty alleviation and income distribution improvement programs are still required through fiscal instruments. Therefore, a good detailed calculation on the cost and benefit of such programs is then needed.

Table 2.3. Indonesia: Government Budget (as % to GDP), 2000-03

	2000	2001	2002	2003
A. TOTAL REVENUE	15.1	19.3	17.9	17.3
I. Tax revenue	10.7	12.9	13.0	13.1
II. Non-tax revenue	4.4	6.5	4.9	4.2
B. GOVERNMENT EXPENDITURES	20.1	23.2	20.4	19.1
I. Central Government Expenditure	15.8	17.8	14.6	13.1
1. Routine Expenditures	3.2	14.9	11.5	9.7
2. Development & net lending	4.3	2.9	3.1	3.4
II. Balanced Fund	0.0	5.5	5.6	5.8
D. BUDGET DEFICIT	-5.0	-3.8	-2.5	-1.8
E. FINANCING	5.0	3.8	2.5	1.8
I. Domestic Financing	2.4	2.5	1.4	1.2
II. Foreign financing	2.5	1.4	1.4	0.6

Source: Ministry of Finance, Financial Notes, various years

CHAPTER 3
WAYANG: A CGE MODEL FOR THE INDONESIAN ECONOMY[2]

3.1. OVERVIEW

This chapter gives a general description of WAYANG, the CGE model used as the tool of this study. It presents the basic feature of the original model, database and some amendments to the model for the purpose of this research. WAYANG is a single country CGE model of Indonesian economy designed for comparative-static analysis of particular economic policy.[3] The theoretical structure of WAYANG model is built closely on that of ORANI, a single region model of Australia (Dixon et. al 1982). It belongs to the class of general equilibrium model, which is linear in proportional changes. This model is originally developed by Warr (1998) and documented and developed further by Witwerr (1999) and others under the ACIAR Indonesia Research Project.

Most of the CGE models, including WAYANG model, which is used in this study, come under the category of comparative static model. It means the analysis produces the change between equillibria given a change in economy. This type of model is particularly useful in analyzing long run effect of a certain proposed economic policy. CGE models can also be categorized as a domestic or multi region one. Multi regions models tried to capture the relation between economies, usually represented as a particular country. The domestic or single country region put more concern on a single country's economic activities. WAYANG model falls into this classification, whereas the model also provides regional analysis within the Indonesian economy.

3.2. DISAGGREGATION

Table 3.1 describes the disaggregation of institutions, factors of production, activities and household in details. In general, the model differentiates household, government, industry and the rest of the world as different institutions. There are ten different groups of household in the economy based on the dominant source of income factors. These households control factors of production. The factors of production can be categorised into five primary factors and one specific factor of production. The model distinguishes 65 groups of private industries, which use these factors in their activities. The industries provide 65 different commodities, of which five are considered as margin commodities. Other institutions appear in the model are the government and the rest of the world. The extension of WAYANG model is constructed into regional disaggregation. However, this essay only put concern on the basic of the model.

[2] Most of this chapter is adopted from Wittwer (1999), except the section on the amendment to the model.

[3] For complete description of WAYANG, visit the model website on http://www.adelaide.edu.au/cies/indlist.htm.

Table 3.1. Sets and Elements of WAYANG Model

Sets	Elements	Disaggregation
Institutions		private intermediate, private investment, household, government, rest of the world
Household	Rural	landless, small, medium, large farmer, poor non-agr. labour, non labour, rich non-agr labour
	Urban	poor labour, non-labour, rich labour
Industries	Agriculture	Paddy, Maize, CassOroot, GroundNut, SoyOtBeans, VegFruit, OFooFibCr, RubberRaw, SugarCane, Coconut, OilPalm, Tabacco, Coffee, Tea, OthAgric
	Non-agriculture	LivestoProd, Wood, ForestHunt, SeaProduct, agricservice, Coal, CrudeOil, NatGas_GThr, MetalOreMini, Quarrying, Meat, PreservFood, Copra, AnmVgOil, Rice, WheatProd, SugarConfect, ProcessFood, AnimalFeeds, AlcohTabac, NonAlcBvrgs, Yarn_Kapok, Textile, KnittMills, Clothing, CarpetRope, Leather, ManuWoodProd, ManuPaperPro, ManuChemical, Fert, Pest, PetrlRefPr, LiqNatGas, ManuRubbPlas, ManuNonmetal, ManuIronStee, ManuNFBM, ManuMetal, ConstrEquip, Machinery, CommunEquip, ManuElectric, TransRepair, OthManu, ElecGasWat, Construc, Trade, RestHotel, RoadRailTrav, SeaAirTrav, SrvcToTrans, Cmunication, BankInsur, BusiReales, GovDef, Othserv
Factors of Production	Non-agriculture	skilled and unskilled labour, variable and fixed capital
	Agriculture	unskilled labour, fertiliser, variable capital,land

3.3. STRUCTURE OF PRODUCTION

Structure of production in WAYANG Model is illustrated in Figure 3.1. In explaining the production technology available in a particular industry or production sector, the diagram in figure 2 can be described in two parts. The lower part of the diagram explains the relation between inputs used and the industry's activity level. The upper part of describes the relation between industry's activity level and its commodity output. The nesting structure of production allow the industry to choose different use of inputs relating to its activity level, while also allow the industry to produce several commodities, although in this model, each industry produces single and unique commodity.

The model assumes that activity level in a production sector take form as a Leontief production function in to choose its production inputs. Each industry requires $g+2$ inputs. The first g of those inputs represents the intermediate inputs used in the production process. Those intermediate inputs

can be supplied from domestic and foreign products. Using the method described by Armington, the model opens the possibility for imperfect substitutability between imported and domestic commodities. To capture the idea, a combination of different sources of inputs is formulated according to a Constant Elasticity of Substitution (CES) behavioural function.

The remaining two inputs used in the production represent the use of primary factor inputs and "other cost" input. This "other cost" is a device for allowing the application production taxes, cost of holding liquidity and inventories and other miscellaneous production costs appear in the process.

For primary factors, WAYANG use three primary factors, fixed capital, variable capital and labor. However WAYANG differentiated primary factors for non-agricultural and agricultural production. In agricultural production, land is also considered as one of the primary factor, while non-agricultural sectors do no use land in their production inputs.

Those elements of primary factors are combined to form effective units of primary factor inputs following a translog behavioural function. The translog function is a more flexible functional form than a CES function. However, the model also provides optional CES function for a model user who is more familiar and more comfortable using the function in constructing primary factors required.

WAYANG also introduce further disaggregation on the use labor in a production sector. The effective input of labor into the production sector is composed following a CES functional form. At current development WAYANG database recognizes the distinction between unskilled and skilled labor. Using the nested transformation function to combine the industry's labor requirement, allow the model user to treat level of substitutability between different types of labor. Each different industry may have different level of substitution between skilled and unskilled labor, and it can be modelled through the use of different elasticity of substitution.

In short, the specification of technology used in the input-activity formulation takes form in a three level nested transformation. At the top level, the model chooses inputs combination between intermediate inputs, "other cost" and primary factors using a Leontief functional form. At the second level, CES functional form takes part in determining combination of imported and domestic commodities for intermediate inputs as well as combination among different primary factors. At the lowest level, again CES function is utilized to explain the combination of labor from different types.

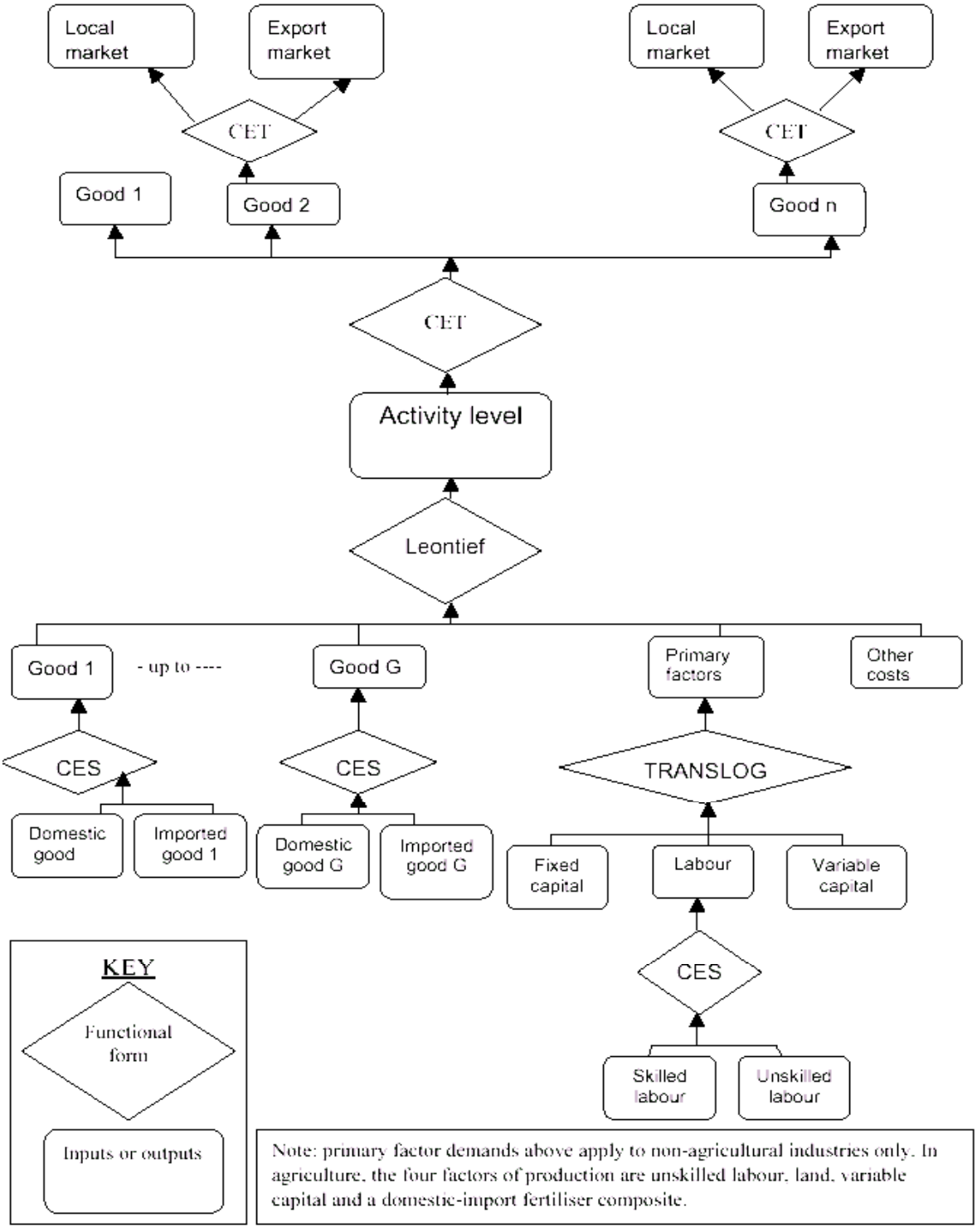
The upper part of the diagram explains the relation between activity level and outputs of an industry. Every industry in the production sectors chooses the combination of output based on a specific transformation form. This feature allows the industry to produce a mixture of different commodities produced using the technology available. The technology in the model takes form as a Constant Elasticity of Transformation (CET) functional form. This functional form is similar to CES. It implies that substitution between different commodities produced in the industry determined by a common value of transformation elasticity. However, because of data inadequacy, at recent development WAYANG only allow a unique commodity produced for each industry.

Commodities produced in an industry are also differentiated by the market destination. Commodities destined for export are not the same as those for the local consumption. Again CET function is utilized to govern the differentiation between those two similar commodities. The level of substitutability depends upon the used of elasticity of transformation in the database.
Based on the structure of production explained above, producers determined their level of production and the utilization of inputs. It implies that each industry exhibit constant return to scale both in output determination and input utilization. The model also assumes that producers are competitive and efficient.

Competitive refers to the producers' behaviour towards the price of input and output. In this model producers treat all input and output price as exogenously given. They are assumed to have no market power that can influence the level of input and price of other producers' output and neither to

influence the output market. They are also efficient in the sense that at any given level of activity, each producer in an industry selects the combination of inputs which minimizes their cost. It also applies in determination of output. The combination of outputs which maximizes their revenue are also the objective of producers in every industry.

Figure 3.1. Structure of Production

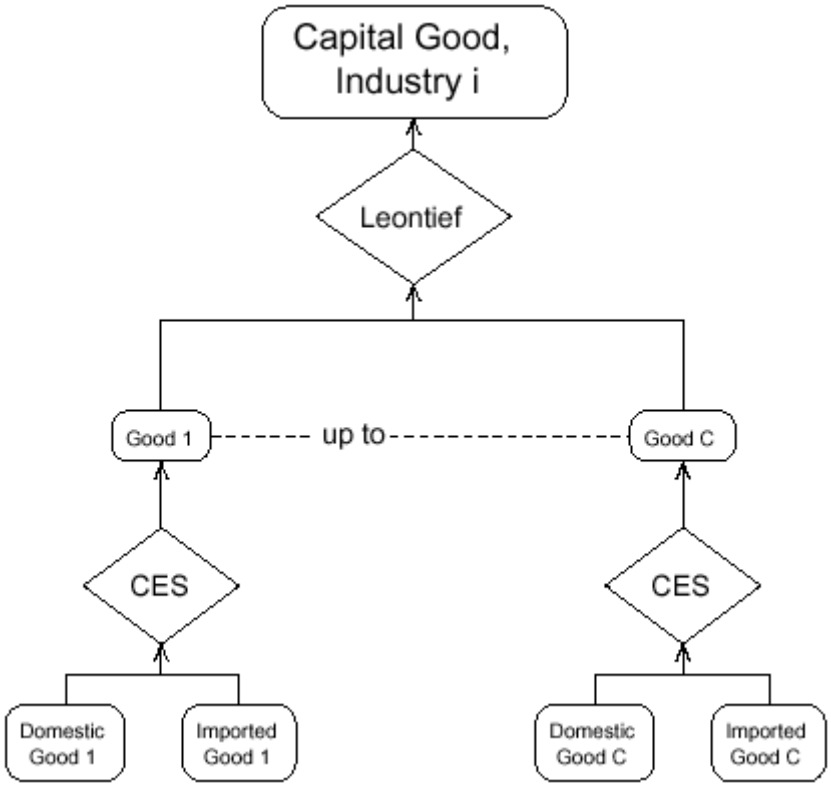


Note: Adopted from Wittwer (1999)

3.4. DEMANDS FOR INVESTMENT GOODS

Like the production structure, the demand for investment goods is also described in a nesting structure of production. Figure 3.2 explains the structure for the production of new units of investment goods. Investment goods in WAYANG model refers to fixed capital formation.

Figure 3.2. Demands for Investment Goods



Note: Adopted from Wittwer (1999).

At the top stage of production, fixed capital is assumed to be created using effective intermediate inputs of commodities produced by production sectors. A unit of fixed capital for the use in an industry can be created according to the production function that take a Leontief form. The effective inputs are defined of the combination of commodities from different sources, domestic and imported. Using a CES functional form, a unit of effective inputs is created for the further use in the creation of fixed capital goods.

Much of the structure in producing investment goods is similar to the structure of production. However, a point of contrast between both structures is that fixed capital creation requires no inputs of primary factors or "other cost" tickets. The reason is the use of primary factors of production and "other cost" tickets related to the creation of investment goods are indirectly included through the use of those factors in the production of service goods, such as construction. The creation of investment goods requires heavy inputs of construction and other service sectors.

The model assumes that investment goods are created competitively and efficiently. Producers of fixed capital goods treat input prices as beyond their control and they choose the combination of

inputs that minimize their cost of production for any given level of capital creation. This structure of production of investment goods, however, does not explain how the composition of units of capital across industries and how the investment level in each industry determined. It is explained in other part of the model.

WAYANG provides two approaches describing the composition of units of fixed capital across industries. The first approach is setting the investment level in each industry exogenously. Several industries are treated that way, as most part of their investment originally comes from government or public investment. Public investment is perceived in the similar way to the model treat public spending.
The second approach tries to relate investment and real rate of return. It relates, for selected industries, the investment/capital ratio to the net rate of return (relative to the economy-wide rate). It is to be interpreted as a risk-related relationship with relatively fast- (slow-) growing industries requiring premia (accepting discounts) on their rates of return.

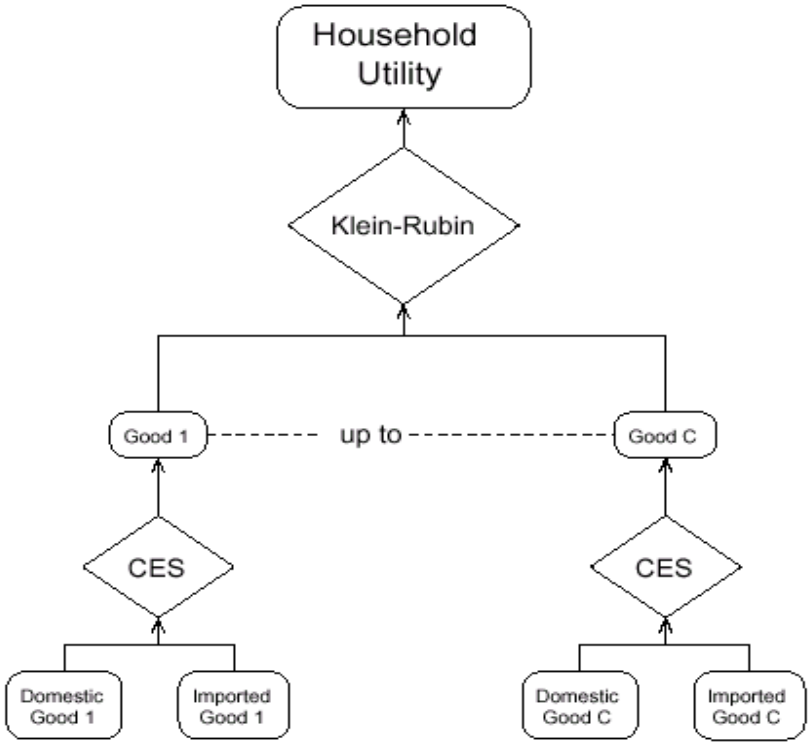
3.5. HOUSEHOLD DEMAND

The nesting structure is also applied for the household demand. Figure 3.3. describes the structure of decision on household demand. Top level of the diagram describes how household is assumed to make a decision on their consumption based on a range of choice of commodities. Consumers behave as if they maximize a single utility function subject to a budget constraint. The utility function is assumed to be Klein Rubin functional form.

The use of Klein-Rubin utility function on household behaviour leads to the linear expenditure system (LES) for household demand. In this type of demand system, expenditure consists of subsistence demand of the good, which is not related to the price and income, and supernumerary expenditure, which is a linear function of price and income. For the supernumerary part of consumption, households adjust their consumption between different types of commodities based on the changes in the relative price of all commodities.

After determining the type and the level of commodities consumed, households compose another step of decision by choosing whether consuming the locally produced goods or the imported one. In doing this, the model allow consumers to satisfy their demand for a good by drawing on imported and domestic sources with the two sources providing imperfect substitutes commodities. The consumption of a commodity is defined by a CES function. Consumers substitute between the two sources of supply in response to changes in relative prices of those goods.

Figure 3.3. Household Demands



Note: Adopted from Wittwer (1999).

3.6. EXPORT AND OTHER DEMANDS

Export is defined in WAYANG following a functional form that relates the demand for exported commodities with the price. The price that appears in the demand function is the fob price of the commodity. It includes payment for transport and other margins and tax involved in the delivery to an Indonesian ports, but it excludes any costs occur in the transportation to final destination.

The relation between demand and price exported commodities depends on the foreign elasticity of demand for export of a particular commodity. It provides more flexibility to treatment of export demand. To model export demand, commodities in WAYANG are divided into two groups: the traditional exports, which comprise the bulk of exports and the remaining, non-traditional one. The export demand of a traditional export commodity is represented by a downward sloping function of its price in foreign currency units. Non-traditional exports are generally small and volatile as shown in the estimation of export demand elasticities used in the function. For non- traded goods, the elasticities can also be set very small to represent the unimportance of export of those commodities.

Other demands in the model are mainly government demand and demands for margin commodities. The government demand, which represent the government spending, is basically determined exogenously. However, it is also common to treat the government demand endogenously, moving in line with real household expenditure. Both alternatives of the treatment to the government demand are determined through the macroeconomic closure selected in a simulation.

Demand for margins is treated to be straightforward. Margin commodities are defined as goods and services that provide facility to the flow of other commodities from the producers to the users. The model assumes that demands for margin commodities are proportional to the commodity demand. For example, if the demand for petroleum used in the chemical industry is doubled, then the amount of transport needed is also doubled.

3.7. THE PRICE STRUCTURE AND MARKET CLEARING

WAYANG recognizes several sets of price for commodities, namely basic prices, purchaser's prices, export prices and import prices. The price structure in the model defines and set out relationship between different types of price based on two initial assumptions. First, there is no excess profit in every economic activity and second, basic prices are uniform across users and across producers in a particular industry.

Basic prices are the prices received by producers as the result of the production process following the maximization revenue problem. They exclude all margin costs and taxes. For imported goods, the basic prices are the prices received by importers. They are cif prices plus import duties and tariffs. Taxes and margin costs associated with deliveries to users are excluded from the prices. The tariffs can be modelled as an a*d valorem* or specific rate on the cif import prices, depend on the model users. Purchaser's prices of commodities as intermediate inputs are determined by the zero excess profits assumption. The basic value of the output of an industry is equal to the total payment for inputs. Simultaneously, all industries set out basic price of commodities produced based on the purchaser's price of inputs used. The rule also applies in determination of purchaser's prices of inputs to capital creation.

The prices of exported commodities are the foreign currency prices paid by foreigner for units of goods at Indonesian ports. The price of an exported commodity is an fob price which includes export tax and margin costs involved in delivering to ports of exit. Export taxes are handled in the same way as the tariffs.

Another type of prices is purchaser's price for final consumption of all domestic and imported goods. The prices include consumer's prices and prices paid by government in its consumption. Consumer's prices include the costs of relevant margins and indirect sales taxes. As the model treats ten different household groups as consumers, margin costs and indirect taxes for different groups are also treated differently. That in turn provides flexibility on differencing purchaser's price faced by each household. The prices for government can also be model in the same way. However, the prices for government do not take part significantly, as explained previously government's demands are not modelled as being price sensitive.

3.8. GDP AND OTHER MACROECONOMIC AGGREGATES

WAYANG is basically a CGE model, which is static in nature and only deals with the "real" sector of the economy. The model is not equipped by macroeconomics variables and procedures. It does not contain monetary variables, for instance, as well as there is no "macro" treatment to price level or other macro aggregates. However, the model tries to give several aggregation to capture overall economic condition, based on the process taken place in micro level. Those important aggregates include the accounting of GDP, aggregate price level, aggregate employment, trade balance and a couple of less significant one.

GDP in this model is measured using both approaches expenditure and income side. From the income side, GDP is made up by nominal aggregation of payments or value added to all primary factors used

in the production including payment to the "other cost" ticket as well as payment for indirect taxes. As the payments to primary factors are considered nominal, the aggregate GDP computed is also nominal GDP.

From the expenditure side, all components of expenditure aggregates form GDP measure. Using the expenditure approach to calculate GDP gives two benefits. First, it provides a basic for accounting identity inspection, as GDP from both sides should be equal in nominal term. Second, it also allows distinction of real GDP calculation from the nominal. Price index for GDP can also be calculated using this approach. The model, in addition, calculates other price aggregates namely, consumer price index, export price index and import price index.

3.9. THE FISCAL EXTENSION

In order to make use of the fiscal information in Indonesia's national accounts data and other sources, we use a fiscal extension. Some coefficients and variables appear in the core part of the model, namely indirect taxes and current government expenditures. The core does not provide any information on capital expenditure by the government, except in so far as exogenous investment industries are defined. Public capital expenditure from the national accounts is allocated to exogenous investment industries. Also, income taxes on households vary proportionately with household income. The other missing fiscal details in the core part of the model are transfers to and from households and rest of the world.

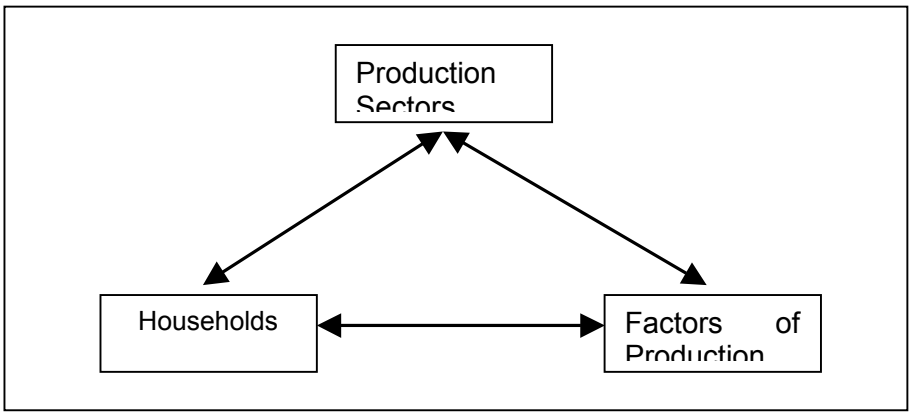
3.10. DISTRIBUTIONAL ASPECTS OF THE MODEL

The distinguished feature of WAYANG model is the capability of the model to estimate the distribution impact of economic policy. This feature comes from the mechanism that channeled the value added from production process into the income of different types of households and other institutions through the return to factors of production.

Figure 3.4 shows the linkages between production sectors in the economy into the income of households. The relation is provided by the ownership of factors of production. Demands of commodities from different households and institutions in the economy, determined the level of output produced by the production sectors. Households pay the particular amount of money regarding their consumption and demand. It generates the demand for labor of different types mobile and fixed capital, as well as land, which belong to households and other economic institutions.

The primary income distribution is, on the other hand, determined by the value added streams from the production sectors to different types of factors of production. Each factor receipt different rate of return; wages is going to labor, rents is going to land and profit to capital. The distribution of income depends on the ownership of different factors of production for each household. Household that abundantly own unskilled labor receipt more unskilled labor wages, which make it has different income to other household that provide more skilled labor. In translating the factorial distribution into income distribution, the classification of households based on the factor of production ownership is the crucial factor.

Figure 3.4. Sectoral Linkages in the WAYANG Model



WAYANG model categorize household in the Indonesian economy mainly based on the resource endowment and location of a particular household. This classification, following the one used in the Indonesian Social Accounting Matrix (SAM). The name of each household group explains the main source of income for household in the group. characteristics determine how the effects of shocks in the simulation distribute among different types of household.

3.11. DATABASE

WAYANG database is arranged in the form of Input-Output database, which is categorised into various economic agents and components. Database used in the WAYANG model is based heavily on the 1995 social accounting matrix (SAM 95) and 1995 input-output tables produced by BPS. Other supplementary data sources provide additional information used in the construction of specific tables such as for fiscal extension or import tax data.

Table 3.2. Households Population and Expenditure

Household Categories	Population		Consumption Expenditure		Per capita Expenditure
	Total (million)	Share (%)	Total (Rp. Bill)	Share (%)	
HH1 Landless	20.79	10.68	12,407	3.45	596.66
HH2 Small Cultivator (< 0.5 ha.)	32.99	16.94	29,642	8.24	898.48
HH3 Medium Cultivator (0.5 to 1 ha.)	13.80	7.08	15,256	4.24	1,105.82
HH4 Large Cultivator (> 1 ha.)	10.70	5.49	16,401	4.56	1,533.26
HH5 Non-Agricultural labour: low income	28.70	14.74	38,084	10.58	1,326.87
HH6 Rural non-labor households	9.10	4.67	9,414	2.62	1,034.79
HH7 Non-Agricultural labour: high income	15.27	7.84	57,486	15.98	3,765.17
HH8 Urban labour: low income	33.84	17.37	59,869	16.64	1,769.45
HH9 Urban non-labour household	10.20	5.24	16,603	4.61	1,628.17
HH10 Urban labour: high income	19.38	9.95	104,686	29.09	5,402.72

Source: BPS, Sistem Neraca Sosial Ekonomi Indonesia 1995 and WAYANG Database

In order to look at how the way of external shocks affect the various household aspects of the model, it is important to summarise the characteristics of the ten households represented in WAYANG. Table 3.2 provides this summary. The seven rural households account for 73% of total population and 61% of total consumption expenditure. The four poorest household categories, measured in terms of expenditure, are all rural. Poverty, in Indonesia as elsewhere in the developing world, is overwhelmingly a rural phenomenon.

The sources of income for the various households are important for the general equilibrium properties of the model and these are summarised in Table 3.3. These characteristics determine how the effects of shocks in the simulation distribute among different types of household.

Table 3.3. Household Data Characteristics

Household Categories	Skilled Labour	Unskilled Labour	Land	Fixed Capital	Variable Capital
HH1 Landless	1.17	45.59	27.39	7.60	3.49
HH2 Small Cultivator (< 0.5 ha.)	5.75	24.99	48.87	12.67	1.49
HH3 Medium Cultivator (0.5 to 1 ha.)	2.59	13.40	54.72	15.65	9.41
HH4 Large Cultivator (> 1 ha.)	3.73	7.29	57.76	16.38	9.22
HH5 Non-Agricultural labour: low income	6.16	38.07	28.78	8.56	6.71
HH6 Rural non-labor households	24.59	12.77	35.26	9.38	2.35
HH7 Non-Agricultural labour: high income	19.98	4.30	46.26	14.04	12.25
HH8 Urban labour: low income	12.26	23.28	44.26	11.97	3.99
HH9 Urban non-labour household	17.78	34.12	20.65	5.73	2.63
HH10 Urban labour: high income	23.53	1.32	55.40	14.82	4.09

Source: BPS, *Sistem Neraca Sosial Ekonomi Indonesia 1995* and WAYANG Database

3.12. AMENDMENT TO THE MODEL

Despite the advantage of WAYANG model to evaluate the distribution impacts of certain economic policies, the model, however, is not able to address poverty and income distribution issues properly since they do not provide any information on intra-group distribution. This issue should be addressed appropriately to obtain a better insight on poverty, considering that the household classification is not based directly on the level of income itself.

Some preliminary works has been done to the model using the mean income of every household as a basic of income distribution analysis (Damuri 2000). However, the assumptions behind this approach are obviously weak and unjustified. They involve the assumption that income is distributed evenly within each group of households. Further works are required to make analysis on income distribution more advantageous.

3.12.1. Parametric Distribution

To assess the impact on poverty through the CGE model, several approaches have been suggested and applied in some models. One method was discussed in details by Dervis et al (1982). This approach consists of assigning a parametric distribution function on income or expenditure for each group, allowing for further poverty and income distribution analysis. The flexibility and easiness of this method make this approach is commonly accepted for incorporating income distribution and poverty aspects of a CGE model.

The distribution of income within each group can be represented by a frequency function characterizing distribution within group. Lognormal distribution function is widely used to present income distribution within household groups. Another alternative formula for income distribution is the Beta distribution function, which allows the distribution to be skewed to the left or to the right depend on the choice of parameters representing characteristics of each household group. Decaluwe *et al* (1997) has used the distribution extensively in their archetype model. The distribution can be represented in the formula below:

$$(1) \qquad PDF = I(\frac{y - mn}{mx - mn}, p, q)$$

where *I(x, p, q)* is incomplete Beta distribution, known as:

$$(2) \qquad I(x, p, q) = \frac{1}{B} x^{p-1}(1-x)^{q-1}$$

and:

$$(3) \qquad B(p, q) = \int_0^1 x^{p-1}(1-x)^{q-1} \, dx$$

Unlike lognormal distribution, which depends on the mean and variance of a population, the Beta distribution are determined by the maximum, *mx* and minimum value, *mn* within the group of population as well as the parameters *p* and *q*. These parameters influence the shape and skewness of distribution. This study will employ the Beta distribution function in order to get intra-group distribution for every household group in WAYANG model. In order to find the appropriate beta distribution for each household group several statistical parameters related to expenditure data used in WAYANG database are derived from available data. The required parameters include mean or average of the group's expenditure, the standard deviation or variance within the group and the range of expenditure for every household group.

Table 3.4 summarizes characteristics of expenditure data for every group. These statistical parameters are estimated from various data sources available from Indonesian Bureau of Statistics (BPS) such as SUSENAS and SKTI. In estimating the parameters, several difficulties arise as the model's database was compiled based on several other data available. The main obstacle deals with data outliers. As the data in each household group have a very wide range value, adjustment on several parameters are required, especially for the maximum value of every group. However, the adjustment

Table 3.4. Statistical Parameters of Group's Expenditure Data

Households	Pop. (mill)	Consumption (Rp thousand)				
		Total (bn)	Mean	Std.Dev	Max	Min
HH1 Landless	20.79	12,407	596,657	327,990	1,688,324	93,502
HH2 Small Cultivator (< 0.5 ha.)	32.99	29,642	898,477	506,681	2,239,832	109,342
HH3 Medium Cultivator (0.5 to 1 ha.)	13.80	15,256	1,105,824	604,805	2,966,869	157,920
HH4 Large Cultivator (> 1 ha.)	10.70	16,401	1,533,256	859,510	4,450,303	214,832
HH5 Non-Agricultural labour: low income	28.70	38,084	1,326,873	765,219	3,099,226	89,286
HH6 Rural non-labor households	9.10	9,414	1,034,786	634,148	3,301,211	114,762
HH7 Non-Agricultural labour: high income	15.27	57,486	3,765,170	2,134,480	8,700,743	264,878
HH8 Urban labour: low income	33.84	59,869	1,769,453	1,071,808	4,975,671	143,572
HH9 Urban non-labour household	10.20	16,603	1,628,174	980,593	4,599,714	156,527
HH10 Urban labour: high income	19.38	104,686	5,402,721	2,893,519	11,917,069	749,669

Source: BPS, Sistem Neraca Sosial Ekonomi Indonesia 1995, SUSENAS, SKTI and WAYANG Database

The representative of probability distribution for each household appears on the appendix. These distribution are based on the particular beta distribution parameters estimated using various statistical parameters described above. The relationship between parameters *p* and *q* in the beta distribution and various statistical parameters of the expenditure data can be described using the formula below:

$$p = \bar{x}\left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1\right) \tag{4}$$

$$q = (1-\bar{x})\left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1\right) \tag{5}$$

while

$$\bar{x} : sample\ mean = \frac{\sum_{i=1}^{n} x_i}{n} \tag{6}$$

$$s^2 : sample\ \text{var}iance = {}^{1}\!/_{n} \sum_{i=1}^{n} (x_i - \bar{x})^2 \tag{7}$$

3.12.2. Poverty and Income Distribution Measurement

After having appropriate distribution for every household group, WAYANG model will be able to carry income distribution effect and poverty analysis of a particular economic shock. Here we use the most common approach for poverty measurement, the headcount ratio:

$$H = \frac{q}{n} \tag{8}$$

where *q* is the number of population living below the poverty line and *n* is the total population.

In addition to poverty incidence measurement, this model will also be completed by an income inequality measurement. Gini coefficient is the most frequently used to asses the rate of overall income inequality:

$$GR = 1 - \sum_{i}^{n} f_i \left(F_i + F_{i-1}\right) \tag{10}$$

where f is the frequency of population in the i th class, while F is the cumulative frequency of the particular class. The value of Gini Ratio lays between 0 and 1.

CHAPTER 4
SIMULATION AND CLOSURE

4.1. OVERVIEW

This chapter describes the simulation and closures of the model in detail. For the purpose of this study, we modified the original WAYANG CGE-model by developing additional equations and closures, and incorporating new data sets to be able to capture the impact of economic shocks, like fiscal policies, on poverty and income distribution. The focus of the simulation conducted in this study is to examine the implications of various fiscal policies on the Indonesian economy, including the distributional impacts on income and poverty.

The main feature of the simulation is a 20% across the board increase in the two major components of government expenditure, namely government consumption and investment. Another component of government expenditure, which is transfer payment, is kept constant. This study also simulates the differential impact of various financing mechanism and different macroeconomic closure on the economy. In other words, the study estimates not only the impact of general increase in expenditure but also the effect of various financing schemes and different treatments and assumptions of macroeconomic set-up.

The first section of this chapter discusses the closure used in all scenarios. The second section explains the the treatments of poverty and income distribution aspects of the simulation. The final part discusses specific closures related to a particular scenario.

4.2. GENERAL MODEL CLOSURES FOR THE SIMULATION

One important factor in conducting a simulation in a CGE model is the choice of model closures in the simulation. Like many other mathematical models with many equations, a CGE model often has fewer equations than variables. In general, the variables can be classified into endogenous and exogenous variables, depending on whether the values are determined within or outside the model. In order to obtain a unique equilibrium solution and to measure the impact of a certain simulation, the number of endogenous variables must be equal to the number of equations in the model. Therefore, a closure could be interpreted as a selection of endogenous and exogenous variables that is used or assumed in the model.

In economics sense, a choice of closure provides the macroeconomic setting to conduct a certain simulation. The usual simulation conducted in a CGE model is to change the value of a certain exogenous variables, of which sometimes are called policy variables because it reflects some policy changes, and to measure the impact of the changes on the equilibrium values of endogenous variables. Therefore, a closure provides certain macroeconomic assumptions behind the simulation. In that sense, a closure could reflect at least two important macroeconomic issues.

First, the closure is associated with the period of time that would be needed for the economy in the model to adjust fully as results of a particular economic shock; it may take form as a short run adjustment or a long run adjustment. Second the closure provides the assumptions needed for a particular simulation and describes various approaches to certain variables that the model could not explain in detailed. In this regard, the WAYANG model falls into a category of static and real economic model that has no detailed description of monetary and financial economic variables such as money demand and supply, interest rates and capital accumulation. In other words, the WAYANG model is a real sector model in which policy shocks affect the equilibrium values instantly. Because

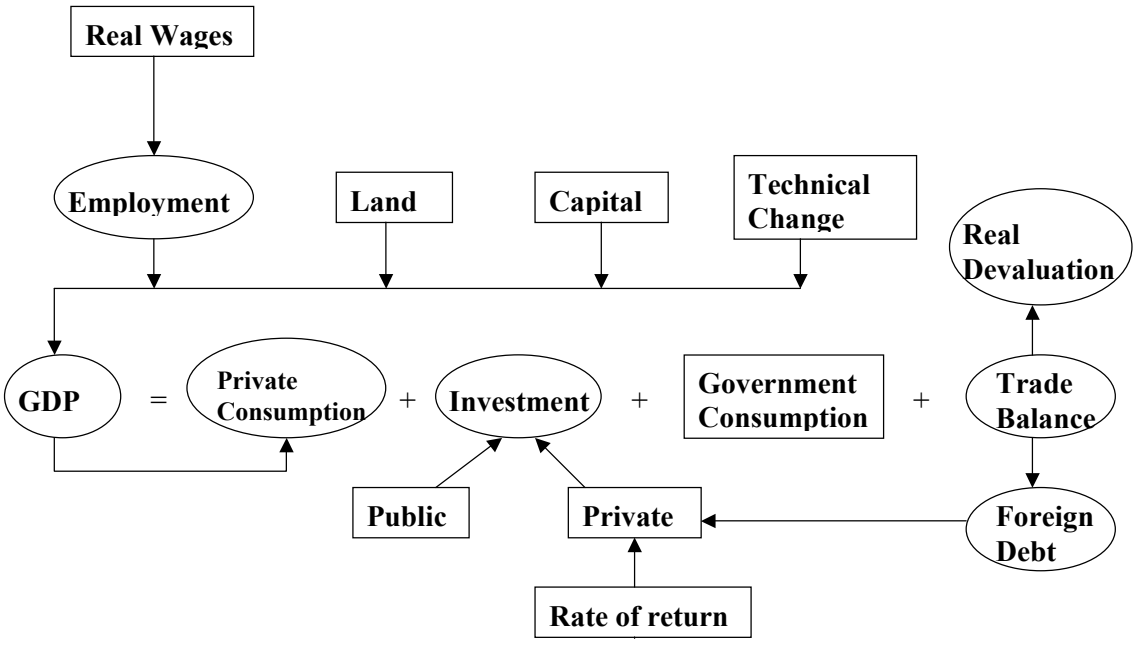
the model has not inter-temporal mechanism of adjustments, there is no explicit financial and monetary transmissions such that trace the movement of interest rates, exchange rates, and financial capital flows.

The simulation conducted in this study is intended to examine the result of 20 percent increase in government expenditure, in the form of consumption and investment, under a static general equilibrium framework. The closures must be made to reduce the inconsistencies between the nature of single period model and multi period aspects of certain variables in the model.

The closures that are used in all simulations in this study are described in Figure 4.1 Exogenously determined variables are presented by variables in rectangles, while the endogenous are those in ovals. The upper part of the diagram presents the supply side of the economy, which consists of factor inputs, such as employment, land, capital, and technical change. The demand side of the economy is illustrated in the lower part of the diagram, which describes the components of GDP like consumption, investment and trade balance. The linking arrows illustrate the direction of interdependences between variables. It is just a simplification as in the simulation the effects of a particular shock will be determined simultaneously.

In the supply side, what matters in affecting individual's income is the payment to factor of production that the individual holds. In the labor market for example, the changes in labor's income is reflected in the changes in value of the labor input to production sectors, which can be decomposed into changes in employment and wage. The closure in this model assumes a fixed real wages, so that any shock in the economy is absorbed through changes in employment. Labors are freely moving between sectors in the economy, while the total stock of labor is fixed. The number of labor in the market will adjust according to the change in the labor demand, without affecting the level of real wages. In short, it is assumed that the labor markets are not fully employed during the period of adjustment, which commonly fit the situation of labor surplus economy in the developing countries like Indonesia. The model also assumes that other factors of production such as land and capital stocks remain unchanged, as it takes some time for those factors to be affected by the economic shock. However, as the use of capital is also affected by investment, the capital usage in a particular industry may adjust to the change in investment.

Figure 4.1 General Closures of The Simulation



In the demand side, the shocks take place in the form of 20 percent increase in government consumption and investment. These shocks will generate adjustment in the demand side, forcing GDP and variables in supply side of the economy to adjust to the changes, including the change in demand for factors of production. As labor market can adjust freely to the demand change, employment increase in the case of increasing demand without significant adjustment in real wages, which in turn leads to an increase in GDP.

The change in government and public spending would also lead to a change in domestic absorptions. This simulation assumes that trade balance move freely towards deficit in response to the increase in government expenditure. By allowing the balance of trade to change, the capital flow also move freely towards deficit or surplus generated by the change in domestic absorption. Implicitly, the closure also allows foreign borrowing to take place in the economy, financing the change in investment without adjustment in the rate of return or interest rate. Here, the model assumes a fixed interest rate, and therefore a constant real private investment to restrict the inter-temporal effects of investment. In other words, private investment is not crowded out by the increase in government expenditure.

4.3. POVERTY AND INCOME DISTRIBUTION ASPECTS

As explained in the previous section, the distribution of income across different household groups depends on types and the amounts of factors of production that a particular household owns. For example, the household group that owns skilled labor relatively more than other factors of production will receive their income mostly from the wage payment to that category of labor. Each type of factors of production has different values of value-added depends on the return to the factor and the quantity used in the economy. The difference in ownership, types, and value added of different factors of production is the main point to understand the link between the adjustment of an economic shock and the distribution of income across household groups.

An economic policy in a simulation affects the utilization of factors of production in either one of two ways; it changes the return to factors of production or adjusts the quantity of the factors used in the economy. The change in one of the two variables would lead to a new formation of value added to a particular factor of production. This, in turn, changes the value of value added received by household groups. An increase in demand of skilled labor as a result of a certain economic shock would lead to an increase in value of skilled labor, and in turn would make the value added obtained by household groups that owned this factor increase as well. The increase in the value of skilled labor comes from the increase in wages (price), or employment (quantity), or the combination of the two.

The simulation in this study is conducted under the short run and static macroeconomic closure. As explained in the previous section, this closure assumes the rigidity of wages in all labor market, while the number of labor itself can move freely toward the economic adjustment. The change in demand of factors of production is transformed to a change in the number of labor employed in the production sector instead of adjustment in wage rates. Although the changes do not take place in wage rates, the results on distribution of income across households are similar. The change in number of employment would adjust the value added received by household groups that in turn change the distribution of income between groups.

The changes in distribution of income among different groups of household serve as a basic framework in determining changes of income distribution in each group, using the method explained previously. However, since the model only has information on the value added to factors of production owned by households as a group, not individual household, there is no information available on the change of value added for the individual one. Based on the information, the change in income or expenditure variables can only be assumed to distribute equally among households within each group. In a more technical term, the simulation only affects the average of income and

expenditure variables of each group, and *does not affect* the variance of income distribution within the group. The distributional aspect of the simulation comes from the fact that the overall distribution of income and expenditure of the entire population will change because the change of average income and expenditure varies between one group of household and another.

4.4. SIMULATION SCENARIOS

In order to have detailed examination on the effects of 20% increase in government consumption and investment, the simulation is based on four different scenarios. The first three scenarios use the general closure described above, where trade balance is floating. The different between those three scenarios is in the way the increase in government expenditure is financed. For each scenario different type of tax rate adjustment is assigned to cover the increase in government expenditure. The last scenario is a variant to the first scenario with a different treatment of trade balance.

The first scenario examines the effects of 20% increase in government expenditure that is financed by an increase in government's budget deficit. In this scenario the government budget deficit is allowed to increase sufficiently to finance the 20 percent increase in the government expenditure, without having the revenue to change to cover the increase. Implicitly, this scenario ensures that the government can make borrowing to cover the increase in expenditure.

The second and third scenarios deal with different ways of tax financing to cover the increase in government expenditure. In the second scenario, income tax rate adjusts to ensure that the government borrowing is unaffected by the increase in the expenditure. In other words, the budget deficit is fixed. In the third scenario, income tax rate adjustment is replaced by the adjustment of sales tax. Through these different ways of financing, the effects of different types of deficit financing can be examined in more detail. This type of scenario is widely used in many CGE simulations to demonstrate the effect of different ways in financing budget deficit. Horridge et all(1995), for example, used the similar approach in conducting their simulation on fiscal expansion in South Africa.

The fourth scenario is a slight modification of the first scenario. Similar to scenario 1, it assumes that the increase in the government's expenditure is financed through borrowing, creating higher deficit in the budget. However, this scenario assumes a fixed trade balance. By having trade balance unchanged, there is no capital flow and foreign borrowing allowed to keep private investment unaffected. The increase of public investment pushes the interest rate to soar as no foreign borrowing takes place. This in turn drives the private investment down to adjust to the changing economic condition. In macroeconomic terms, the last scenario deals with a condition where private investment might be crowded out due to a shock in government expenditure and investment.

CHAPTER 5
RESULTS

5.1. OVERVIEW

This chapter presents the results of the simulations. The discussion starts with the impacts on macroeconomic variables. It is then followed by the impact on the sectoral and industrial level. The impact of various schemes of fiscal expansion on income distribution and poverty, which is the main part of this research, is presented in the final two sections.

5.2. MACROECONOMIC IMPACTS

Summary of the macroeconomic or economywide impacts of fiscal expansion under the four scenarios is presented in table 5.1. In this section we will discuss four aspects on the macroeconomic impacts: 1) the effects on Gross Domestic Product (GDP), 2) the effects on employment, 3) changes in the government budget, and 4) the household impact.

Table 5.1 Economy Wide Impacts of Government's Spending Expansion

	Scenario			
Impact on	**1**	**2**	**3**	**4**
Overall Economy:				
Gross Domestic Product				
Nominal	3.53	1.06	2.61	0.84
Real	1.97	0.93	0.45	0.83
GDP Deflator	1.53	0.12	2.16	0.01
Employment:				
Skilled	7.68	5.09	3.92	5.04
Unskilled	3.93	1.54	0.55	-0.04
Return to variable capital (nominal):				
Non-agriculture	0	0	0	0
Agriculture	2.12	-1.43	-2.82	0.71
Government Budget:				
Revenue (nominal)	3.12	16.31	16.4	0.1
Expenditure (nominal)	18.96	18.34	18.44	14.56
Budget Deficit (Rp bill)	12,142.35	--	--	11,359.58
Changes in Tax *	--	2.98	4.68	--
Household Sector:				
Consumption				
Nominal	3.4	-1.74	0.19	0.8
Real	2.07	-1.53	-3.09	0.6
Consumer Price Index	1.31	-0.21	3.38	0.2
Real Rate of Return	0	0	0	31.78

Notes: All results are percentage change unless otherwise stated
* The change is percentage changes in the power of tax (1 + tax rate)

Gross Domestic Product

It is expected that the strongest effect of fiscal expansion is obtained from scenario 1 because fiscal expansion is financed by loan, which will be paid in the future, so that there is no crowding out effect trough tax increases. This reflects the static nature of the model in which the economic agent does not expect to pay back the debt through higher taxes and lower potential income in the future. However, when the budget deficit is accompanied by fixed trade balance (scenario 4), the impact of fiscal expansion on real GDP is smaller than that of scenario 1. Consistent with the closure developed for model, fixed trade balance means that the real rate of return on capital or real interest rate increases as a result of fiscal expansion. Higher interest rate leads to lower private investment and crowds out the positive effect of fiscal expansion on aggregate demand. In other words, the total positive effect of fiscal expansion on real GDP is reduced. In contrast with scenario 1, the real interest rate is kept constant by floating the balance of trade. With a fixed interest rate, any pressure to raise interest rate will be offset by the inflow of foreign capital inputs and therefore changes in trade balance.

The simulation results confirm the hypothesis. An increase of government spending and investment by 20%, or 2.24% of GDP, leads to an increase of nominal GDP by around 3.3% in scenario 1, and by 0.8% in scenario 4. In real term, scenario 1 consistenlty gives the biggest impact, 1.97%, while the other scenarios only lead to a less than 1% increase of real GDP. Prices also tend to be constant in scenario 4, since trade balance is fixed under the scenario. Consequently, any fiscal expansion and increase in domestic demand has to be filled by domestic supply, so there is both demand and supply expansion.

Scenario 2 and 3 lead to the increase of nominal GDP by 1.06% and 2.61% respectively. Nevertheless, the increase of real GDP is higher in scenario 2 (0.93%), compared with that in under scenario 3 (0.45%), as scenario 3 leads to increase in prices by 3.3.8%. Conversely, prices decline by 0.21% in scenario 2. The reason for this is clear. The increase in sales tax has a direct impact on prices and leads to higher increase in prices compared with the results of other scenarios. On the other hand, an increase in income tax would reduce overall income and depress demands, which in turn lower inflationary pressure. The higher impact on real GDP expansion under scenario 2 implies that financing fiscal deficit through income tax has a larger effect on real GDP because the impact on prices can be minimized.

Employment

In the model, we implicitly assume that the adjustment in the labor sector is captured by changes in employment rather than in wages. Hence, our analysis regarding to the labor market only concerns on the changes in employment after the shock. The effects on employment is consistent with changes in GDP. The highest impact is obtained from scenario 1, with a 7.68% increase in employment. Scenario 2 and 4 gives relatively similar effects, increasing employment by around 5%, while scenario 3 only increase employment by less than 4%.

Government Budget.

From the expenditure side, a 20 % increase in the government spending and investment leads to around 18-19% increase in total government expenditure. The difference basically arises from the transfer of payment which is assumed to be fixed.

In scenarios 1 and 4, as expected, budget deficit increase by Rp11-12 trillion. That is equal to 2% to GDP. Note that despite all increases in expenditure are financed through increasing budget deficit, there is still increases in tax revenue in both scenarios. This is due to the increase in tax base, i.e. higher income gained because increased budget deficit provides stimulus to the economy.

In scenarios 2 and 3, the increase of government revenue needed to finance the 18.4% on expenditure is 16%. It is interesting to note that the necessary increase in income tax rate is lower than that of the sales tax in order to finance the 20% increase in government spending and investment. Measure by

the power of tax (defined by 1 + tax rate), the required increase in income tax is estimated to be 3% while that of sales tax is 4.7%.

Effect on Personal Consumption

The impact of fiscal expansion on personal consumption plays a crucial role in determining poverty level because the changes in personal expenditure is used to calculate the changes in poverty level. The results of the simulation clearly show that the significant increase in personal consumption takes place in scenario 1, in which fiscal expansion is financed by budget deficit. In fact, the impact of fiscal expansion on personal consumption is negative when fiscal expansion is financed by taxes. In other case, when budget deficit is accompanied by fixed trade balance (or increase in interest rates), the impact of fiscal expansion on the increase in personal consumption is small.

Based on scenario 1, 20% increase in government spending and investment is expected to raise personal consumption by 3.4% in nominal term and 2.1% in real term. But based on scenario 2, when fiscal expansion is fueled by higher income tax, the impact on personal spending is estimated to be –1.74% in nominal terms and –1.55% on real terms. This is not surprising because an increase in income tax would directly reduce personal consumption.

It is interesting to note that the decline in real consumption expenditure is larger when the sales tax, rather than income tax, is used to finance the budget expansion. The result of scenario 3 shows that household consumption increases by 0.19% in nominal term, but decline by 3.09% in real term, because prices (CPI) is expected to increase by 3.4%. The results confirms the notion that the change in personal consumption depends on inflation because what matters in poverty alleviation is not the changes in nominal but real expenditure. In other words, small increase in nominal personal expenditure could potentially lead to large increase in real expenditure, and rapid decline in poverty level, when inflation is low.

5.3. OUTPUT AND TRADE

The analysis of this section concerns on: 1) changes in sectoral output, 2) changes in industry-level oputput, 3) changes in commodity prices, and 4) the impact on the international trade.

Sectoral output

Table 5.2 below presents the impact of fiscal expansion (based on scenario 1-4) on production or output of aggregated sectors. The results show that fiscal expansion through deficit financing leads to higher outputs in the agricultural and services sectors. Based on the result in scenario 1, for example, 20% increase in government spending and investment is expected to increase the output in the agricultural and services sectors by 1.6 and 3.6% respectively. The impact on manufacturing production is also positive, but at a lesser extent, while the impact on natural resource sectors like mining is mixed. The increase in tax to finance fiscal expansion as modeled in scenario 2 and 3 has negative impact on agriculture. The production of the agricultural sector is expected to decline by 1 to 2%.

Table 5.2. The Changing Patterns of Sectoral Output (% change)

	Scenario			
Sectors	**1**	**2**	**3**	**4**
Agriculture	1.56	-1.07	-2.11	0.53
Manufacture	0.80	0.52	0.41	-0.10
Service	3.58	2.23	1.60	1.57
Natural Resources	0.86	0.49	0.33	-0.32

Industrial output

The changing patterns of industrial outputs as a result of fiscal expansion (scenario 1) in more detailed can be seen in Table 5.3. In the table the changes in output is decomposed into three sources: changes in output for local markets, changes in imports, and changes in exports. In general fiscal stimulus as simulated based on scenario 1 leads to increasing imports (negative growth of import substitution) and lower exports (negative growth of export). In other words, increasing demands in the domestic market are met by an increased in domestic supply and import, and a lower level of export.

By looking at various industries, large increase in industrial output takes place in construction by 5.69%, followed machinery (2.33%), real estate (1.63%) and petroleum refinery (1.59%). Output in the natural resources and sea products industries change by only less than 1%, while textile and clothing industries expect declines in their output by 0.06% and 0.51% respectively.

Table 5.3. The Impact of Fiscal Stimulus on Industrial Output (% change)

Scenario 1: Budget Deficit Financing

	Sources of Change			
Industry	**Local Market**	**Import Substitution**	**Export**	**Total Change**
Paddy	1.43	0.00	0.00	1.43
Livestock	1.56	-0.13	-0.02	1.41
Wood	1.14	0.00	-0.02	1.12
Sea products	1.00	0.00	-0.22	0.78
Rice	1.48	-0.04	0.00	1.44
Sugar and Confectionary	1.26	-0.07	-0.09	1.10
Textile	0.81	-0.16	-0.71	-0.06
Clothing	1.04	0.00	-1.55	-0.51
Petroleum Refinery	2.18	-0.07	-0.52	1.59
Machinery	3.75	-0.88	-0.54	2.33
Electronics	2.74	-0.58	-0.88	1.28
Construction	5.69	0.00	0.00	5.69
Trade	1.77	0.00	-0.28	1.49
Real Estate	2.05	-0.34	-0.08	1.63

Commodity Prices

Table 5.4. presents the changes in prices, classified into firm's and buyer's price in the first and third simulation scenario. The results show that in general fiscal expansion, either financed by increasing budget deficit or sales taxes, leads to increase in prices. But in a more detailed analysis, the different between buyers' and sellers' prices is larger in scenario 3. This is due to the tax effect. The presence of tax also tends to increase buyers' prices but lower sellers' prices. Commodities with high tax rates – e.g. electronics, machinery, petroleum refinery, woods and processed food – appear to experience the highest increase in prices

Table 5.4. Price Effects of Fiscal Expansion : Scenario 1 and 3 (% change)

	Budget deficit (scenario 1)		Sales tax (scenario 3)	
Commodities	**Sellers**	**Buyers**	**Sellers**	**Buyers**
Paddy	0.56	0.00	-0.69	0.00
Livestock	2.96	2.96	-3.61	0.69
Wood	1.70	1.86	1.21	5.03
Sea products	1.43	1.63	-2.25	1.91
Rice	0.68	0.99	-0.77	3.24
Sugar and Confectionary	0.96	1.22	-0.90	3.16
Textile	0.38	0.73	-0.29	3.68
Clothing	0.40	0.75	-0.26	3.71
Petroleum Refinery	0.43	0.77	0.17	4.09
Machinery	0.54	0.86	0.07	4.02
Electronics	0.78	1.07	0.14	4.08

International Trade

Table 5.5. presents the impact of all simulations on export and import of selected major commodities. By looking at the changes in trade balance, the simulation results show that higher government spending leads to higher imports and lower exports in scenario 1 and 2. An increase in government spending and investment clearly lead to larger aggregate demands for domestic and imported goods. Compared with the results in scenario 2, larger increase in overall domestic demand in scenario 1 leads to larger imports and reduction in trade balance. In scenario 3, however, export is expected to increase larger than imports, mainly because of the difference in price effects. Sales tax leads to lower price at the firm or producer side and higher price at the consumer side. Declining price at the firm level makes Indonesian products look more competitive and in turn leads to higher exports.

Looking at the results on individual commodities, deficit-financed fiscal expansion leads to weakening export and higher import for almost all major commodities. The impact of scenario 4 is lower, obviously, as the trade balance is assumed to be unchanged. Wood and electronics are commodities experiencing the biggest drop in export. Increase in taxes lead to higher exports for commodities with lower tax (i.e. wood, textile, clothing), but decline in export for commodities which are heavily taxed. The impact of scenario 2 and 3 on import of selected major commodities does not vary too much.

The terms of trade is increasing in all scenarios execpt scenario 4. It illustrates that the impact of the increrase in budget deficit or income tax lead to higher prices of Indonesian commodities in the world market. At the same time, the country imports more cheaper goods.

Table 5.5. The Trade Balance Effect (% change)

Selected Commodities	Scenario 1		2		3		4	
	Export	Import	Export	Import	Export	Import	Export	Import
Wood	-6.97	2.85	0.04	2.44	3.28	2.26	-0.71	-1.53
Textile	-3.05	2.94	0.20	-1.82	1.55	-3.51	-0.31	0.77
Clothing	-3.13	1.74	0.04	-1.08	1.38	-2.27	-0.29	0.62
Refined Petroleum	-3.26	2.93	-1.32	0.90	-0.48	0.09	-0.05	0.07
Machinery	-3.68	4.89	-1.18	3.86	-0.09	3.40	0.29	-2.38
Electronics	-4.70	4.07	-1.60	1.44	-0.36	0.37	0.03	-0.70
ALL COMMODITIES	-4.03	3.84	-0.48	1.30	1.09	0.23	-0.24	-0.18
Trade Balance *	-1.47		-0.36		0.15		0.00	
Terms of Trade	0.83		0.10		-0.22		0.05	

Note: * Number shows percentage of trade balance over GDP (% balance of trade/GDP)

5.4. INCOME DISTRIBUTION

There are three mechanisms through which economic policy gives influences on distribution of income across household. The first is through the direct effects of income due to the changes of primary factor returns. As the effects of the economic policy take place, households as the owner of primary factors will receive more income if the price of their owned primary factor increase, while the income goes down in the opposite situation. Since each household control different combination of primary factors, the result on their income also varies across households.

The second mechanism is the effects of income tax changes to household disposable income. One of the scenarios in this simulation shows the effect of government expenditure expansion while the budget is fully recovered by the adjustment of income tax rate. Changes in the tax rate vary between different household groups. Tax condition in Indonesia affects how the change in gross income realized in disposable form.

The price effect is the last factor that contributes to the change in income. While the changes in factor income can be seen as the effect of the policy to household in the "supply" side, the effects of price changing affect household from "demand" side. Since each household has different consumption pattern, the effect of price changes on household budgets also vary. These effects will affect the distribution of real income.

All of those factors affect the change in real consumption of different household groups that would be examined further. To explore the effect of the increase of government expenditure, all three factors above are examined by looking in turn at changes in nominal gross income, net income and then real disposable income and consumption expenditures. The three aspects above represent the factors affecting change in distribution of income that in turn reflect the change in poverty incidence. The first aspects in analyzing income distribution effect of the policies are shown in the Table 5.6. Changes in nominal gross incomes for each group of household, as displayed in the table, arise from changes in the factor incomes through changes in primary factor returns.

Most scenarios of fiscal expansion lead to positive effects on the nominal gross income for all groups except for several groups under scenario 3. As expected from the macroeconomic result, the highest

changes in gross income occur when the fiscal expansion is conducted under budget deficit scenario. Under other scenarios, the effect does not as significant as the deficit one. The different in the results can be associated to the change in overall economic performance. Under deficit scenario, expansion of the government expenditure provides stimulus to the economy without imposing burden to pay it, while in other scenarios, the increase in government expenditure means increase in government revenue, which is imposed to the economy.

Looking at more detail in scenario 1, unequal distribution of the policy effects appears quite obvious. Most household groups receive more than 3% increase in their gross income, while for some groups, the changes are less significant, especially for medium and large farmer in rural areas. The largest benefit falls to urban households, which enjoy an increase of more than 3.5%.

Table 5.6. Nominal Gross Income Changes Under Various Scenarios

	Scenarios			
	1	**2**	**3**	**4**
HH1 Landless	3.01	0.66	0.06	0.05
HH2 Small Cultivator (< 0.5 ha.)	3.15	0.40	-0.12	0.27
HH3 Medium Cultivator (0.5 to 1 ha.)	2.61	0.10	-0.46	0.17
HH4 Large Cultivator (> 1 ha.)	2.60	0.12	-0.48	0.23
HH5 Non-Agricultural labor: low income	3.16	0.46	0.35	0.36
HH6 Rural non-labor households	3.76	1.47	1.11	1.29
HH7 Non-Agricultural labor: high income	3.44	0.89	0.02	1.14
HH8 Urban labor: low income	3.45	0.79	0.20	0.64
HH9 Urban non-labor household	3.53	1.18	0.73	0.93
HH10 Urban labor: high income	3.74	1.38	0.35	1.23
Gini Ratio	0.43	0.43	0.43	0.43

To explore the changes in gross income of each household, detail inspection on the sources income changes are quite meaningful. Table 5.7 shows the decomposition of these changes into their sources by factor of production for every household under the budget deficit scenario. This decomposition is based on the contribution of primary factor owned by specific groups. The more important the specific primary factor on a particular household income, the more significant the changes of its return on that household group. Note that the total of income from primary factor increase more than those in table 6, due to the exclusion of production tax and transfer to the households.

WAYANG database (shown in the table 3.3 above) reveals that unskilled labor plays important factor as the source of income in the rural areas, particularly for lower to middle income household group. For agricultural labors which own no land, unskilled labor account for around 45% of their income. Unsurprisingly, the increase in the number of employment unskilled labor due to the expenditure expansion gives positive contribution to the whole group's income. As explained before, changes in the income variables might be associated not only to the changes in the price (wages), but also to the changes in the quantity (employment) of primary factors used in the production sectors. However, rural households whose income mostly comes from land are not able to generate higher positive income changes. Household 3 and 4 whose income mostly comes from land, do not receive high increase of gross income. It is in line to the assumption of simulation that hold fixed both the price and quantity of land.

Skilled labor income, which contribute largely to the richest groups of urban households also provide higher increase to their gross income along with the increase of employment. Moreover, positive

changes in return on fixed capital also contribute further expansion of income, particularly to the richest household groups both in rural and urban area.

Table 5.7. Sources of Gross Income Changes (Scenario 1)

	Skilled Labor	Unskilled Labor	Fixed Capital	Variable Capital	Total
HH1 Landless	0.11	2.11	0.99	0.04	3.25
HH2 Small Cultivator (< 0.5 ha.)	0.54	1.20	1.83	0.03	3.61
HH3 Medium Cultivator (0.5 to 1 ha.)	0.23	0.61	1.96	0.11	2.91
HH4 Large Cultivator (> 1 ha.)	0.33	0.34	2.08	0.11	2.86
HH5 Non-Agricultural labor: low income	0.56	1.76	1.05	0.08	3.45
HH6 Rural non-labor households	2.12	0.56	1.21	0.03	3.93
HH7 Non-Agricultural labor: high income	1.80	0.20	1.68	0.14	3.81
HH8 Urban labor: low income	1.11	1.08	1.61	0.06	3.86
HH9 Urban non-labor household	1.59	1.56	0.74	0.03	3.93
HH10 Urban labor: high income	2.03	0.06	1.91	0.06	4.06

Beside primary factor contribution to households' income, the changes on distribution are also affected by the changes in income tax. The effects are obviously observed in scenario 2, which financing the change in government expenditure by adjusting income tax rate. By setting government budget exogenously in the closure, every pressure on the government budget would be directed to income tax changes by changing the tax rate. Consequently, income tax changes for each household are not proportional to their income changes. The greater the income tax paid by households, the more significant their claim to the tax reduction effect of the policies. Table 5.8 shows take home income change for different household groups under scenario 2. Since the income tax rate in other scenarios is assumed to be unchanged, income tax paid by households, changes proportionally to the change in gross income.

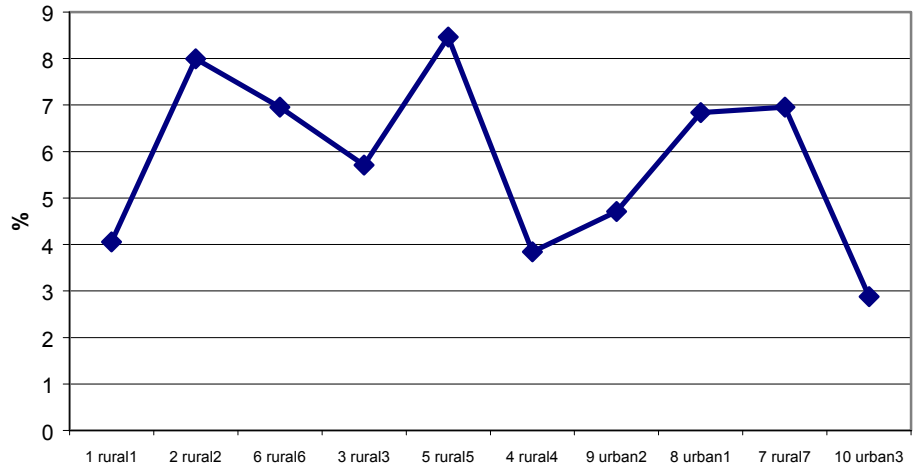
It is shown that financing government expenditure by adjusting income tax rate results reduction in take home income for all household groups. The gross income change in this scenario is actually less than gross income in other scenarios. This is amplified by the income tax rate changes that reduce income even further. Note that the changes in income tax differ from one household to another. It is also interesting to observe that the changes in tax rate might not be associated to the level of income. Table 8 also provides the information on what percentage of gross income that goes as the additional income tax paid by each household.

Table 5.8. Changes in Take Home Income (Scenario 2)

	Net Income	Gross Income	Difference (Gross - Net)
HH1 Landless	-1.36	0.66	2.02
HH2 Small Cultivator (< 0.5 ha.)	-3.23	0.40	3.63
HH3 Medium Cultivator (0.5 to 1 ha.)	-3.25	0.10	3.35
HH4 Large Cultivator (> 1 ha.)	-2.65	0.12	2.77
HH5 Non-Agricultural labor: low income	-3.49	0.46	3.95
HH6 Rural non-labor households	-0.55	1.47	2.02
HH7 Non-Agricultural labor: high income	-1.44	0.89	2.33
HH8 Urban labor: low income	-2.47	0.79	3.26
HH9 Urban non-labor household	-2.19	1.18	3.37
HH10 Urban labor: high income	-0.15	1.38	1.53

Several richer households both in urban and rural area pay less additional income tax compare to several poorer one. This finding can be associated to a relatively regressive tax rate to different household. WAYANG database reveals that the richer the household does not automatically pay higher income tax rate. In fact the richest group, high-income urban labor, pay the lowest rate among other households. Figure 5.1 below shows the general income tax rate to each group of household, arranged from the lowest to the highest income group.

Figure 5.1. Income Tax Rate for Different Groups of Household



After examining the effect of the shocks to distribution income from the income itself, the last factor, which is the effects of policy to the change of household's purchasing power, is also important to mention. Price increase reduces the real income of household, which cut off their purchasing power and consumption. Table 5.9 provides real take home income. These are derived by deflating the change in each household's nominal gross income by a corresponding consumer price index. The index reflects the consumption pattern of that particular household.

As shown in the table, all households earn lower real income under scenarios, of which the budget deficits are financed by the increase either in income tax rate or the sales tax. The reductions are bigger under the third scenario. Even households in urban area that obtain most benefit from the increase of skilled and unskilled labor, also suffer from real income lose. These happen because the increase of government expenditure in this scenario pushes sales tax rate to soar for financing the deficit. The price increase associated to the higher tax for consumption, unavoidably, puts more pressure to the purchasing power of the households. Urban poorer household is among the one which lose real income most.

There is another factor that notable to be mentioned in measuring purchasing effect of the policy, namely the effect of the policy into household real consumption expenditures. The changes in this aspect reflect the changes in the welfare of household. The effects of government's expenditure Households' on real consumptions, however, do not differ too much than the change in their real net income as the simulation is conducted under the assumption of fixed consumption and income ratio. This real consumption serves as the basic for further analysis of poverty incidence and income distribution.

Table 5.9. Real Take Home Incomes

	Scenarios			
	1	**2**	**3**	**4**
HH1 Landless	1.70	-1.15	-3.32	-0.15
HH2 Small Cultivator (< 0.5 ha.)	1.84	-3.02	-3.50	0.07
HH3 Medium Cultivator (0.5 to 1 ha.)	1.30	-3.04	-3.84	-0.03
HH4 Large Cultivator (> 1 ha.)	1.29	-2.44	-3.86	0.03
HH5 Non-Agricultural labor: low income	1.85	-3.28	-3.04	0.16
HH6 Rural non-labor households	2.45	-0.34	-2.28	1.09
HH7 Non-Agricultural labor: high income	2.13	-1.23	-3.36	0.94
HH8 Urban labor: low income	2.14	-2.26	-3.19	0.44
HH9 Urban non-labor household	2.22	-1.98	-2.66	0.73
HH10 Urban labor: high income	2.44	0.06	-3.03	1.03

In conclusion, the benefits from a fiscal expansion are mainly transferred to the urban households and non-labor rural households, which are basically the wealthiest segments of the society. There are several explanations on such phenomenon. First, those segments possess factors of production which are benefited most from the policy, i.e. skilled labor and fixed capital. Second, those types of household are not affected significantly by the increase in prices. This is due the structure of consumption of each households. Third, the data revealed that the tax system in Indonesia is regressive. That means rich households are taxed less than the poorer ones, in real term.

However, Gini ratio in all four scenarios is relatively unchanged. It suggests that income distribution is not affected much by the policies. The reason is since the population of urban and non-labor rural households is only a smaller part in total population. Hence, a big gain received by those households does not affect the overall income distribution very much. Another reason is related to the limitiation on the model, in which variance of household income in each group is assumed constant. This will be explained later in the concluding chapter.

5.5. POVERTY

As mentioned in the earlier chapter, a household is defined as poor if its income is below a given poverty line. Since the data on household income is not available, we use household expenditure as proxy of household income, consistent with the official measurement of poverty in Indonesia. The official poverty line, calculated by BPS, is derived based on a group of commodities representing the basic needs required to meet a certain standard of living. There are 52 commodities included in the official poverty line calculation.

Since the model uses the 1995 SAM as the database, we need to base the poverty calculation on the official poverty line in the same year. Unfortunately, the BPS only publishes the official povert line once every three year, and the nearest available data is in 1993 and 1996. To obtain the 1995 poverty line, we do an intrapolation by deflating the available 1996 poverty line the inflation rate in the respective year. Using the calculation, the 1995 real poverty line is Rp421,116 per year for urban areas, and Rp301,836 per year for rural areas. Since in the model we use real consumption expenditure, we do not have to adjust for price changes after simulations and modify the poverty line.

Table 5.10 presents the results on each scenario on poverty incidence. If fiscal expansion is financed by increasing budget deficit (scenario 1), population under the poverty line is expected to decline by around 9.5%. Poverty declines faster in the urban compared with in the rural areas. However, since the population of urban poor is relatively small, the decline in absolute term is smaller than the decline in rural poor population. Table 5.10 also shows that small cultivator, landless household and low-income labor households in the rural areas, along with the low-income labor in the urban areas, are segments who benefit most from the policy, in numbers of population escaping from poverty. But, since these segments are the largest proportion in total population, decline of poverty in percentage terms are small.

Increasing taxes, either income or sales taxes, would result in higher population living below the poverty line. Higher income taxes (scenario 2) is associated to almost 13% increase in poor population, while higher sales taxes (scenario 3) increases poor population by more than 17%. The effect of income tax is larger since income tax rate is progressive. Therefore

Table 5.10. Impact of Fiscal Expansion on Poverty

	1		2		3	
	%	Population	%	Population	%	Population
HH1 Landless	-5.98	-270,801	4.21	190,492	11.89	538,237
HH2 Small Cultivator (< 0.5 ha)	-8.95	-369,213	16.05	662,011	18.11	746,644
HH3 Medium Cultivator (0.5-1 ha)	-9.27	-80,929	24.47	213,600	30.41	265,409
HH4 Large Cultivator (> 1 ha)	-14.19	-33,535	32.02	75,678	51.89	122,643
HH5 Non-Agricultural labour: low income	-10.48	-248,506	21.10	500,249	18.72	443,848
HH6 Rural non-labor households	-12.64	-123,044	1.88	18,267	12.54	122,134
HH7 Non-Agricultural labour: high income	-39.61	-19,245	30.67	14,903	96.43	46,857
HH8 Urban labour: low income	-12.10	-344,229	14.25	405,343	19.75	561,934
HH9 Urban non-labour household	-12.26	-114,678	12.10	113,194	15.82	148,032
HH10 Urban labour: high income	0.00	0	0.00	0	0.00	0
Rural	-8.71	-1,145,273	12.74	1,675,200	17.38	2,285,770
Urban	-12.13	-458,907	13.72	518,537	18.78	709,966
Total	-9.47	-1,604,180	12.96	2,193,737	17.69	2,995,736

CHAPTER 6
CONCLUSION

6.1. SUMMARY OF RESEARCH

This research seeks to quantitatively measure the impact of fiscal policy on poverty in Indonesia. This research is conducted using WAYANG, the CGE model for Indonesian economy. Our concern on poverty is based on the fact that the economic crisis that began in 1997 has been accompanied by widespread social distress in the country. A fall in output and incomes in these countries has been invariably accompanied by massive job losses as bankruptcies and cutbacks in production have multiplied. This has led to a sharp rise in open unemployment and underemployment. As the result, people living below the poverty line increased and income distribution has been deteriorated.

The crisis which struck in 1997 has affected the situation on poverty and income distribution through at least three channels. The first channel is the adjustment at the macro level at the output and input markets, especially labor market. The second category is the adjustment at the micro level, namely the changing patterns if household income and expenditure. Finally, there is an indirect transmission through the government expenditure, namely the provision of public social services.

According to the official BPS statistics, the crisis has increased the number of people living below poverty line from 34.5 million (17.7% of total population) in 1996 to 49.5 million (24.2%) in 1998. Poverty figure in 1996 was used as the benchmark since there is an absence of survey or estimation on poverty in 1997, when the crisis began. Small progress in the economy, especially lower inflation and return-to-positive GDP growth has reduced the poverty incidents in the subsequent years. In 1999, BPS calculated that poverty incident declined to 37.5 million (18.2% of total population). Poverty figures in the subsequent years are estimated based on SUSENAS Core data, excluding two troubled provinces of Aceh and Maluku. This results in the decline of poor population to 37.3 million in 2001, but the poverty rate is higher, 18.9%. Poverty incident continued to decline, although not much, in 2001. The data also show that after the crisis poverty increased faster in urban rather than rural areas. Poverty also increased faster in modern sectors such as finance or construction.

The failure of the Social Safety Net program does not necessarily wipe out the fact that there is still the need for a good government policy to alleviate poverty and redistribute income. While stimulating economic growth is considered a longer-term remedy, the government can directly intervene through fiscal policy instruments. Fiscal policy for the purpose of poverty alleviation and income redistribution actions are implemented most directly by three instruments by which the government could allocate budget. The *first* one is direct or personal subsidy, targeted on the low-income households. The *second* one is price subsidy, which is a subsidy allocated to commodities which are used chiefly by the low-income households, or specifically named as basic commodities. Due to the limitation of the model, we will only focus on these two areas of expenditure on this research. There is a *third* area of expenditure, which is the direct government spending on public services and infrastructures, especially on welfare, health and education, which particularly benefit low-income households. On the revenue side, financing can be obtained either domestically or from external funding. From the domestic side, we will be limiting our attention on income and commodity taxes. External funding can be in various forms, but will be limited on external (public) borrowings.

However, the government is currently facing a serious fiscal constraint. The ability of government budget to provide fiscal stimulus for the economy is very limited. In 2003, the government should lower its budget deficit to only 1.8% of GDP. Hence, given the expected role of government budget to contribute to the poverty alleviation, a detailed and specific measurement of the effect of any policy is required. Our study using WAYANG CGE model is aimed to provide such requirement.

For the purpose of this research, we should first make some amendments to the WAYANG original model by incorporating the parametric distribution and headcount poverty calculation. Using the model, we run four scenarios. *Scenario 1* examines the effects 20% increase in government expenditure under the condition of government's budget deficit. *Scenario 2* deals with a different way of tax financing to cover the increase in government expenditure. In the second scenario, income tax rate adjusts to ensure that the government borrowing is unaffected by the increase in the expenditure. Ini s*cenario 3,* income tax rate adjustment is swapped to the adjustment of sales tax. Finally, s*cenario 4* is basically similar to the first one, but with fixed trade balance.

6.2. SUMMARY OF FINDINGS

6.2.1. General Findings

The research has shown that different schemes of fical expansion matter in affecting income distribution and poverty. The benefits from a fiscal expansion are mainly transferred to the urban households and non-labor rural households, which are basically the wealthiest segments of the society. There are several explanations on such phenomenon. First, those segments possess factors of production which are benefited most from the policy, i.e. skilled labor and fixed capital. Second, those types of household are not affected significantly by the increase in prices. This is due the structure of consumption of each households. Third, the data revealed that the tax system in Indonesia is regressive. That means rich households are taxed less than the poorer ones, in real term.

Fiscal expansion could also used as a policy instrument to reduce poverty incidence. But it does not always lead to poverty decline, as it depends on the source of financing. In the research, we find that fiscal expansion leads to decline in poverty if it is financed by increasing budget deficit. Increasing either income or sales taxes gives the opposite results.

6.2.2. Macroeconomic impact

Analysis on the macroeconomic impact focuses on: 1) the effects on Gross Domestic Product (GDP), 2) the effects on employment, 3) changes in the return to variable capital, 4) changes in the government budget, and 5) the household impact.

Effects on GDP

It is expected that scenario 1 gives the highest impact on GDP because fiscal expansion is financed by loan, which will be paid in the future, so that there is no crowding out effect trough tax increases. The simulation results confirm the hypothesis. An increase of government spending and investment by 20% (2.24% of GDP) leads to an increase of nominal GDP by around 3.3% in scenario 1, and by 0.8% in scenario 4. In real term, scenario 1 consistenlty gives the biggest impact, 1.97%, while the other scenarios only lead to a less than 1% increase of real GDP. Scenario 2 and 3 lead to the increase of nominal GDP by 1.06% and 2.61% respectively. Nevertheless, the increase of real GDP is higher in scenario 2 (0.93%), compared with that in under scenario 3 (0.45%), as prices increase in scenario 3, while decline in scenario 2.

Effects on Employment

The effects on employment is consistent with changes in GDP. The highest impact is obtained from scenario 1, with a 7.68% increase in employment. Scenario 2 and 4 gives relatively similar effects, increasing employment by around 5%, while scenario 3 only increase employment by less than 4%.

Changes in the Government Budget

From the public finance perspective, a 20 % increase in the government spending and investment leads to around 18-19% increase in total government expenditure. In scenarios 1 and 4, as expected, budget deficit increase by Rp11-12 trillion (around 2% of GDP). In scenarios 2 and 3, the increase of government revenue needed to finance the 18.4% on expenditure is 16%.

Household Impact

On the household level impact, based on scenario 1, 20% increase in government spending and investment is expected to raise personal consumption by 3.4% in nominal term and 2.1% in real term. But based on scenario 2, when fiscal expansion is fueled by higher income tax, the impact on personal spending is estimated to be –1.74% in nominal terms and –1.55% on real terms. It is interesting to note that the decline in real consumption expenditure is larger when the sales tax, rather than income tax, is used to finance the budget expansion. The result of scenario 3 shows that household consumption increases by 0.19% in nominal term, but decline by 3.09% in real term, because prices (CPI) is expected to increase by 3.4%.

6.2.2. Output and Trade

The sectoral level analysis concerns on: 1) sectoral output, 2) industrial output, 3) commodity prices, and 4) international trade.

Sectoral Output

Fiscal expansion through deficit financing leads to higher outputs in all sectors, with agricultural and services sectors experience the highest incease. If trade balace is fixed, the impact is smaller, with manufacture and natural resource sectors experience decline in output. The increase in tax to finance fiscal expansion as modeled in scenario 2 and 3 has negative impact on agriculture. The production of the agricultural sector is expected to decline by 1 to 2%.

Industrial Output

Changes in industrial output is decomposed into three sources: changes in output for local markets, changes in imports, and changes in exports. In general fiscal stimulus as simulated based on scenario 1 leads to increasing imports (negative growth of import substitution) and lower exports (negative growth of export). By looking at various industries, large increase in industrial output takes place in construction by 5.69%, followed machinery (2.33%), real estate (1.63%) and petroleum refinery (1.59%).

Commodity Prices

Fiscal expansion in general, either financed by increasing budget deficit or sales taxes, leads to increase in prices. But in a more detailed analysis, the difference between buyers' and sellers' prices is larger in scenario 3, due to the tax effect.

International Trade

Higher government spending leads to higher imports and lower exports in scenario 1 and 2. An increase in government spending and investment clearly lead to larger aggregate demands for domestic and imported goods. In scenario 3, export is expected to increase larger than imports, mainly because of the difference in price effects. Sales tax leads to lower price at the firm or producer side and higher price at the consumer side. Declining price at the firm level makes Indonesian products look more competitive and in turn leads to higher exports. On individual commodities, deficit-financed fiscal expansion (scenario 1 and 4) leads to weakening export and higher import for almost all major commodities. Increase in taxes (scenario 2 and 3) lead to higher exports for commodities with lower tax (i.e. wood, textile, clothing), but decline in export for commodities which are heavily taxed.

6.2.3. Income Distribution

Most scenarios of fiscal expansion lead to positive effects on the nominal gross income for all groups except for several groups under scenario 3. Looking at more detail in scenario 1, unequal distribution of the policy effects appears quite obvious. Most household groups receive more than 3% increase in their gross income, while for some groups, the changes are less significant, especially for medium and large farmer in rural areas. The largest benefit falls to urban households, which enjoy an increase of more than 3.5%. The reason is that skilled labor income, which contribute largely to the richest groups of urban households, provide higher increase to their gross income along with the increase of employment. Moreover, positive changes in return on fixed capital also contribute further expansion of income, particularly to the richest household groups both in rural and urban area.

6.2.4. Poverty

If fiscal expansion is financed by increasing budget deficit (scenario 1), population under the poverty line is expected to decline by more than 9%. Increasing taxes, either income or sales taxes, would result in higher population living below the poverty line. Higher income taxes (scenario 2) is associated to almost 13% increase in poor population, while higher sales taxes (scenario 3) increases poor population by more than 17%.

6.3. LIMITATIONS AND SUGGESTIONS FOR FURTHER STUDIES

It is important to note some limitations and weaknesses of this research. The first area of limitation is the nature of CGE models in general. Like the majority of CGE models, WAYANG was designed originally for comparative-static simulations. Its equations and variables are refer implicitly to the economy at some future time period (Wittwer, 2002). Hence, all results presented in this research should be interpreted as "the condition expected to happen in the future after the specific policy is undertaken, compared with the situation without the adoption of policy". The second area of limitation is on the results. The model assumes that income distribution in a specific household group is constant. A policy shock changes mean of income in a household group, but the variance is unchanged. Consequently, income distribution would not differ much before and after a policy is taken. This is shown by the Gini coefficient, which is relatively constant in all scenarios.

There are two reasons for such condition. First, the choice of parametric distribution used to measure household's income distribution is somehow arbitrary. In this research, we assume that household's income follows a *Beta* distribution, with different parametres assigned for different groups. Although *Beta* distribution is a quite powerful and flexible distribution, the *ad hoc* choice of such distribution might distort the hypothetical distribution from the actual one. Second, the coefficient on the *Beta* distribution is also set based on the descriptive statistic (mean and median) taken from related to expenditure from the available data. The required parameters include mean or average of the group's expenditure, the standard deviation or variance within the group and the range of expenditure for every household group. This approach is simple, but the varations of intra-group characteristics are hidden since we are primarily concern only on group average.

Based on the limitations of this research, we would like to suggest some inputs for further researches in this area. We suggest making further amendments to the model, so that variances of household income could vary after a shock take place. We also suggest using better techniques in measuring parametric coefficient i.e. from survey or econometric estimations.

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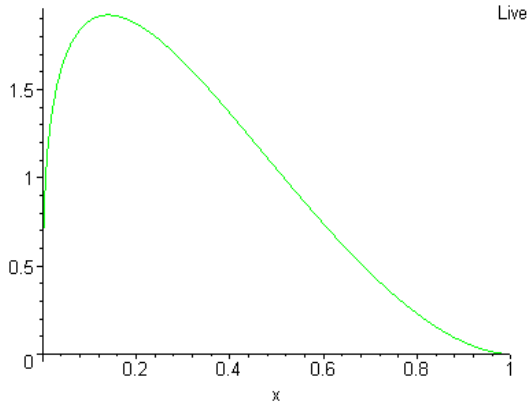
APPENDIX 1

ESTIMATION OF BETA DISTRIBUTION FOR EACH HOUSEHOLD

Group I

p = 6.3 q = 7.1



Group II

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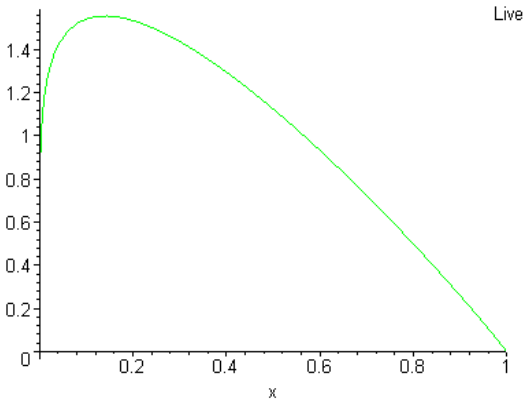
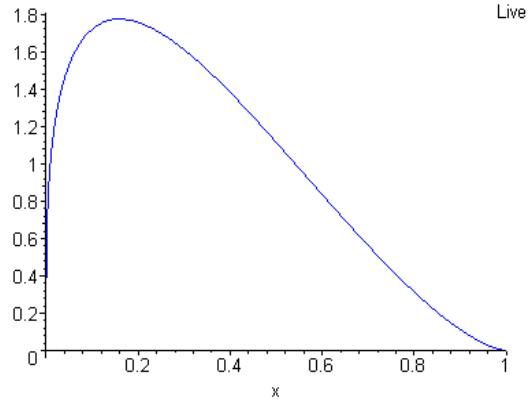


Group III

p = 2.4 q = 6.4



Group IV

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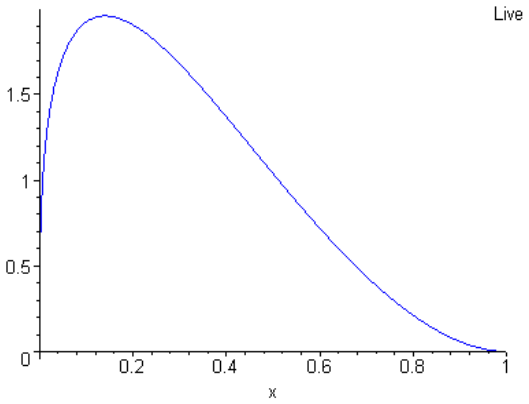

Group V

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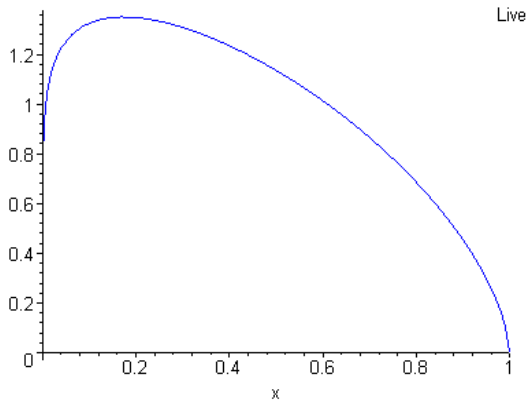

Group VI

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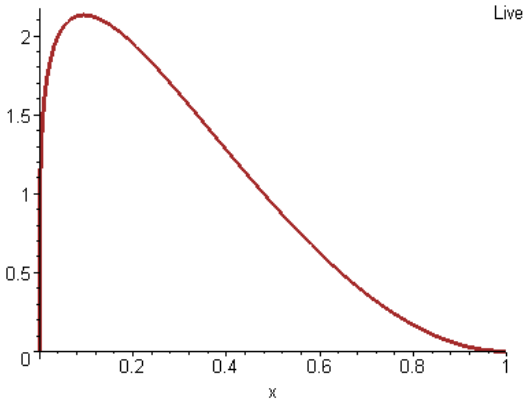

Group VII
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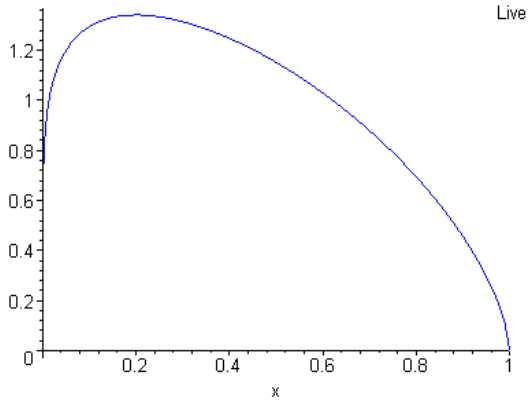
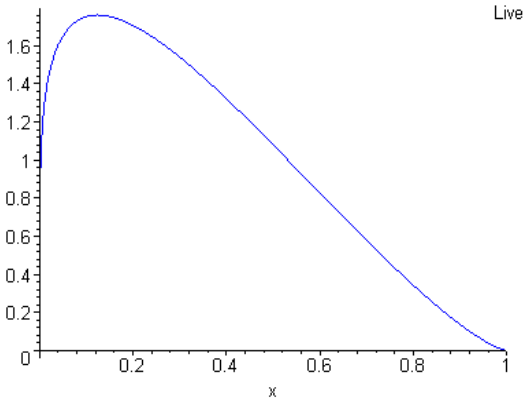


Group VIII
p = 1.2 q = 1.9



Group IX
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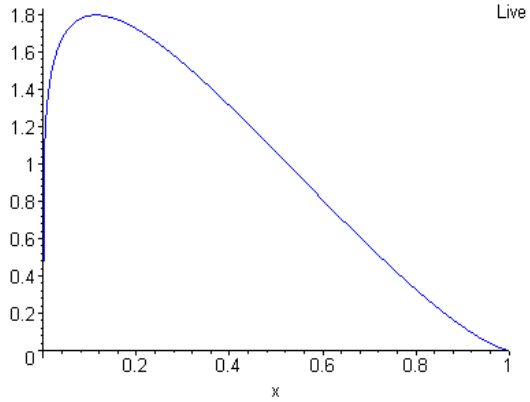

Group X
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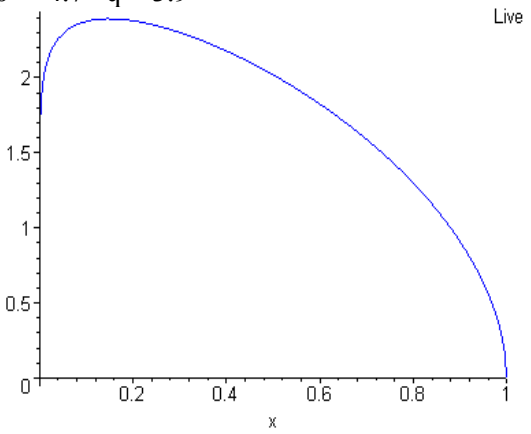

APPENDIX 2

NOTES ON INCOME DISTRIBUTION AND POVERTY CALCULATION IN WAYANG MODEL

INTRODUCTION

This note try to describe several important aspects of the income distribution and poverty calculation developed in the recent WAYANG Model progress. It describes the theoretical background of Beta Distribution used in the calculation, the computational method and the Tablo languange documentation of the the procedure used in the poverty estimation. This document could serve as an entry point for further development in estimation of income distribution and poverty using WAYANG and other CGE Models.

BETA PROBABILITY DENSITY FUNCTION AND ITS PARAMETERS

Beta Distribution

The Beta Distribution belongs to the family of continous distribution which is defined over a specific range of interval. Other distribution under this category are included Gamma distribution function. Unlike some other distribution functions which describes for any real number of random variable, this beta distribution has both its starting and end points fixed at exact locations. In addition this distribution also can be categorized to the group of flexible distribution function.

The function related to beta distribution make it possible to generate kind of distribution which has different value of statistical moments such as different value of mean, median and mode. In other word, the function enable the use of right or left skewed distribution. Because of its extreme flexibility, the distribution appears ideally suited for the description of subjective population estimates which deviates from standard normal distribution.

A standardized beta probability density function (pdf) usually is defined over an interval of random variable [0,1]. It means the distribution has minimum point of 0 and the end point of 1. The function below describe the pdf of the distribution.

$$f(X) = \frac{X^{p-1}(1-X)^{q-1}}{B(p,q)} \qquad (1)$$

while $B(p,q)$ is the Beta function with parameters p and q given by

$$B(p,q) = \int_0^1 X^{p-1}(1-X)^{q-1}dx \qquad (2)$$

This standardized beta pdf can be also used for any random variable defined over other interval. The function can be rescaled and shifted to obtain exactly the same shape of distribution to obtain the value of random variable Y over interval [a,b], where a is minimum point and b is maximum point, using the transformation

$$Y = a + (b-a)X \qquad (3)$$

leading to

$$f(Y) = \frac{1}{B(p,q)} \quad \frac{(Y-a)^{p-1}(b-Y)^{q-1}}{(b-a)^{p+q-1}} \qquad (4)$$

The shape of the Beta PDF depends on the choice of its two parameters *p* and *q*. The parameters are any real number greater than negative one, and depending on their values the Beta PDF generated will have the "U", the "J", the triangle or the general bell shape of the unimodal function. Estimating these parameters is controlled by data availability. Next section is intended to brief the readers for several method of estimation available.

Estimation of Parameters

Perhaps one of the popular methods in estimation of parameters is the maximum likelihood method. With this method, a researcher needs to choose the parameter value that maximizing the likelihood of the function, in that case is beta pdf. The likelihood has the same form as the beta pdf. But for the pdf, the parameters *p* and *q* are constants and the variable is *x*. The likelihood function reverses the roles of the variables. Here, the sample values (the *x*'s) are already observed. So they are the fixed constants. The variables are the unknown parameters. Maximum likelihood estimation (MLE) involves calculating the values of the parameters that give the highest likelihood given the particular set of data.

The estimation of parameters using this method produces parameters that are known as a consistent and asymptotically unbiased, its bias goes to 0 as the sample size increases. However, this method heavily depends on the availability of sufficient data and requires extensive computation. In the absence of data, a resercher can use subjective information to estimate the parameters of the Beta PDF expected to describe the construction operation. The subjective information needed to determine the two Beta parameters that will describe a unique Beta curve include four characteristics: the minimum and maximum times, as well as two of the following subjective statistics; mode, mean, variance or selected percentiles. The use of mean and variance is among the most popular way to estimate the parameters. The percentiles also can be used to represent the percent chance that the analyzed activity duration will not exceed certain value of random variable. The method below use the availability of mean and average to construct beta parameters.

The random variable X~Beta(p,q) with minimum point of 0 and maximum point of 1 has mean E(X) and variance Var(X) given by

$$E(X) = \overline{X} = \frac{p}{p+q} \qquad (5)$$

$$Var(X) = s^2 = \frac{pq}{(p+q+1)(p+q)^2} \qquad (6)$$

These equations can be solved to find explicit solutions for *p* and *q* in terms of E(X) and Var(X).

$$p = \overline{x}\left(\frac{\overline{x}(1-\overline{x})}{s^2} - 1\right) \qquad (7)$$

$$q = (1-\bar{x})\,(\frac{\bar{x}\,(1-\bar{x})}{s^2} - 1) \qquad (8)$$

This method is very straightforward, easy to compute and doesn't require abundance of data for estimation. It also produces consistent parameters. However, in many cases, the parameters obtained are not the best one.

INCOME DISTRIBUTION AND POVERTY IN WAYANG

TABLO language is originally built to solve mathematical equation simultaneously and is not intended to be a program for calculation and data manipulation. However, in order to accommodate the result from WAYANG Model easily as well as to make the analysis easier, the calculation of income distribution and poverty rate is developed using the language. As most data manipulation using TABLO and GEMPACK, our calculation program also utilizes the procedure of *Coefficient* and *Formula* in the language. Since TABLO does not provide the computation of statistical distribution used in this program, namely Beta pdf, the calculation will be held manually. This section explains several important aspects in the calculation using TABLO language.

Tablo Documentation

Excerpt 1 in this documentation of TABLO languange defines commands for preparation of several sets and coefficients use in the later steps of calculation. The set defining household groups in this program, use exactly the same format as the one in WAYANG Model. Other sets identify parameters used in the calculation.

Coefficient Ch_Cons is the key point that relates the simulation results from WAYANG to the program. It reads the variable of change of real consumption (x3_tot) of every household in the model. However, to use the variable in the calculation, we convert it into a coefficient:

$$Ch\_Cons = 1 + \frac{x3tot\_hh}{100} \qquad (9)$$

Other coefficients read several statistical parameters required to calculate parameters in Beta pdf, such as mean, standar deviation and maximum and minimum value of households' consumption.

As the calculation of income distribution and poverty rate in this program is based on the utilization of standard Beta pdf, all statistical parameters and values in this program have to be converted into standardized random variable, range between [0,1]. In excerpt 1, poverty line read from the database are converted using the formula:

$$X_1 = \frac{Y - minm}{minm - maxm} \quad \text{where } X_1 \text{ is value of poverty line in a range of [0,1]} \qquad (10)$$

Simulation in the WAYANG model affects the value of statistical parameters through the change in real consumption variable *x3tot_hh.* It shifts the value of mean, minimum and also maximum of each household's consumption. In order to capture the change in this real consumption, poverty line used after the simulation, also need to recalculate using the formula below.

$$X_2 = \frac{Y - minm\quad Ch\_Cons}{minm\quad Ch\_Cons - maxm\quad Ch\_Cons} \qquad (11)$$

```
! Excerpt 01 of TABLO input file: !
! Preparation !

File  PDATA  # Data file #;
File (NEW) RST # Result file #;

SET HH  # household types #  (rural1-rural7, urban1-urban3);
SET MM # household types of parameter expenditure # (Y,pop);
SET DTPAR # Statistical parameter from expenditure data #  (mean,std,
                                                           maxm,minm);
SET STATPAR # Statistical distribution parameter #  (alpha,beta);

Coefficient (all,h,HH)Ch_CONS(h);
    Read Ch_CONS from file PDATA header "CONS";

Coefficient (all,h,HH)(all,p,DTPAR) DT_PAR(h,p) # Read parameters # ;
    Read DT_PAR from file PDATA header "IDPM";

Coefficient (all,h,HH)(all,m,MM)POVLINE(h,m) # Poverty line # ;
    Read POVLINE from file PDATA header "PLHH";

Coefficient (all,h,HH) BETALINE1(h)
            # Poverty line in standardized BETA (Y-Minm)/(Maxm-minm)   # ;

    Formula (all,h,HH) BETALINE1(h)= (POVLINE(h,"Y") - DT_PAR(h,"minm"))/
                                     (DT_PAR(h,"maxm") - DT_PAR(h,"minm"));

Coefficient (all,h,HH) BETALINE2(h)
            # Poverty line in standardized BETA (Y-Minm)/(Maxm-minm)   # ;

   Formula (all,h,HH) BETALINE2(h)=
                        (POVLINE(h,"Y")/Ch_CONS(h) - DT_PAR(h,"minm"))/
                        (DT_PAR(h,"maxm") - DT_PAR(h,"minm"));
```

The next step is the estimation of parameters used in the Beta pdf. Due to the availability of data and the simplicity of the method, this calculation program employs the method of moments in estimating parameters of beta pdf. With the method of moments in hand, parameters of the distribution can also be re-estimate after the simulation to capture the changes in distribution of income within each household group.

As with other value of statistical parameters used in this calculation program, mean of every household's consumption expenditure has to be transformed into a value within interval [0,1], using the formula of transformation explained above. The standard deviation also need to be readjusted to describe deviation within the interval. It can be done through the transformation formula below:

$$std_1 = \frac{std}{maxm - minm} \qquad \text{where } std_1 \text{ is the standard deviation of } X \ [0,1]$$

Thus the variance will be

$$var_1 = \left(\frac{std}{maxm - minm}\right)^2$$

Both of those statistical parameters are now ready to use for the estimation of Beta pdf's parameters using the method of moments describe in the previous section. Re-estimation of distribution's parameters are accomplished through the recalculation of statistical parameters taking account the change in real consumption of each household. The change, however only affects the variance of standardized of real consumption as the change in mean is exceeded by the change of maximum and minimum value of every household groups' consumption.

Excerpt 3 of this calculation program conducts the calculation of Beta function, Beta pdf and Beta cumulative distribution function (cdf) manually using several functions and facilitates available in the GEMPACK program. The first step is defining a series of number associated to the random variable X of the distribution. We define the random variable as a series of a hundred thousand numbers within the range of [0,1] with equal interval.

```
!          Excerpt          02          of          TABLO          input          file:          !
!               Statistical                Parameters                Estimation                !

SET     STATPAR     #     Statistical     distribution     parameter     #          (alpha,beta);

!                          Before                          Simulation                          !

Coefficient    (all,h,HH)(all,p,DTPAR)    DT_PAR1(h,p)    #    Standardized    parameters    #    ;
Formula
(all,h,HH)         DT_PAR1(h,"mean")=          (DT_PAR(h,"mean")          -          DT_PAR(h,"minm"))/
                                    (DT_PAR(h,"maxm")          -          DT_PAR(h,"minm"));
```

$$var_2 = \left(\frac{std}{(maxm \quad Ch\_Cons) - (minm \quad Ch\_Cons)}\right)^2$$

$$= \frac{var_1}{(Ch\_Cons)^2}$$

$$\overline{X}_2 = \frac{(\overline{Y} \quad Ch\_Cons) - (minm \quad Ch\_Cons)}{(maxm \quad Ch\_Cons) - (minm \quad Ch\_Cons)}$$

$$= \frac{\overline{Y} - minm}{maxm - minm} = \overline{X}_1$$

```
(all,h,HH)                DT_PAR1(h,"variance")=                (DT_PAR(h,"std")                /
                                    (DT_PAR(h,"maxm")          -          DT_PAR(h,"minm")))^2;

Coefficient    (all,h,HH)(all,p,STATPAR)    ST_PAR1(h,p)    #    Calculation    Parameters    #    ;

Formula
(all,h,HH)                                                                    ST_PAR1(h,"alpha")
        =                                                                      DT_PAR1(h,"mean")
          *((DT_PAR1(h,"mean")*(1-DT_PAR1(h,"mean"))/DT_PAR1(h,"variance"))-1)                ;

(all,h,HH)                                                                     ST_PAR1(h,"beta")
        =                                                                  (1-DT_PAR1(h,"mean"))
          *((DT_PAR1(h,"mean")*(1-DT_PAR1(h,"mean"))/DT_PAR1(h,"variance"))-1);

!                          After                          Simulation                          !

Coefficient    (all,h,HH)(all,p,DTPAR)    DT_PAR2(h,p)    #    Database    parameters    #    ;

Formula
(all,h,HH)          DT_PAR2(h,"mean")          =          DT_PAR1(h,"mean")          ;
(all,h,HH)       DT_PAR2(h,"variance")       =       DT_PAR1(h,"variance")/(Ch_CONS(h))^2;

Coefficient    (all,h,HH)(all,p,STATPAR)    ST_PAR2(h,p)    #    Calculation    Parameters    #    ;

Formula
(all,h,HH)                                                                    ST_PAR2(h,"alpha")
        =                                                                      DT_PAR2(h,"mean")
```

```
          *((DT_PAR2(h,"mean")*(1-DT_PAR2(h,"mean"))/DT_PAR2(h,"variance"))-1);

(all,h,HH)                                                                    ST_PAR2(h,"beta")
        =                                                                   (1-DT_PAR2(h,"mean"))
          *((DT_PAR2(h,"mean")*(1-DT_PAR2(h,"mean"))/DT_PAR2(h,"variance"))-1);
```

Beta function is calculated using the equation (2) above. Since GEMPACK does not provide facility to calculate integer, the beta function is computed using integer approximation method of trapezoidal approach.

As a continuous distributional function, the area under beta pdf between a particular interval represents the proportion of population complying with specific criteria. Our criteria here are the population whose consumption is below the poverty line. In order to measure the proportion of population living below the poverty line for every household group, a cumulative probability of beta pdf between *0* and poverty line of each group should be calculated, again using trapezoidal approach of integral approximation:

$$CDF = \int_0^l \frac{1}{B} X^{p-1}(1-X)^{q-1} \quad \text{where} \quad l \text{ is poverty line in standardized random variable}$$

Having this cumulative probability of beta pdf for each household group multiplied by total population of the particular group result in the poverty population for every group of household. The

$$\int_0^1 f(x)\,dx \cong \frac{1}{2}\frac{1}{n}(y_0 + 2y_1 + 2y_2 + \ldots + 2y_{n-1} + y_n)$$

$$\cong \frac{1}{2}\frac{1}{n}\left(\sum_0^n 2y_i - y_0 - y_n\right) \text{ where}$$

$$y_i = f(x_i) = x^{p-1}(1-x)^{q-1} \quad ; \quad i = 0, 1, \ldots\ldots, n$$

$$x_i = \frac{1}{n} i$$

$$n = 100000$$

total of:

this population is the number of people whose real consumption is below poverty line. The procedure is repeated for the variable representing the change in real consumption after simulation. Comparing the number of people living below poverty line before and after simulation give the change of population under poverty as the impact of policy and other economic shock simulation.

```
!         Excerpt         03         of         TABLO         input         file:         !
!              Beta                Distribution              Calculation                 !

SET     SERIES     #     Series     of     number     for     calculation     #     (x0-x100000);

Coefficient   (all,x,SERIES)   NUMBER(x)   #   Value   of   random   variable   in   Beta   Dist.#;

    Formula          (all,x,SERIES)          NUMBER(x)          =          ($POS(x)-1)/100000;

!                          Before                          Simulation                        !

Coefficient                          (all,h,HH)(all,x,SERIES)                          INTCAL1(h,x)
                                      #   Intermediate   Value   of   Beta   Function   #   ;
```

```
    Formula                         (all,h,HH)(all,x,SERIES)                        INTCAL1(h,x)
            =                                                   {NUMBER(x)^[ST_PAR1(h,"alpha")-1]}
                *                     {[1-NUMBER(x)]^[ST_PAR1(h,"beta")-1]}                    ;

Coefficient     (all,h,HH)      BETA1(h)      #     Value     of     Beta     Function     #     ;

    Formula      (all,h,HH)      BETA1(h)=      1/200000      *      {SUM[x,SERIES,INTCAL1(h,x)]*2
                          -INTCAL1(h,"x0")-INTCAL1(h,"x100000")};

    !Formula     (all,h,HH)     BETA1(h)     =          1/300     *     (4*SUM(x,ODD,INTCAL1(h,x))
              +                 2*SUM(x,EVEN,INTCAL1(h,x))-INTCAL1(h,"x0")-INTCAL1(h,"x100"));!

Coefficient     (all,h,HH)     CDF1(h)     #     Cumulative     distribution     function     #     ;

    Formula       (all,h,HH)       CDF1(h)       =             [1/BETA1(h)]       *       [1/200000]
                   *                        {SUM[x,SERIES:NUMBER(x)<BETALINE1(h),INTCAL1(h,x)]+
                     SUM[x,SERIES:NUMBER(x)<(BETALINE1(h)-1/100000),INTCAL1(h,x)]
                       -INTCAL1(h,"x0")};

Coefficient     (all,h,HH)     POVPOP1(h)     #     Population     under     poverty     line     #     ;

    Formula       (all,h,HH)       POVPOP1(h)       =       CDF1(h)       *       POVLINE(h,"pop");

!                          After                                Simulation                                !

Coefficient                         (all,h,HH)(all,x,SERIES)                        INTCAL2(h,x)
                                     #     Intermediate     Value     of     Beta     Function     #     ;

    Formula                         (all,h,HH)(all,x,SERIES)                        INTCAL2(h,x)
            =                                                   {NUMBER(x)^[ST_PAR2(h,"alpha")-1]}
                *                     {[1-NUMBER(x)]^[ST_PAR2(h,"beta")-1]}                    ;

Coefficient     (all,h,HH)      BETA2(h)      #     Value     of     Beta     Function     #     ;
    Formula     (all,h,HH)     BETA2(h)=          [1/200000]     *     {SUM[x,SERIES,INTCAL2(h,x)]*2
                          -INTCAL2(h,"x0")-INTCAL2(h,"x100000")};

Coefficient     (all,h,HH)      CDF2(h)      #     Cumulative     distribution     function     #;
    Formula       (all,h,HH)       CDF2(h)       =             [1/BETA2(h)]       *       [1/200000]
                   *                        {SUM[x,SERIES:NUMBER(x)<BETALINE2(h),INTCAL2(h,x)]+
                     SUM[x,SERIES:NUMBER(x)<(BETALINE2(h)-1/100000),INTCAL2(h,x)]
                       -INTCAL2(h,"x0")};

Coefficient     (all,h,HH)     POVPOP2(h)     #     Population     under     poverty     line     #     ;

    Formula       (all,h,HH)       POVPOP2(h)       =       CDF2(h)       *       POVLINE(h,"pop");

!              Change              in              Poverty              incidence              !

Coefficient     (all,h,HH)     CHGPOV(h)     #     Change     in     poverty     incidence     #     ;

    Formula       (all,h,HH)       CHGPOV(h)       =       CDF2(h)       /       CDF1(h)       -       1;

Coefficient      CHGPOV_H      #      Change      in      Total      poverty      incidence      #;

    Formula              CHGPOV_H              =              Sum{h,HH,POVPOP2(h)}              /
                        Sum{h,HH,POVPOP1(h)}  - 1 ;
```

The last part of the program, excerpt 4, describes the calculation of gini ratio coefficient based on the selected beta distribution for each household. The calculation of gini ratio requires an attempt to reformat the population from the current household groups classification into one distribution corresponding to the whole population. The distribution of total population then divided into several groups of population based on income. This program classified population into a hundred groups of income.

The first step in calculation gini ratio coefficient is the definition of set in conjunction with groups of income, and then having the income group classification itself. The population in every household group has to be sorted out into several particular groups of income based on a certain classification. However, since the distribution of population in household groups is developed using a standardized

beta distribution, the classification should also be adjusted to follow the interval of the standardized distribution using formula derived from the equation (3).

```
SET(INTERTEMPORAL) IG0 (i0-i100);
SET(INTERTEMPORAL) IG (i1-i100);
Subset IG is Subset of IG0;

Coefficient (all,i,IG) IGC(i) # Income Group Classification #;

    Formula (all,i,IG) IGC(i) = DT_PAR("rural1","minm") +
            [DT_PAR("urban3","maxm") - DT_PAR("rural1","minm")]/100 * $pos(i);

Coefficient (all,i,IG)(all,h,HH) RANG_IG(i,h) # Standadized Income Group #;
    Formula (all,i,IG)(all,h,HH) RANG_IG(i,h) =
            [IGC(i) - DT_PAR(h,"minm")] / [DT_PAR(h,"maxm") - DT_PAR(h,"minm")];
```

After defining groups of income for population in all household groups, the next step is to classify individuals from every household group into related specific income group. Gini coefficient is then calculated based on the cumulative number of population under the income groups.

```
Coefficient (all,i,IG0)(all,h,HH) CPD1(i,h)
            # Cumulative Probability Distribution for Specific Group #;

  Formula         (all,h,HH) CPD1("i0",h) = 0;
  Formula (all,i,IG)(all,h,HH) CPD1(i,h)
        = 1 - if{RANG_IG1(i,h)<=1,1-[1/BETA1(h)] * [1/200000]
        * {SUM[x,SERIES:NUMBER(x)<RANG_IG1(i,h),INTCAL1(h,x)]
        +  SUM[x,SERIES:NUMBER(x)<(RANG_IG1(i,h)-1/100000),INTCAL1(h,x)]
        - INTCAL1(h,"x0")}};

Coefficient (all,i,IG) ID1(i) # Population Under Specific Group #;

  Formula (all,i,IG)ID1(i) =
    if(i="i1",SUM{h,HH,[(CPD1(i,h) * POVLINE(h,"pop"))]}) +
    if(i NE "i1",SUM{h,HH,[(CPD1(i,h)-CPD1(i-1,h)) * POVLINE(h,"pop")]});

Coefficient (all,i,IG0)F_ID1(i) # Cummulative Population Under Specific Group #;

  Formula F_ID1("i0") = 0;
  Formula (all,i,IG)F_ID1(i) = F_ID1(i-1) + ID1(i);

Coefficient GR1 # Gini Ratio Coefficient #;
  Formula GR1 = SUM[i,IG,F_ID1(i) + F_ID1(i-1)] * (1/2) * (1/2)
        * (1/SUM[h,HH,POVLINE(h,"pop")]) * (1/100);
```

The calculation program describes here employ several coefficients determined in an input file called “PDATA” as logical name. In practice this input file is associated to the “output file” of a simulation conducted by WAYANG. In order the simulation produces output file containing the related coefficient, several new data are added into the WAYANG database, namely the data on population, statistical parameters of income distribution and poverty line. Those data should be arranged following household classification, so that every household group has specific information on the distribution of income.

CONCLUSION

This note explains several technical aspects on the attempt of assigning poverty and income distribution calculation into WAYANG model. Several notes should be addressed as the limitation of

the approach utilized. The first is on the calculation of Beta Distribution parameters as it is based on the method of moments approach. Although this method is simple and straightforward, some information from the data might not be captured quite well. Other rigorous method such as maximum likelihood is a potential candidate for a better analysis despite the availability of data.

The second comes from the nature of approach that utilize a parametric distribution. Although the beta distribution is a very flexible statistical distribution, it does not prevent us to hold assumption on the change of variance within each household group. Further study in cooperating poverty estimation to WAYANG model is needed to find a more thorough understanding on the impact of economic policy to the income distribution.