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Macroeconomic Policy and Poverty

Iwan Azis

June 2008

ADB Institute Discussion Paper No. 111

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Abstract

... A great many countries are searching for a route to greater general prosperity and greater economic inclusion of disadvantaged groups...a morally acceptable economy must have enough dynamism to make work amply engaging and rewarding; and have enough justice, if dynamism alone cannot do the job, to secure ample inclusion.

- Edmund S. Phelps, Macroeconomics for a Modern Economy, Nobel Prize Lecture, 8 December 2006.

Slower growth and higher inflation can worsen poverty. By implication, maintaining macroeconomic stability is necessary to reduce poverty. When a typical aggregate demand (AD) policy for stabilization is not effective, however, its impact on poverty could be devastating as incomes of the poor typically decline with falling output. In this study, I argue that when poverty reduction is included in welfare objectives, it is imperative that policymakers weigh the impact of macroeconomic policy on the poverty line and household incomes. I address this issue by exploring the theoretical and empirical link between output, price, poverty line, and household incomes, and juxtapose them with their combined effect on poverty. Central to my argument is the premise that neither growth itself nor stability per se is the answer to poverty reduction. Applying a structural vector autoregression (SVAR) with the Blanchard-Quah (B-Q) restriction to the data of two Asian countries, Thailand and Indonesia, it was revealed that the aggregate supply (AS) curves in both countries are flat, implying that a stabilization policy based on AD shock is not effective. On the other hand, an AD expansion can produce non-inflationary growth and raise the incomes of the poor. To the extent that the transmission mechanism through which output affects household incomes is complex, involving direct, indirect, and feedback effects within an economy-wide system, a general equilibrium model with a detailed financial block was used. From the model simulations, poverty and income inequality results were found to be sensitive to the type of shock, price elasticity of wages, and structure of the economy, particularly the mechanisms by which the financial sector affects household income. While a positive fiscal shock tends to reduce poverty in Thailand, but not in Indonesia, the effect of an expansionary monetary policy on poverty can be either favorable or unfavorable. As shown in the Indonesia case, when the price elasticity of wages is low, the effect can be favorable but it can be unfavorable if the elasticity is high. An expansionary policy can raise the earnings of financial asset holders (i.e., higher income households) more than the incomes of the poor, as is the case in Indonesia, but not in Thailand. A fundamental gain from using the approach is to allow policymakers to measure the intensity of the trade-offs between growth, stability, and poverty, based upon which macroeconomic stability with lower poverty can be achieved.

JEL Classification: E52, I31, C68, G11, O1

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I. INTRODUCTION¹

Many hold that economic growth is the single most important factor influencing poverty and that macroeconomic stability is essential for growth, therefore it is widely suggested that macroeconomic stability should be promoted. Furthermore, because low inflation is good for the poor, macroeconomic stability is even more essential for poverty reduction. This study argues that such claims are incomplete. Without clarifying the effect of inflation on the poverty line and the repercussions of output fall on the incomes of poor households, the derived policy could be misleading. At the very least, it is too general to be useful for policymaking when poverty reduction is among the overall goals. The usual argument—"what really matters is quality of growth"—is also insufficient since it does not provide clear guidance as to how much tightening or expansion is needed and how to achieve it.

The literature on poverty and worldwide experience has also confirmed that income inequality matters, i.e., growth associated with progressive distributional changes will have a greater impact on poverty (World Bank, 2001). But again, this line of reasoning requires further explanation as to how the income distribution can be improved while simultaneously making the economy grow faster. The bottom line is that growth, stability, income inequality, and poverty are all endogenous and interrelated.

This study analyzes the link between macroeconomic policy and poverty by delving into the theoretical and empirical side of the link. The starting point was to measure the slopes of the aggregate supply (AS) and aggregate demand (AD) curves. Given the elasticity of the poverty line with respect to price level and of household incomes with respect to output, these slopes determined the resulting impact of macroeconomic policy shock on the poverty line and incomes of the poor. Since growth and income distribution are endogenous and the transmission mechanism from policy shock to these variables is unarguably complex, the empirical test to measure the two elasticities is based on a computable financial general equilibrium (CFGE) model that captures the intricate links between the financial sector and the real side of the economy. Thailand and Indonesia are used as case studies.

Interest in the study of the link between macroeconomic policy and poverty has been peaked and fallen numerous times. The most recent renewed interest was triggered, among other things, by the poverty impact of the macroeconomic and financial policy response to the crisis that spread across the globe during the 1990s. In its transcript on the *Panel on Macroeconomic Policies and Poverty Reduction*, the International Monetary Fund (IMF) stated, "While there is a great deal of literature and experience on poverty and poverty eradication, many of the links between macroeconomic policies and poverty are not well understood" (IMF, 2001). An IMF study by Cashin et.al (2001) also stated that key questions about the nature of crises responses and their impact on poverty are being asked but not researched, and as quoted by Bretton Woods Update (2001) "there appears to be little or no research so far exploring how or why the extent of worsening poverty differs across crisis-hit countries." This study is an attempt to fill that gap. In addition, a more fundamental goal of this study is to provide guidance for making poverty reduction an important additional target variable in the conduct of macroeconomic policy by identifying the nature of interrelations between macroeconomic stability, growth, and poverty, and by quantifying the extent of the trade-offs that may arise.

¹ I wish to thank Masahiro Kawai, Mario Lamberte, and Thanong Bidaya for their constructive comments during my stay at the Asian Development Bank Institute (September–December 2007). For the case study on Thailand, I am grateful for the stimulating discussions with colleagues at the Fiscal Policy Research Institute of Thailand's Ministry of Finance, particularly Kanit Sangsubhan and Olarn Chaipravat, during summer 2007, and for the frequent exchange of views on the Thai model with Chanin Manopiniwes of the World Bank office in Bangkok. For the Indonesian case study, I would like to acknowledge the constructive comments and discussions with researchers and policymakers at the Indonesian central bank during the period of my consulting work with Bank Indonesia (2003–2007). Any errors and responsibility for the views expressed in the report are mine.

Section II of this paper discusses the effectiveness of AS and AD shocks in promoting growth and stabilization by estimating the slopes of the AS and AD curves. Two Asian countries, Thailand and Indonesia, are used as case studies. By adopting a decomposition technique, I found that the AS curves in both countries were flat, and got even flatter, after the Asian financial crisis; a negative AD policy was not effective to combat inflation under such a condition, but a positive AD shock would have been effective to stimulate non-inflationary growth. Section III discusses the concept of how such findings relate to poverty measure, in which the transmission mechanisms from changes in general price levels and output to the poverty line and household income are explained by way of a general equilibrium model. Section IV addresses the analysis based on the results of model simulations that focus on the impacts of expansionary and contractionary policy on income inequality and poverty. Finally, Section V reports and examines the study's conclusions.

II. MACROECONOMIC POLICY: AS AND AD CURVES

If an economy has a flat AS curve, implying that AD policy would be more effective to stimulate growth, it remains unclear what type of AD shock should be pursued. When the resulting output growth and prices are linked with the poverty line and incomes of the poor, the uncertainty in terms of policy implications on poverty gets even bigger, e.g., raising government expenditure will generate different outcomes of growth-poverty nexus than lowering the interest rate.²

Two irregularities prompt investigation of the AS and AD curves' slopes: first, a standard AD-based policy is not always effective when used to counter a major shock like the Asian financial crisis that occurred in 1997; second, AD management policy to control inflation may not work effectively, making a combination of slow growth and high inflation possible, both of which tend to worsen poverty conditions. This partly explains why the predominantly AD-based policies of the financial crisis have led to a significant increase in poverty. The outcome of the policy response in Thailand (where the Asian financial crisis originated) and in Indonesia (where the effect of financial crisis was most severe) has not been the same; less effective in the latter than in the former. The post-crisis experiences of the two countries also differ: Thailand has achieved a non-inflationary high growth pattern while, as of 2007, Indonesia is still trapped in a slow-growth high-inflation mode.

Central to the diverging outcomes of policy response are the characteristics of the output-price relations in the two countries. Under normal circumstances, a line stretching from northwest to southeast quadrant is generated under AS shocks, and a line from northeast to southwest quadrant is generated under AD shocks. However, simply plotting the data of quarterly growth rates of real gross domestic product (GDP) and inflation will not provide information as to whether the locus shifts are due to AD or AS shocks. To the extent that both shocks jointly determine the changes in output and prices, a decomposition procedure needed to be applied. This could be done either through a univariate approach of autoregressive integrated moving average (ARIMA) with the assumption that disturbances are either orthogonal (Watson, 1986) or serially correlated (Beveridge and Nelson, 1981), or, through a multivariate approach. This study used the latter by adopting the structural vector autoregression (SVAR) with the Blanchard & Quah (1989) (hereafter B-Q) restriction and a decomposition technique used in Gamber (1996). Appendix 1 outlines the model and the procedure in more detail.

I used the 1993:Q1–2007:Q2 data of real GDP and consumer price index (CPI) (with 2000 as the base year) for Thailand and Indonesia to measure the slopes of AS and AD curves in the two countries. Unit root test using (Augmented Dickey-Fuller [ADF]) suggested that when the second-difference log is used, the null hypothesis of unit-root is rejected at 1% level (Appendix 2). To determine the appropriate time lag, the Ljung-Box test was used for the

² This is in addition to the issue of sectoral composition

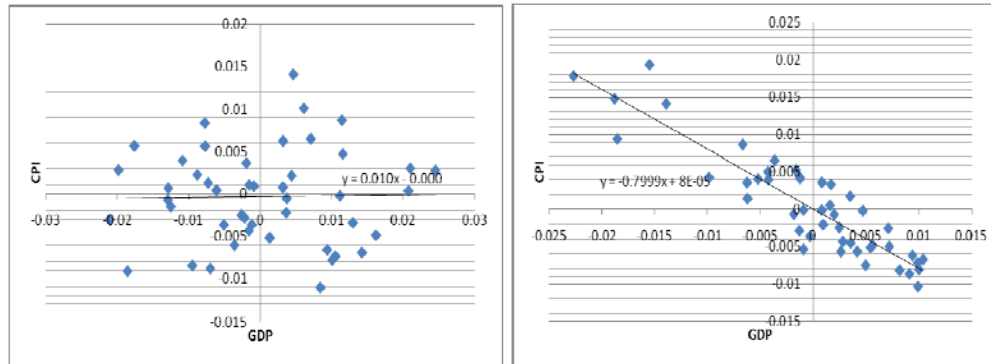
selection process, from which it was found that all residual series will no longer be correlated when a lag length of 4 is used (Appendix 3). Thus:

$$\Delta^2 y = b_0 + \sum_{i=1}^4 b_{1i} \Delta^2 y_{i-1} + \sum_{i=1}^4 b_{2i} \Delta^2 p_{i-1} + \varepsilon_t^{\Delta y}$$

$$\Delta^2 p_t = d_0 + \sum_{i=1}^4 d_{1i} \Delta^2 y_{i-1} + \sum_{i=1}^4 d_{2i} \Delta^2 p_{i-1} + \varepsilon_t^{\Delta p}$$

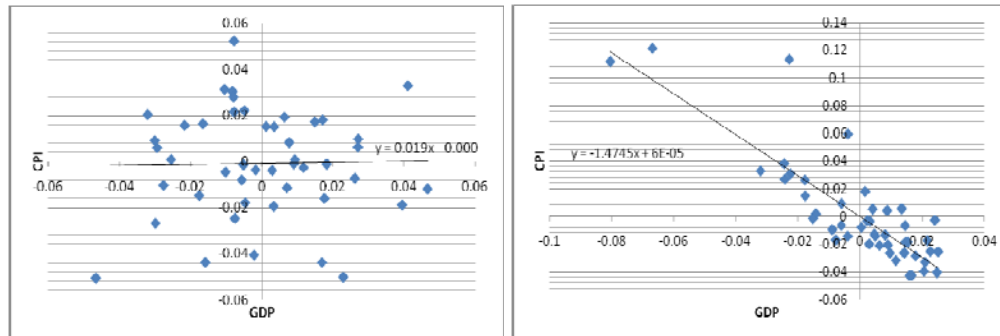
The results show that, in both countries, the slopes of AS and AD are according to what the theory predicts, i.e., positive for AS and negative for AD (Figures 1 and 2). The slopes in both countries are clearly flat—even more so when compared to the slopes in Republic of Korea (hereafter Korea) and Malaysia.³ This suggests that in Indonesia and Thailand a positive AD shock would have been effective to stimulate non-inflationary growth during the period of observation; output would have increased faster than prices. Along the AS curve, a positive growth innovation of 1% corresponds to a positive inflation innovation of 0.01% and 0.02% in Thailand and Indonesia, respectively.

Figure 1: Thailand's AS and AD Curves, 1994q3-2005q4



Source: Author's calculation based on the decomposition model.

Figure 2: Indonesia's AS and AD Curves, 1994q3-2005q4



Source: Author's calculation based on the decomposition model.

The decomposition results also show that Indonesia has a steeper AD curve (with a slope equal to -1.474). Along the AD curve a positive inflation innovation of 1% corresponds to a negative output growth innovation of -0.68%. The corresponding figure for Thailand is -1.25. To the extent that a stabilization policy tends to focus on inflation control, a steep AD curve suggests that using AS shock rather than AD policy to lower price levels would have been more effective.

³ The slopes in other Asian countries also confirm the theory prediction (due to space constraint, the results are not reported here).

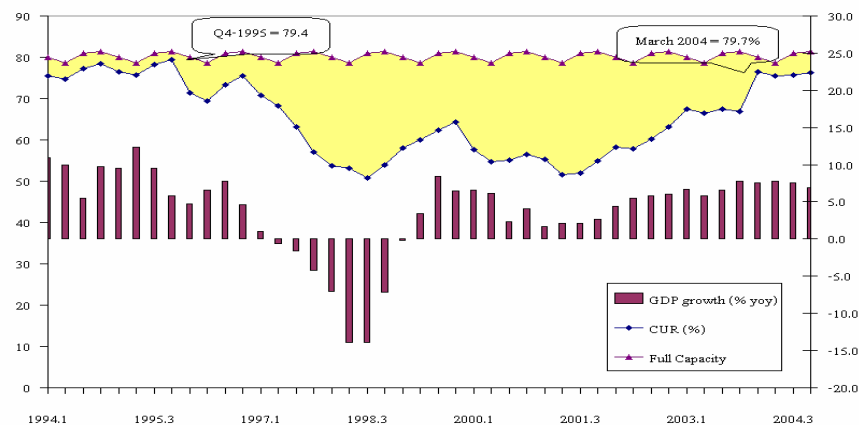
Table 1: Slopes of AS and AD Curves

	Thailand	Indonesia
AS Curve Slopes		
Pre-crisis	0.59	0.316
Post-crisis	0.008	-0.133
All periods (1994q3-2005q4)	0.01	0.019
AD Curve Slopes		
Pre-crisis	-0.919	-0.819
Post-crisis	-0.686	-1.008
All periods (1994q3-2005q4)	-0.799	-1.474

Source: calculated from the decomposition model.

Broken down into pre- and post-crisis, Table 1 shows that the slope of the AS curve in both countries became much flatter after the crisis, i.e., from 0.590 to 0.008, and from 0.316 to -0.133 in Thailand and Indonesia, respectively.⁴ In the case of AD curve, however, the trend was the opposite: it became flatter in Thailand (from -0.919 to -0.686) and steeper in Indonesia (-0.819 to -1.008). This clearly suggests that after the crisis, an AD-based policy would have been even more effective than before the crisis in stimulating growth and less effective for controlling inflation. This finding is most profound in Indonesia because not only has the slope of the AS curve turned negative, but the AD curve has also become much steeper. In Thailand's case, the post-crisis AS curve slope remains positive, and the negative-slope AD curve has become less steep.

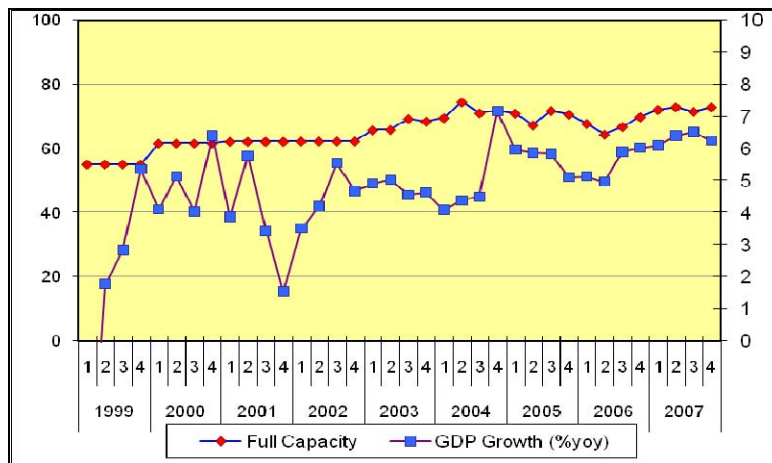
Capacity utilization during and after the crisis is usually low (i.e., the gap between potential and realized output is large), in which case an expansionary policy is needed. As shown in Figures 3A and 3B, this was indeed the case in Thailand and Indonesia, respectively.

Figure 3A. Thailand's Capacity Utilization


Source: Ministry of Finance, Thailand.

⁴ By now it has been widely recognized that the Asian financial crisis was not a standard current account crisis. There was little evidence of substantial overvaluation of exchange rates (only about 5–8% stronger than their 1990–1996 average), and there was a dramatic swing of the current account, i.e., from deficit to surplus. For example, in Thailand, the current account swung from a deficit of 8% of GDP in 1996 to a surplus of 12% in 1998. This startling adjustment was accomplished entirely by a compression of imports, as they plunged by 40%.

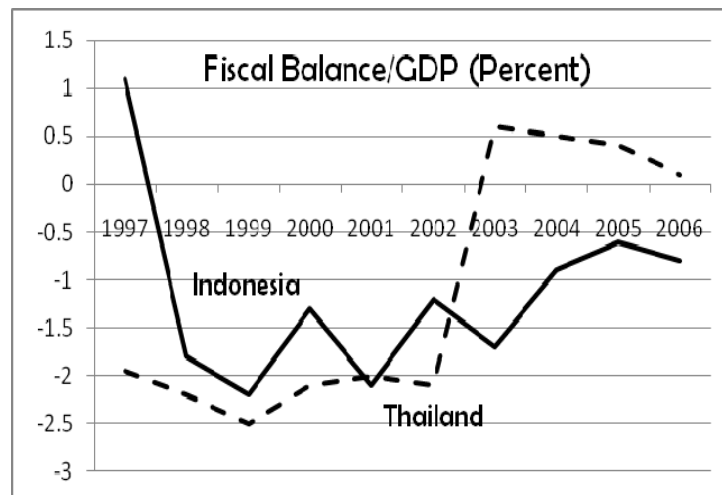
Figure 3B. Indonesia's Capacity Utilization



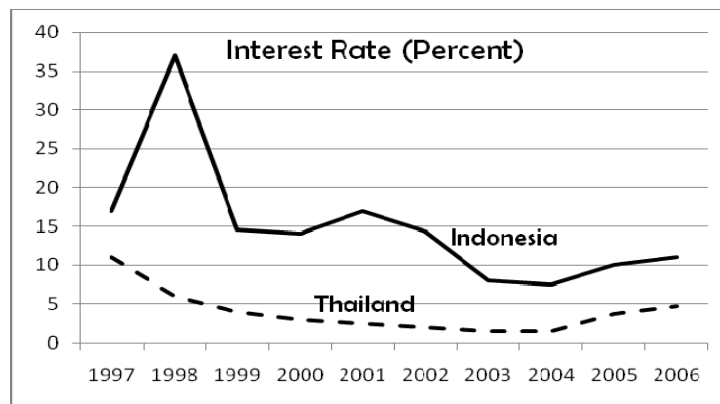
Source: Bank Indonesia.

Comparing the findings in Figures 3A and 3B with the actual policy in both countries validates the predicted outcome. As Figures 4 and 5 show, immediately after the crisis Thailand adopted an expansionary AD policy, the fiscal deficit widened, and the interest rates were lowered. The expansionary fiscal policy continued even when the external assistance provided under the Miyazawa Fund and other sources ended in 2000. In 2001 and 2002, the fiscal deficit was recorded at between 2% and 3% of GDP. As the economy recovered, fiscal surpluses began to appear in 2003.

Figure 4. Fiscal Balance in Thailand and Indonesia

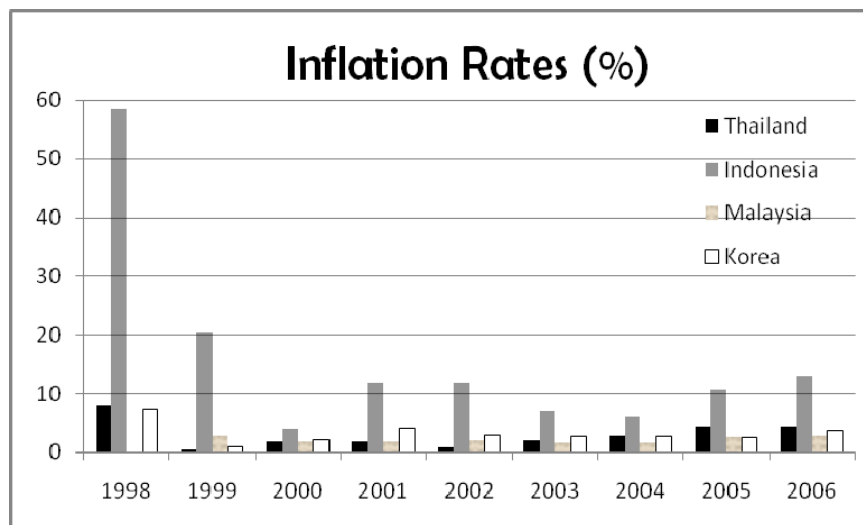


Source: Ministries of Finance of Thailand and Indonesia.

Figure 5. Interest Rates in Thailand and Indonesia

Source: Bank of Thailand and Bank Indonesia.

By contrast, Indonesia's fiscal position was in surplus even in the early stages of the crisis and its tight monetary policy lasted longer despite the downward pressure on the output during the time. Only a few years later, a fiscal deficit began to appear. Until 2002, as a percentage of GDP, Indonesia's deficit was not only lower than Thailand's but also lowest among all the Asian countries hit by the crisis. This is quite puzzling given that Indonesia suffered the most from the shock, with the sharpest fall in output.⁵ While the interest rates in Thailand were lowered in 1997, the rates in Indonesia were raised to 17% in 1997 and 37% in 1998. Since then, the rates have continued to be at double-digit levels, except in 2003 and 2004, when Indonesia's rates were a lot higher than Thailand's (Figure 6).

Figure 6. Inflation Rates in Thailand and Indonesia

Source: IMF, International Financial Statistics, various issues.

Thus, while Thailand's policy was consistent with what the decomposition analysis suggests, Indonesia's policy was not. The resulting outcomes were as expected: Thailand's economy recovered more steadily than did Indonesia's.

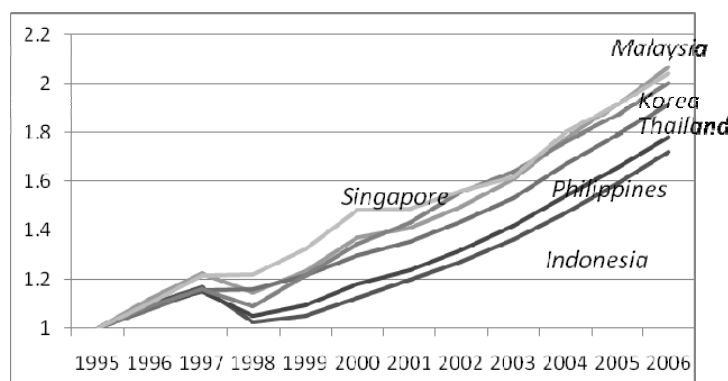
Following the decline during 1996:Q4 and 1997:Q1, Thailand's real GDP rebounded briskly in 1997:Q2, peaked in mid-1997, then fell more than 10% before reaching a trough during

⁵Not constrained by the IMF agreements, Malaysia's fiscal deficit was fairly large, reaching close to 6% of GDP during 2000–2003. The deficit remained larger than 2% in 2006, validating the country's stand in adopting the necessary counter-cyclical fiscal policy. Even Korea's fiscal deficit during and immediately after the crisis was larger than in Indonesia. However, the Korea's V-shaped recovery subsequently allowed the Korean government to reverse the trend by achieving a fiscal surplus in 2000–2002.

the second half of 1998. The inflation rate also surged, reaching 9% in the first quarter of 1998, then a double-digit rate in the second quarter, before declining to 5% in the last quarter (Figure 6). As expected, the poverty line and incomes of the poor (hence the poverty incidence) was adversely affected (see Figures 25 and 26 in Section IV).

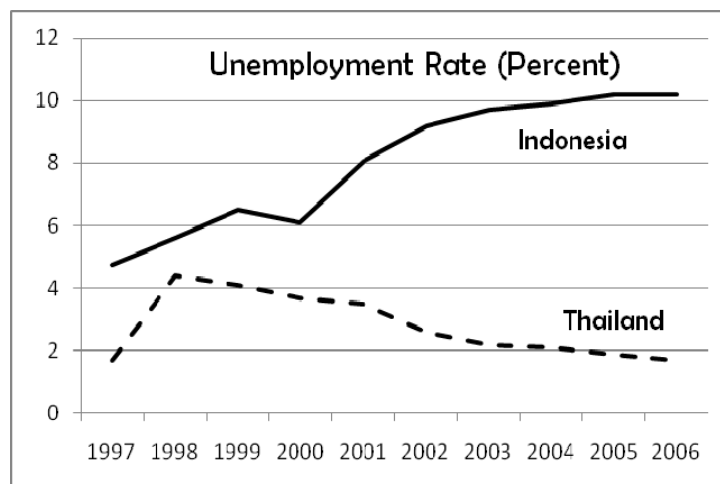
Indonesia's GDP growth, on the other hand, has been the most disappointing among all Asian crisis countries (Figure 7); its largest GDP fall was in 1998, but Indonesia's turn around has been the slowest. The government's decision to inject a huge amount of liquidity support to some troubled banks led money supply to increase significantly, despite the high interest rates. As a result, investment fell and prices soared. The IMF-recommended policy of structural change (AS policy shock) failed to produce the necessary recovery because the AD was severely curtailed.

Figure 7. Trend of Purchasing Power Parity (PPP)-Based GDP in Selected Asian Countries



Source: Processed from IMF calculations of PPP-based GDP

Figure 8. Unemployment Rates in Thailand and Indonesia



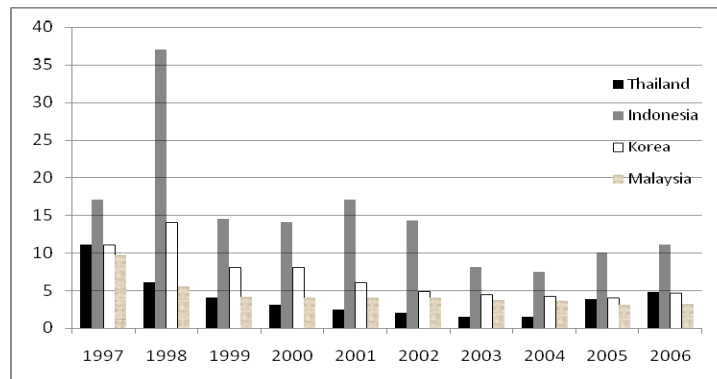
Source: Statistical Office of Thailand and Indonesia.

With real GDP falling by 15% between the third quarters of 1997 and 1998, inflation surged, the unemployment rate increased persistently (Figure 8), creating a double whammy: lower incomes of the poor and rising prices and poverty line. This was why Indonesia's poverty incidence soared dramatically during that period (Figures 25 and 26).

Indonesia's inflation rate has been the highest among the crisis countries. This is despite its relatively tight monetary policy (Figures 6 and 9). The AD-based policy has clearly been less effective. As indicated earlier, the country's AS curve was flat and the AD curve was very steep. Yet, all indications point to a strong tendency for the authority to continue using the AD-based policy to curb inflation at the costs of growth, income, and poverty. Indeed, during

the crisis the negative impacts of the policy responses on poverty has been much more severe in Indonesia than in Thailand.

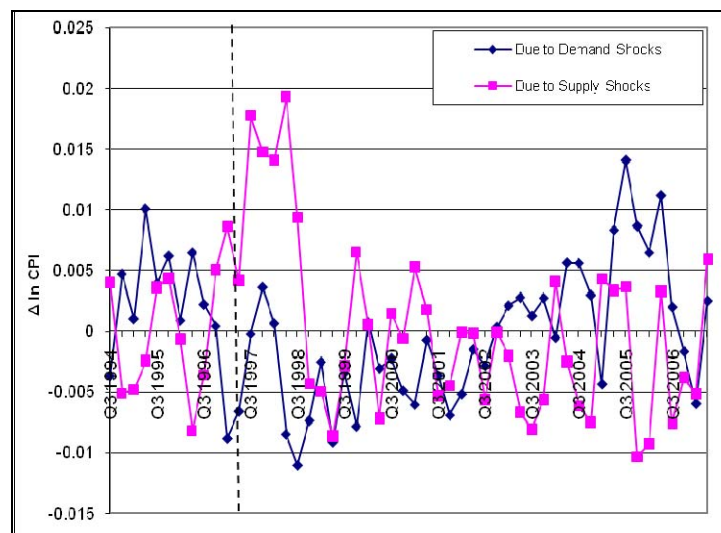
Figure 9: Interest Rates in Selected Asian Countries



Source: International Financial Statistics, and country's statistical office.

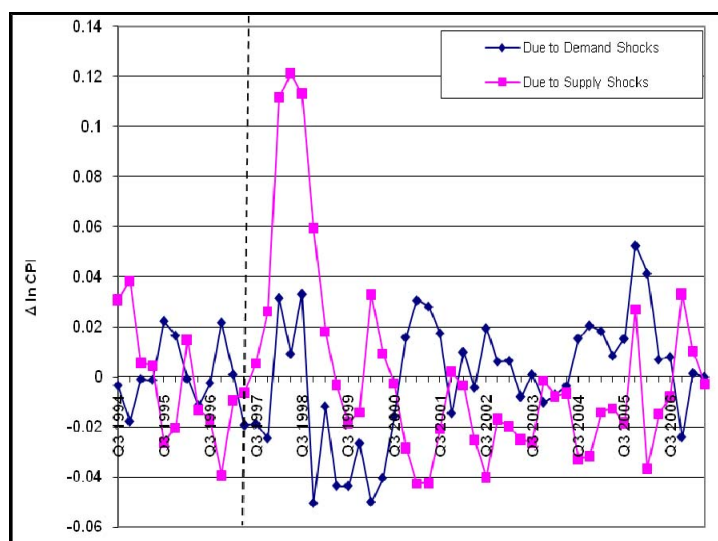
The role of the supply and demand shocks as the source of inflationary pressure can also be analyzed by generating the time series of inflation due to each shock. The results are shown in Figures 10 and 11 (excluding the drift term that represents the persistent impacts of the supply shock). The reconstructed time series components clearly show that in both economies the supply shock dominated the source of the sharp fluctuations of prices in 1997. In Thailand, the domination occurred from 1997:Q2 to 1998:Q3, while in Indonesia it lasted longer, i.e., from 1998:Q2 to 2002:Q4. By far, Indonesia's price increase was the most dramatic as the country's socio-political crisis and major institutional changes prompted a major cost-push pressure. The severe drought season related to the *El Nino* weather phenomenon also exacerbated inflationary pressure during that time. At any rate, controlling AD to curb inflation in such circumstances was clearly ineffective.

Figure 10: Inflation Dynamics in Thailand



Source: Author's calculation based on the decomposition model.

Figure 11: Inflation Dynamics in Indonesia



Source: Author's calculation based on the decomposition model.

III. RELATION WITH POVERTY: ENDOGENOUS INCOMES AND POVERTY LINE

How does the above analysis relate to the measure of poverty? The standard poverty measure depends critically on the poverty line (PL) and incomes of the poor (Y^{Poor}). The starting point to determine PL is to select a basket of basic needs reflecting the consumption pattern of households near the presumed poverty line and yielding threshold caloric requirements. Food is typically by far the most important commodity in the basket of basic needs. Denoting the basket of basic needs with π_{com} , the poverty line is essentially $\sum_{com} \pi_{com} \cdot P_{com}$, where P_{com} is the endogenously derived poverty line prices. To arrive at the poverty measure, one has to determine first the intra-group income distributions corresponding to the characteristics of each group. Given such a distribution, various poverty measures may then be used.⁶

Clearly, PL and INC_h hold the key to the poverty measure. In an expansionary policy, the price increase can be larger or smaller than the increase in PL ; and, GDP expansion may be greater or smaller than the increase in incomes of the poor (Y^{Poor}). A contractionary policy may also generate a fall of PL that is smaller or larger than the decline in GDP. The results vary by country and type of policies being implemented (e.g., fiscal versus monetary). The precise relation will be known only after the transmission mechanisms are evaluated empirically. In the cases of Thailand and Indonesia, it is known only from the earlier analysis that the AS curve is flat, but how it translates into poverty is yet to be analyzed.

⁶ One of the most common measures is the Foster-Greer-Thorbecke (FGT), which is capable of measuring: (1) headcount, i.e., the number of people below the poverty line; (2) poverty gap, or shortfall of the poor below the poverty line (a measure of the resources required to eliminate poverty); and (3) severity of poverty. The general formula of FGT is (Foster, Greer, Thorbecke, 1984):

$$P_{\alpha}^h = \int_0^1 \left(\frac{PL - INC_h}{PL} \right)^{\alpha} f^h(INC_h) dINC_h,$$

where PL is the poverty line, α is the poverty-aversion parameter, and INC_h is household income h . $\alpha=0$ is the headcount index, $\alpha=1$ measure the poverty depth, and $\alpha=2$ gives the measure of poverty severity. Clearly, PL and INC_h hold the key to the poverty measure.

If under an expansionary policy the relation between PL and Y^{Poor} form a convex curve (PL being the x-axis), the likelihood of improved poverty conditions is high because the increase of PL is smaller than the increase of Y^{Poor} . However, there is no reason that a convex curve cannot result in a larger increase of PL than of Y^{Poor} . Two scenarios may arise under a convex curve case: worsening poverty condition—represented by the thin curves and thin arrows; and improved poverty condition—represented by the bold curves and bold arrows in quadrant 2, 3, and 4 (Figure 12). Thus, even if we know the precise shape of the curves, it is still uncertain whether the expansionary policy will generate a favorable or unfavorable poverty outcome. The same is true for the contractionary policy, where all curves are concave: the case of worsening poverty is depicted by the thin curves, while the bold curves represent a scenario of improved poverty condition (Figure 13).

Figure 12. General Equilibrium Relations Under Expansionary Policy

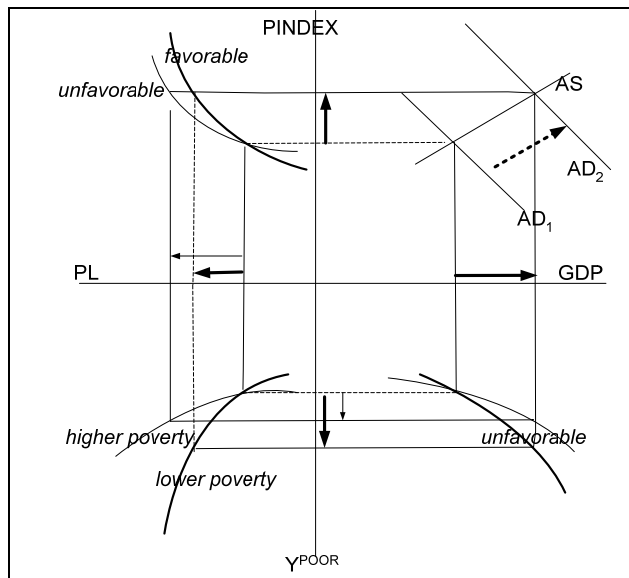
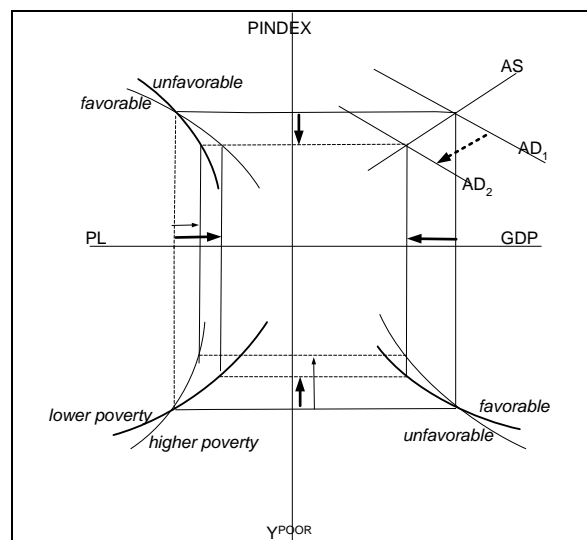


Figure 13. General Equilibrium Relations under Contractionary Policy



As far as the relation between GDP and Y^{Poor} (in quadrant 4) is concerned, the dynamic slope of the curve also predicts what happens with the income distribution: in an expansionary policy, a concave curve suggests that inequality tends to worsen after the policy shock, whereas in a contractionary policy, a concave curve implies an improvement in

income distribution after the shock. On the other hand, in an expansionary policy, a convex curve suggests that inequality tends to improve after the policy shock, and in a contractionary policy a convex curve implies a deterioration in the post-shock income distribution.

To the extent that the relations between PL and price level ($PINDEX$), as well as between output (GDP) and incomes of the poor (Y^{Poor}) are too complex to be estimated in a partial equilibrium setting, a general equilibrium model with a detailed financial sector is used to estimate those relations.

First, I started with the relation that captures the response of poverty line (PL) to changes in prices. The general price level is endogenously determined through the interactions between supply and demand of both domestic and foreign goods, in which the demand consists of domestic and import demand ($PD.D + PM.M$):

$$PQ_p = \frac{PD_p \times D_p + PM_p \times M_p}{Q_p}$$

where Q , D , and M refer to total supply of goods available, goods produced and sold domestically, and imported goods, respectively, and subscript p denotes the economic sector. PQ , PD , and PM are the corresponding prices. A similar notion applies to the prices of domestic output, PX :

$$PX_p = \frac{PD_p \times D_p \times (1 - tdom_p - ttd_p) + PE_p \times E_p}{X_p}$$

where $tdom$ and ttd are indirect tax rates on domestic goods and the trade and transport margin rate on domestic goods, respectively.

The above specification is based on a production structure that is modeled as a set of nested constant elasticity of substitution (CES) function. In the first stage, the production function (expressed as value-added) is determined, in which the primary inputs are the right-hand side variables. Since a considerable portion of intermediate inputs are imported, the composite intermediate inputs $INTM$ are modeled as a CES function of domestic and imported inputs ($DOMINTM$ and $FORINTM$).⁷ In the second stage, the domestic output is specified as a CES function of the value-added VA and the composite intermediate inputs. The resulting price of value-added PV is:

$$PV_p = \frac{PX_p \times X_p - PINTM_p \times INTM_p}{VA_p}$$

where $PINTM$ is the price of intermediate inputs. The unit price of imported and domestically produced intermediate inputs ($PDINTM$ and $PFINTM$) are, respectively:

$$PDINTM_p = \sum_{pp} \{aad_{pp,p} \times PD_{pp}\}$$

$$PFINTM_p = \sum_{pp} \{aam_{pp,p} \times PM_{pp}\}$$

where aad and aam are the share parameters, and subscripts p and pp refer to the production sector. From these two equations, the price of composite intermediate inputs is derived:

⁷ In the Thai model, however, due to a lack of data, the distinction between $DOMINTM$ and $FORINTM$ cannot be made. I want to acknowledge the modeling work of Chanin Manopiniwes, based upon which the Thai model used in this study was developed (Manopiniwes, 2005).

$$PINTM_p = \frac{PDINTM_p \times DOMINTM_p + PFINTM_p \times FORINTM_p}{INTM_p}$$

The value-added price PV determines the nominal value-added. After taking into account the indirect tax ($INDTAX$), $TARIFF$, and subsidy (SUB), the nominal GDP (GDP at current price, or $GDPCUR$) can be derived:

$$GDPCUR = \sum VA_p \cdot PVA_p + INDTAX_p + TARIFF_p - SUB_p - SUBM_p$$

The general price level ($PINDEX$) is derived as the GDP deflator:

$$PINDEX = \sum GDPCUR / GDP$$

where the GDP at constant prices is derived from the expenditure side.

The prices of the basic needs presumably consumed by the poor, are classified according to urban and rural, and formal and informal. Rural poverty line prices are distinguished from prices in urban areas, and so are the consumption patterns. Hence, the relation between P and PL is:

$$PL^{r,u} = \left(\frac{P}{PDAVG} \right) \times \sum \alpha_p^{r,u} \times PD_p$$

where $\alpha_p^{r,u}$ is the sectoral consumption parameter that captures different consumption patterns between rural and urban.

Next is to identify the relation between GDP and incomes of the poor in the lower right quadrant of Figures 12 and 13. Income of different households consists of factor income (wages), transfers, and income from financial assets. Given labor market segmentation (wages being strongly sector-specific), labor income is specified as follows:

$$WAGES_p = PINDEX^\rho \times \left(\frac{PV_p}{PV0_p} \right)^{(1-\rho)} \times \left(\frac{X_p / \sum_p FACDEM_{p,fl}}{PDL0_p} \right)^{\eta}$$

where $PDL0$ and $FACDEM$ are, respectively, labor productivity before the shock and factor (labor) demand. Note that ρ , the price elasticity of wages, can play a critical role in determining the effect of a policy shock that causes changes in prices on wage income. In particular, an expansionary macroeconomic policy (e.g., a positive AD shock) could affect the wages of the low income group differently when the value of ρ is altered. This implies that the value of ρ can determine the resulting poverty, depending on a given poverty line.

The average wage rates for each labor category are arrived at on the basis of the above sectoral wage rates and the wage shares of each type of labor in each sector ($wshare_{p,fl}$):

$$WF_{fl} = WF0_{fl} \times \sum_p WAGES_p \times wshare_{p,fl}$$

The unemployment and rural-urban migration reflect the slack in the labor market as such that the total supply of labor equals the demand for labor plus the unemployed labor force.

Household income from sources other than factor income is denoted by $ITRAN$. It consists of transfers among households, firms, and rest of the world ($OTRAN$), government subsidies ($GTRAN$), and returns on financial assets ($RTRAN$):

$$ITRAN_{i,j} = GTRAN_{i,j} + OTRAN_{i,j} + RTRAN_{i,j}$$

where i, j reflect different institutions.

The inclusion of financial assets, which is the core feature of the CFGE model, is particularly important amid what has been happening during the last few years in most emerging markets, including Thailand and Indonesia. In these two countries, there exists an excess liquidity (saving) characterized by a faster growth of investment in financial assets than in the real sector. This phenomenon is supported by existing data which shows total saving as greater than total investment in the real sector (most excess saving goes to financial investments).

Unlike in a standard non-financial computable general equilibrium (CGE) model, investment is endogenously determined by the investment function and institutional portfolio allocations (“fixed” asset investments). Institutional savings will also be a part of the institutional balance sheet as they represent changes in wealth.⁸ While, in general, the rate of return for each asset is determined based upon the supply and demand of financial assets, some returns determine the supply (e.g., the supply of time deposit follows the demand and given deposit rates)—and others determine the demand (e.g., the demand for government bonds is determined by how much is offered and at what rate).

The saving-investment closure in the model departs drastically from the neo-classical specifications. Based on a number of empirical studies (Azis, 2002), investment in sector p can be specified as a function of value added VA (output accelerator), loan interest rates rn_c , and exchange rate EXR :

$$INV_p = \lambda_p VA_p^{\lambda_{1p}} (1 + rn_c)^{\lambda_{2p}} (EXR)^{\lambda_{3p}}$$

where rn_c is the loan interest rate and λ s are constant; the size of λ_3 depends on the sensitivity of investment on exchange rate fluctuations. This specification reflects the financing behavior of agents (i.e., bank-dependent) and balance sheet constraints (Bernanke & Gertler, 1989, Krugman, 2001, Aghion, Bacchetta and Banerjee, 2001). When the exchange rate is stable, few firms are constrained by their balance sheets: the direct effect of EXR on aggregate demand is minor. On the other hand, if the exchange rate depreciates sharply, agents’ ability to expand is adversely affected. Since the balance sheet effect in Thailand during the post-crisis period has declined substantially, EXR is not included in Thailand’s investment function.

The portfolio allocation of institutions is specified based upon the assumption that there is no perfect substitutability, as suggested by Tobin (1970); Brunner and Meltzer (1972); Bernanke and Blinder (1988), and used in Bouguignon, Branson, and de Melo (1989), and Thorbecke et al. (1992). In the Thai model, after specifying the money demand of household hh (MD_{hh}), the following equations determine how much households want to hold in cash and demand deposits:

$$AssetS_{cu, hh} = cush_{hh} MD_{hh}$$

$$AssetS_{dd, hh} = (1 - cush_{hh}) MD_{hh}$$

where ($cush_{hh}$) is a fixed share. The weighted average rate of return on other assets (i.e., time deposit, equity, and government bond), rn_{hh} , is defined as:

$$rn_{hh} = \frac{rn_{td} AssetSLag_{td, hh} + rn_{eq} AssetSLag_{eq, hh} + rn_{gb} AssetSLag_{gb, hh}}{AssetSLag_{td, hh} + AssetSLag_{eq, hh} + AssetSLag_{gb, hh}}$$

where subscripts td , eq , and gb refer to, respectively, time deposit, equity, and government bond. The ratio of time deposit to equity ($gh1/(1-gh1)$) depends on the ratio of their returns, i.e., interest rate on time deposit (rn_{td}) and return on equity (rn_{eq}):

⁸ “Asset = Liability + Wealth” is the core balance in the financial module.

$$\frac{ghl_{hhf}}{1 - ghl_{hhf}} = \theta_{hhf} \left(\frac{1 + r_{td}}{1 + r_{eq}} \right)^{\sigma_{hhf}}$$

where θ_{hhf} and σ_{hhf} are constant. Thus, the values of time deposit and equity are, respectively:

$$AssetS_{td,hhf} = ghl_{hhf} OAssetS_{hhf}$$

$$AssetS_{eq,hhf} = (1 - ghl_{hhf}) OAssetS_{hhf}$$

In the Indonesian model, incomes received by household h from institution j are determined as follows:

$$RTRAN_{hh,j} = AssetsH_{hh} \sum_s r_s LiabG_{j,s}$$

where r_s is the return on asset type s , $LiabG_{j,s}$ is the stock of asset type s transferred from institution j at the beginning of the period and $AssetsH_{hh}$ is the share of total assets held by household j . For institution i , the latter is defined as:

$$AssetsH_i = \sum_s (r_s AssetG_{s,i}) / \sum_{s,j} (r_s AssetG_{s,j})$$

where $AssetG_{s,i}$ and $AssetG_{s,j}$ are, respectively, the stock of asset type s in the beginning period held by institution i , and the stock of asset type s transferred from institution j . For example, if i is urban-rich household and s is the time deposit, the above equation indicates the ratio of time deposit held by urban-rich household over the time deposit of all households. Thus, the ratio shows how much of the total time deposit is held by the urban rich.

From the above specifications, it is clear that if the interest rate r_s is raised to combat inflation (s is the time deposit), the $RTRAN$ of households hh which hold savings will also increase. Hence, those who own more time deposits will receive higher incomes. From this mechanism alone, the relative income distribution can be altered, implying that the link between macroeconomic policy and poverty, as well as the growth-poverty nexus, can also change.

IV. CFGE SIMULATIONS AND ANALYSIS

To the extent that certain forms of relations (shape of the curve) have different impacts on poverty when analyzed under expansionary and contractionary policy, the following analysis was conducted under these two sets of simulation. In each set I distinguished the impact of monetary (interest rate) and fiscal (government expenditure) policy. The mechanisms to arrive at the poverty condition are based on the CFGE model, and the focus is on the relations among four variables in the 4-quadrant setting described earlier. The ultimate variable of interest is the real income of the poor denoted by Y^{Poor} (deflated by the appropriate poverty line prices). Since the role of income inequality in affecting the growth-poverty nexus is critical, the simulations in each scenario also include relative income distribution.

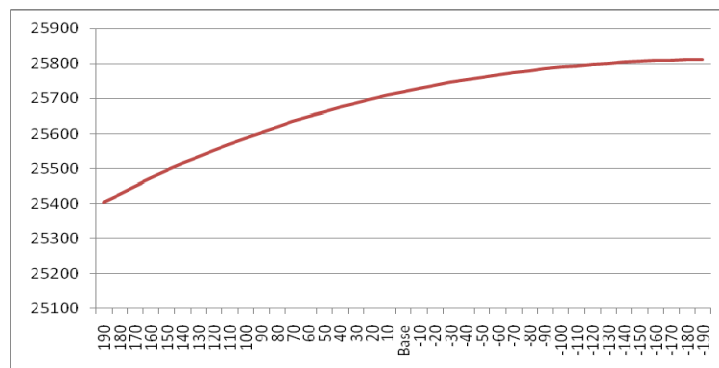
From the sensitivity analysis and re-examination of the model structure, it was revealed that the wage equation, particularly parameter ρ that links $WAGES$ and $PINDEX$ (in the equation below)

$$WAGES_p = PINDEX^\rho \times \left(\frac{PV_p}{PV0_p} \right)^{(1-\rho)} \times \left(\frac{X_p / \sum_p FACDEM_{p,fl}}{PDL0_p} \right)^{\eta}$$

holds the key to the results; influencing not only the factor income but also prices. More fundamentally, while incomes of the poor change according to the policy shock, i.e., declines under a contractionary policy and increases when the economy expands, the effect on real income of the poor Y^{Poor} depends critically on what happens with the prices and the poverty line. In scenarios where ρ are low, the rate of income change is faster than the rate of price change, while in large ρ scenarios the reverse applies. Thus, applying different values of ρ in each simulation is warranted.

Under low ρ , an expansionary monetary policy (by lowering the interest rates successively) in Indonesia would generate higher income for the poor but it would also create a higher poverty line threshold (hence higher PL). On the other hand, higher interest rates would lower the income of the poor and PL . The net effect on Y^{Poor} was eventually determined by which of the two changes is larger. As shown by the curve to the right of the “Base” point in Figure 14, lowering interest rates successively would likely raise the Y^{Poor} , implying that the rate of income increase is higher than the rate of PL increase. Conversely, by raising the interest rates successively, the Y^{Poor} tends to decline (left side of the vertical line), suggesting that income will fall faster than PL .⁹ Note, however, that the change in Y^{Poor} in both directions is at a decelerating rate. This is to be expected: given the prevailing excess capacity, a positive shock of AD would effectively raise GDP without a strong inflationary pressure. But as the excess gets smaller and eventually disappears, a further positive shock of AD would become less effective in stimulating growth and would generate strong inflationary pressure, such that the expected rate of increase of GDP and real income of the poor would decelerate.

**Figure 14. Monetary Policy Simulation With Low ρ :
Indonesia's Real Income of the Poor (y axis in Rp)**

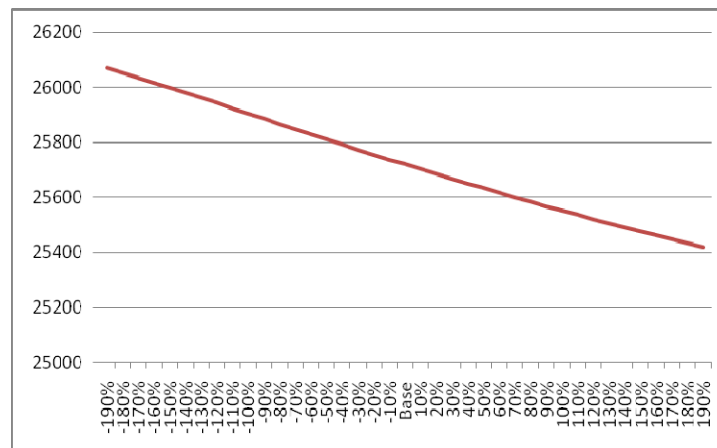


Source: Results of Indonesian CFGE model simulations.

Less expected is the outcome of the scenario under fiscal policy simulation. As shown in Figure 15, higher government expenditure tends to reduce real income of the poor. Two possibilities may explain this result. First, the expenditure shock is applied without making any changes in the sectoral composition of expenditure. The fact that the base year of the financial social accounting matrix (FSAM) used in the model is 2005, during which a less pro-poor policy took place (there were two drastic cuts on the subsidy for domestic fuel price—one in March and another in October of 2005 (Azis, 2006)), implies that the successive shocks in the simulation continue to be less favorable for low income households. Secondly, the financial channel tends to work to the benefit of high income households because interest rates and returns on financial assets increase as a result of the rightward shift of the IS curve. In turn, this generates extra earnings for high income households who own such assets, but it also drives up prices. While incomes of the poor are unaffected, the resulting poverty line tends to increase, thereby lowering the Y^{Poor} .

⁹ Note that the unit of measurement in Figure 14 is in basis point.

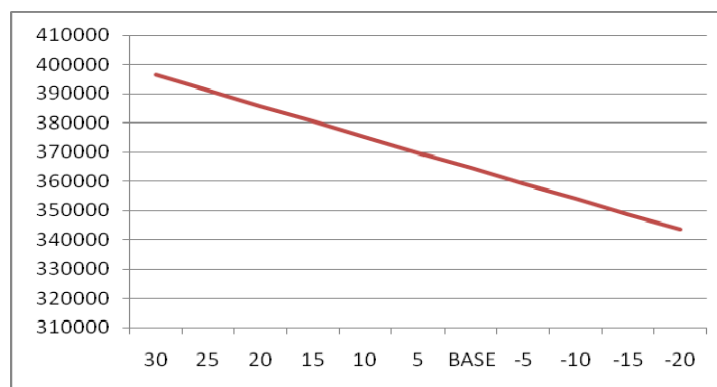
**Figure 15. Fiscal Policy Simulation With Low ρ :
Indonesia's Real Income of the Poor (y-axis in Rp)**



Source: Results of Indonesian CFGE model simulations.

The simulation results based on Thailand's CFGE model, however, show a different pattern. A monetary expansion would have caused higher inflation and poverty line in such that the Y^{Poor} tends to decline (Figure 16). But a fiscal expansion is likely to raise the income of the poor more than the price increase. As shown in Figure 17, given a low ρ the greater the fiscal spending the higher the Y^{Poor} . The non-linear nature of the relations is clearly shown by the accelerated increase and the decelerated decrease of Y^{Poor} under the higher and lower spending conditions, respectively. The turning point under lower spending is at around 50%; a further cut beyond that level would result in a sharp fall of the poverty line such that the Y^{Poor} tends to increase.¹⁰

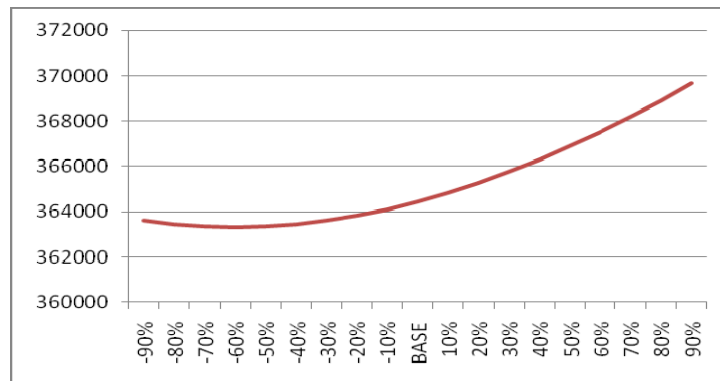
**Figure 16. Monetary Policy Simulation with Low ρ :
Thailand's Real Income of the Poor (y axis in Baht)**



Source: Results of Thailand CFGE model simulations.

¹⁰ However, it is important to note that a spending cut of such a large proportion would have resulted in a less desirable, economy-wide outcome as indicated by other endogenous indicators (GDP, consumption, and financial sector variables).

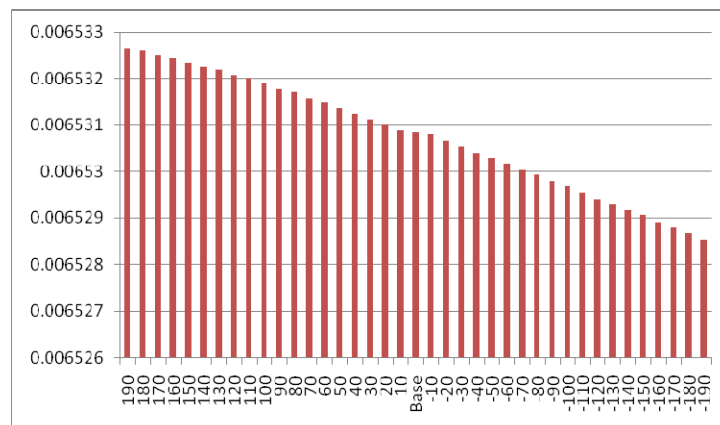
**Figure 17. Fiscal Policy Simulation with Low ρ :
Thailand's Real Income of the Poor (y axis in Baht)**



Source: Results of Thailand CFGE model simulations.

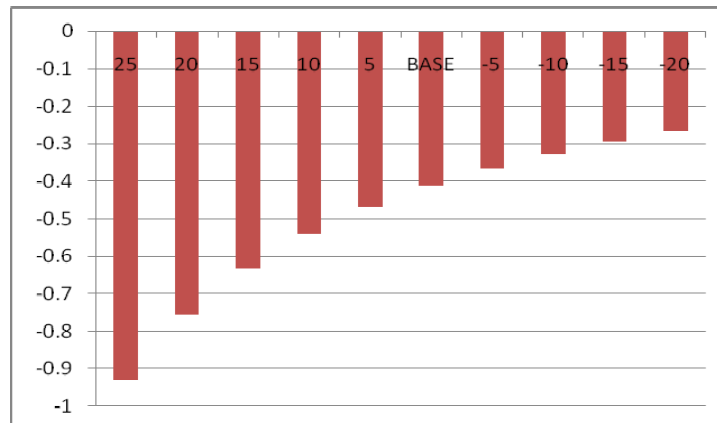
What happens with the resulting income inequality under the above policy scenarios? The favorable effect of monetary expansion on poverty in Indonesia tends to reduce income inequality as indicated by the dynamic trend of the slope between GDP and income of the poor (see the relation in quadrant 4 of Figure 12). As the interest rates are lowered, the slope gets larger, suggesting that the income of the poor increases more proportionally than the increase of GDP. On the other hand, a contractionary monetary policy tends to worsen income inequality as indicated by the decreasing size of the slope to the left of the vertical line in Figure 18. This is similar to the case in Thailand. Although an expansionary policy through successive falls of interest rates would have generated lower Y^{Poor} , the resulting income distribution would have slightly improved, as indicated by the increasing size (decreasing negative value) of the slope as shown in Figure 19.

**Figure 18. Monetary Policy Simulation With Low ρ :
Indonesia's Dynamic Slope GDP and Real Income of the Poor**



Source: Results of Indonesian CFGE model simulations.

**Figure 19. Monetary Policy Simulation With Low ρ :
Thailand's Dynamic Slope GDP and Real Income of the Poor**

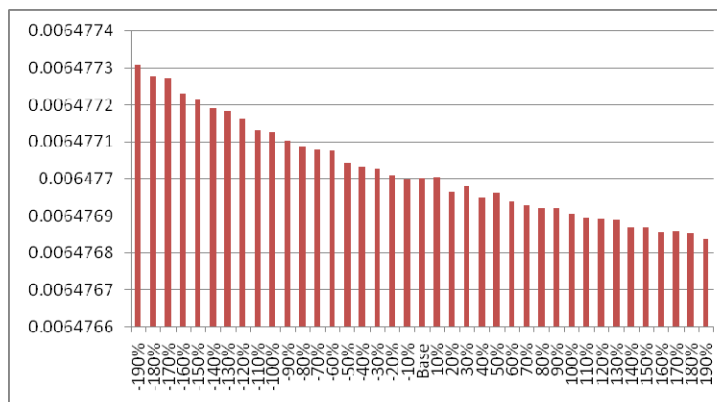


Source: Results of Thailand CFGE model simulations.

A further look at the mechanisms points to the vital role of price (hence of the PL). In Thailand's case, the inflationary pressure (rising $PINDEX$) will not cause a price-spiraling effect; this is because a low ρ implies that price changes have only a mild effect on wages. With relatively smaller inflationary pressure and lower increase of PL , the effect of income deflator is also limited, leading to rising real income of the poor. On the other hand, in the Indonesian case, the effect of monetary policy on price level is larger, so the increase of incomes of the poor is likely offset by the PL increase. On relative income distribution, the channel through which income from financial assets is determined turns out to play an important role. As the returns on financial assets fall with interest rates, the incomes of those owning such assets (high income groups) also declines. Poor households, on the other hand, are unaffected; they are insulated from the changing returns on financial assets as they generally do not hold such assets. This finding highlights the importance of incorporating the financial sector in the model.

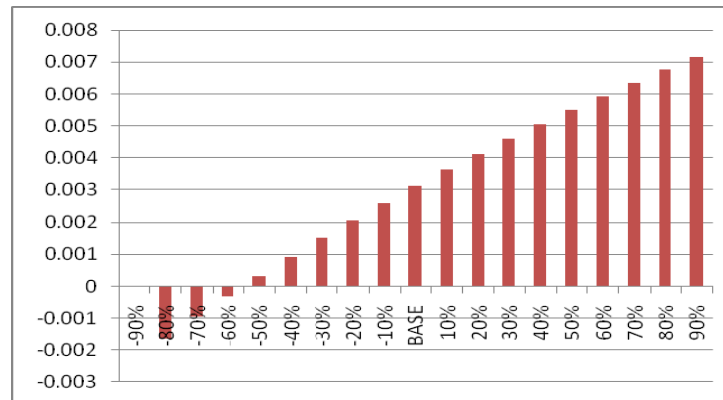
The distributional effect of fiscal expansion in Thailand is expected: it tends to lower income inequality as indicated by the rising slopes of GDP and Y^{Poor} in Figure 20. Less expected are the results for Indonesia: if fiscal spending is raised, the income distribution tends to get worse as the slope tends to get smaller. On the other hand, if the spending is lowered, the income distribution is likely to get better as the slope tends to get larger) (Figure 21). As argued earlier, this is likely due to the fact that the expenditure composition in 2005, the base year used in the model was less pro-poor and that the fiscal expansion assumed in the scenario keeps such a composition unchanged.

**Figure 20. Fiscal Policy Simulation With Low ρ :
Indonesia's Dynamic Slope of GDP and Real Income of the Poor**



Source: Results of Indonesian CFGE model simulations.

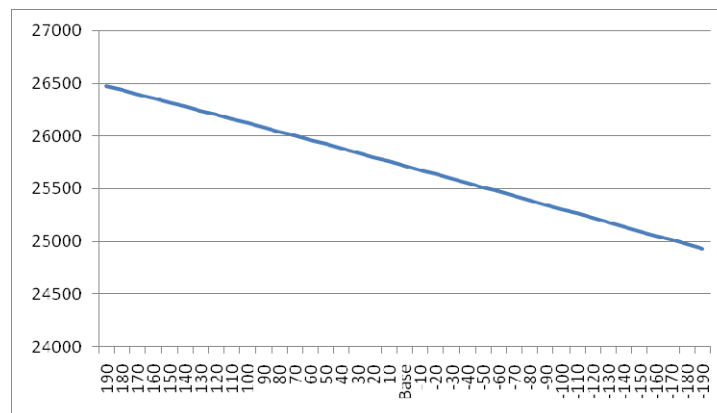
**Figure 21. Fiscal Policy Simulation With Low ρ :
Thailand's Dynamic Slope of GDP and Real Income of the Poor**



Source: Results of Thailand CFGE model simulations.

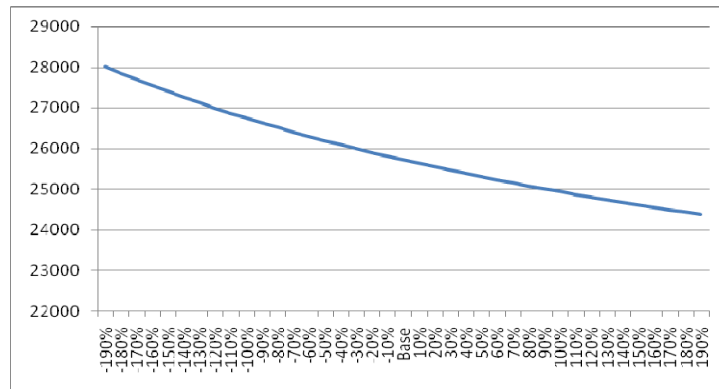
When ρ are higher, the results of model simulations for Indonesia show that the increase of income following an expansionary policy is less than the increase of price and PL . Consequently, lowering interest rates worsens the poverty condition and real income of the poor tends to decline (Figure 22). On the other hand, a monetary tightening through successive interest rate increases tends to improve the poverty condition as the decrease of PL is larger than the fall in income. A similar pattern is observed when the expansion and contraction are conducted through fiscal policy (Figure 23). The decline in Y^{poor} following increased expenditure, however, occurs at a more decelerated rate.

**Figure 22. Monetary Policy Simulation with High ρ :
Indonesia's Real Income of the Poor**



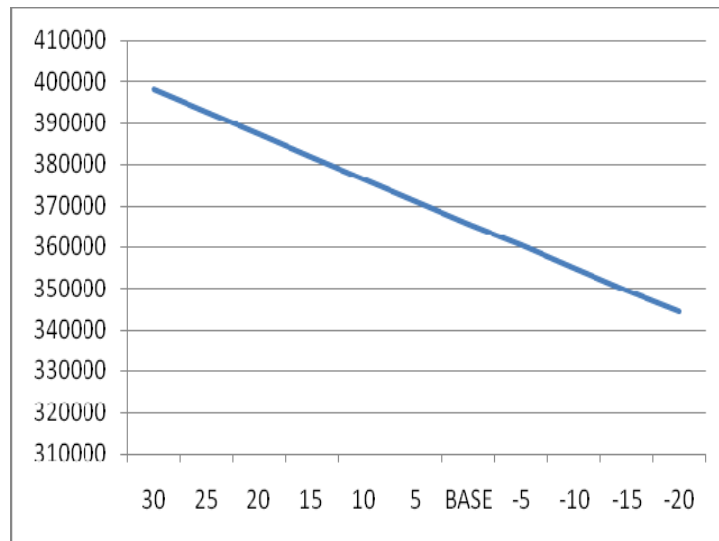
Source: Results of Indonesian CFGE model simulations.

**Figure 23. Fiscal Policy Simulation with High ρ :
Indonesia's Real Income of the Poor**



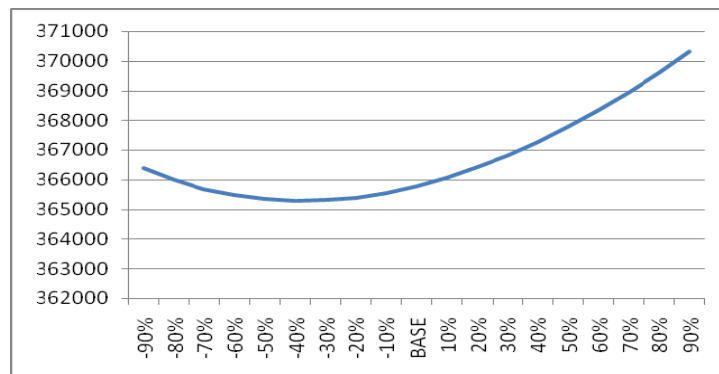
Source: Results of Indonesian CFGE model simulations.

**Figure 24. Monetary Policy Simulation With High ρ :
Thailand's Real Income of the Poor**



Source: Results of Thailand CFGE model simulations.

**Figure 25. Fiscal Policy Simulation with High ρ :
Thailand's Real Income of the Poor**



Source: Results of Thailand CFGE model simulations.

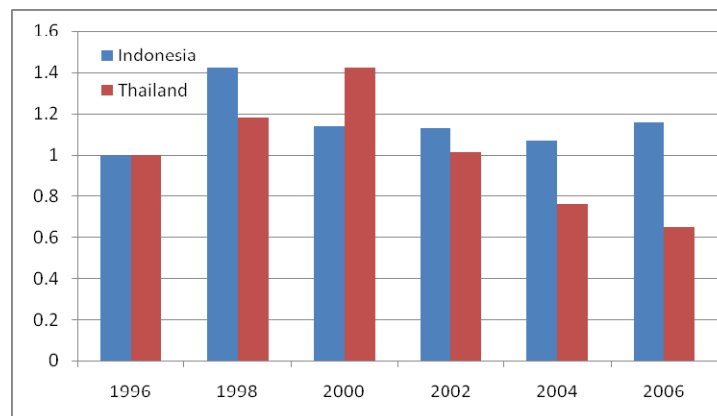
In the Thailand case, the size of ρ does not seem to influence the adverse effect of a positive monetary shock on poverty: Y^{Poor} tends to decline, just as in the case of low ρ (Figure 24).

Interestingly, the effect of fiscal expansion is also unaffected by the size of ρ ; it continues to be favorable for poverty reduction (Figure 25). Thus, it is clear that as far as the effect of macroeconomic policy on poverty is concerned, the size of ρ matters in Indonesia but not in Thailand. A fiscal expansion in Thailand is favorable for poverty reduction, whereas a positive monetary shock in Indonesia is favorable when the price elasticity of wages is low.

To the extent that the fiscal policy in Thailand during the post-crisis period was actually expansionary (discussed in Section II), a poverty decline should be expected. As shown in Figures 26 and 27, this was indeed the case since 2000. What is also obvious is that since 2000, the trend in the two countries has differed: the poverty decline has been consistent in Thailand but has fluctuated in Indonesia. In fact, during 2004–2006 the number of poor in Indonesia has increased; there were more poor people in 2006 than in 1996, the year before the crisis. Such a disappointing trend is consistent with the absence of expansionary AD policy that has led to meager growth performance, despite the fact that the country's AS curve is flat. As shown earlier, under certain conditions (i.e., low ρ) a more monetary expansion would have been able to reduce poverty.

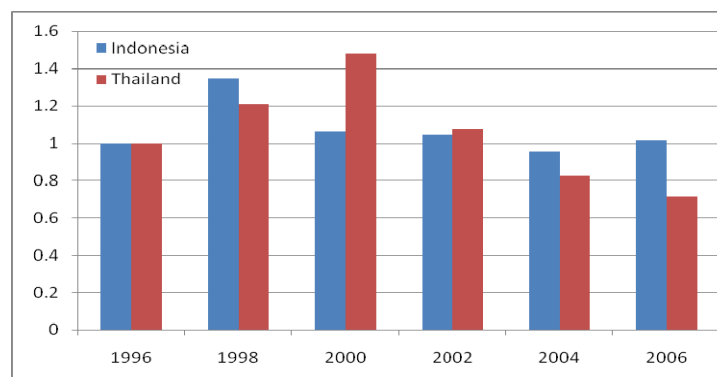
The importance of output growth in generating higher incomes of the poor is also supported by the fact that the increasing trend of the poverty line in Thailand has been more significant than in Indonesia (Figure 28), yet the poverty incidence has been favorable in the former but not in the latter.

Figure 26. Index of Number of Poor in Thailand and Indonesia (1996=1)



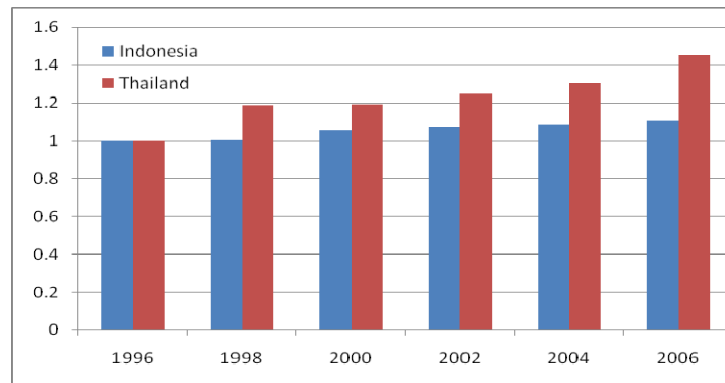
Source: NESDB Thailand, CBS Indonesia.

Figure 27. Index of Poverty Incidence in Thailand and Indonesia (1996=1)



Source: NESDB Thailand, CBS Indonesia.

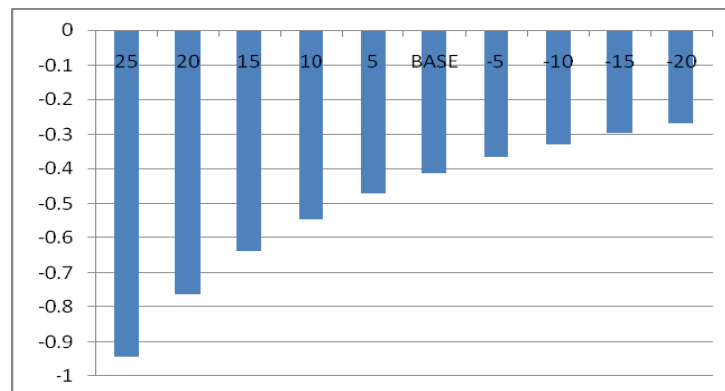
Figure 28. Poverty Line Index in Thailand and Indonesia (1996=1)



Source: NESDB Thailand, CBS Indonesia.

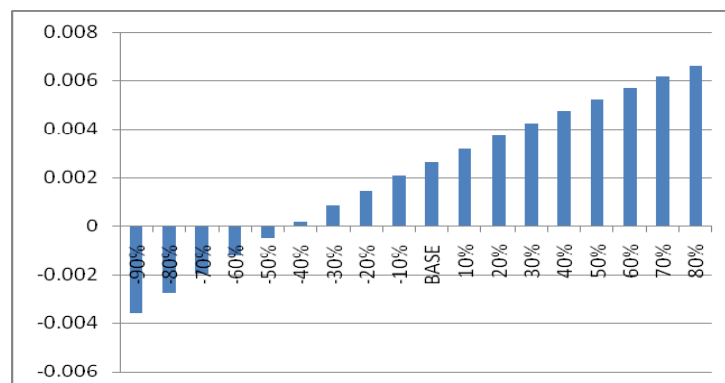
The resulting income distribution of monetary expansion with a larger ρ is favorable in Thailand, as indicated by the increasing slope of $GDP-Y^{Poor}$ (Figure 29). Thus, as far as the impact of monetary policy is concerned, the size of ρ in Thailand influences neither the impact on poverty nor on income inequality. The same is true with respect to the impact of fiscal policy (Figure 30). In the Indonesian case, although the size of price-wage elasticity can reverse the resulting poverty of monetary policy (discussed earlier in this section), it does not really affect the resulting income inequality. As shown in Figures 31 and 32, the slope under a high ρ scenario tends to decline as is also the case when ρ is low (Figures 18 and 20).

Figure 29. Monetary Policy Simulation with High ρ : Thailand's Dynamic Slope GDP and Real Income of the Poor



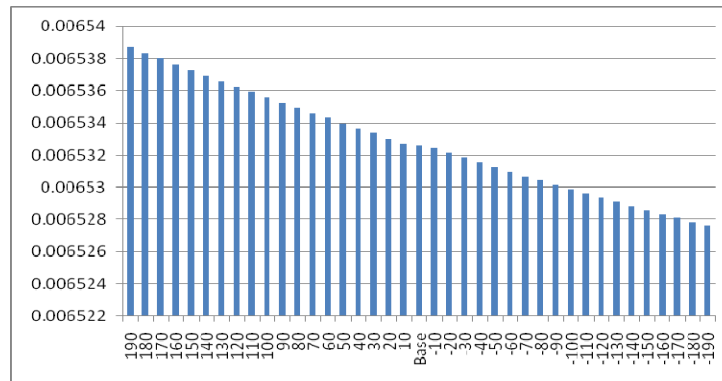
Source: Results of Thailand CFGE model simulations.

Figure 30. Fiscal Policy Simulation with High ρ : Thailand's Dynamic Slope GDP and Real Income of the Poor



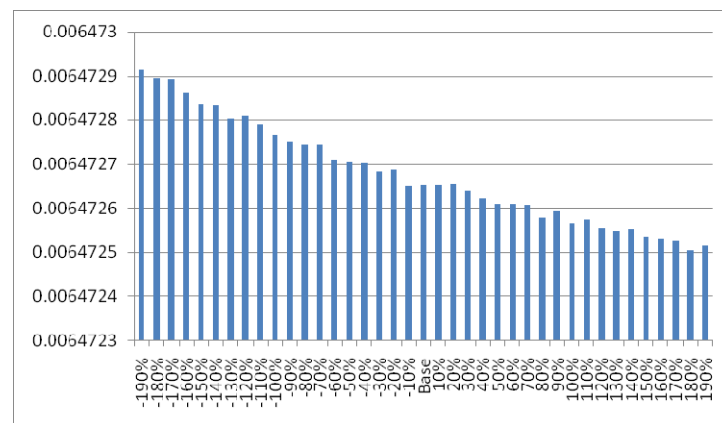
Source: Results of Thailand CFGE model simulations.

Figure 31. Monetary Policy Simulation with High ρ : Indonesia's Dynamic Slope GDP and Real Income of the Poor



Source: Results of Indonesian CFGE model simulations.

Figure 32. Fiscal Policy Simulation with High ρ : Indonesia's Dynamic Slope GDP and Real Income of the Poor



Source: Results of Indonesian CFGE model simulations.

V. CONCLUSIONS

The study of the link between macroeconomic policy and poverty is held in relatively low esteem by mainstream economists. The issue was considered relevant only in the early stages of development. As most countries began to reach a higher level of welfare, the topic was disparaged as outdated. The renewed interest in the issue was triggered by, among other things, the poverty impact of the macroeconomic policy response to the crisis that spread across the globe during the 1990s. To the extent that the effectiveness of the macroeconomic policy response to the Asian financial crisis remains debatable, Asia continues to hold the world record for the largest number of people living in absolute poverty (about 600 million people, using the US\$1-a-day-poverty line), and that, in recent years, income inequality throughout the region has risen, this study can be viewed as an attempt to push further the renewed interest on the subject and to make the subject more imperative for policymaking in Asia.

The starting point is to look at the precise slope of the AS and AD curves. Most East Asian economies exhibit textbook shapes of AD and AS curves. This is clearly true in Thailand and Indonesia, the two countries used as case studies in this paper. However, the AS curve in both countries are relatively flat and have become flatter since the crisis. The trend of their AD curves is the opposite. This clearly suggests that after the crisis, a positive AD shock would have been more effective in stimulating non-inflationary growth. To the extent that incomes of the poor and the poverty line—the two variables used in the income poverty

measure—are directly and indirectly affected by the output growth and general price level, respectively, a CFGE model was used to point out the specific mechanisms by which the effect of macroeconomic policy shock on poverty can be derived.

It was revealed from the model simulations that the results cannot be generalized. A positive fiscal shock tends to reduce poverty in Thailand but not in Indonesia, although the results in Indonesia could also be poverty-reducing if the composition of government expenditure was made more pro-poor. On the other hand, a positive monetary shock in Thailand is not favorable for reducing the number of poor households since the poverty line is sensitive to the increase of prices but the incomes of the poor are less responsive to output growth. The effect of monetary expansion in Indonesia is influenced by the price elasticity of wages: given a low elasticity, a positive monetary shock will reduce poverty, but if the elasticity is high a positive monetary shock will increase poverty.

The impact of a policy shock on income inequality is more influenced by what happens in the financial sector. An expansionary policy can raise the earnings of financial asset holders (higher income households) more than the increase of incomes of the poor. This is found to be the case in Indonesia but not in Thailand. Thus, the structure of the economy clearly sets the outcome of the policy shock apart.

In sum, the mechanisms by which macroeconomic policy affects poverty are too complex to be generalized. Advocating growth alone is insufficient and focusing on only macroeconomic stability is far from adequate. As the simulations in this study have shown, the effects of macroeconomic policy shocks on the poverty line and incomes of the poor hold the keys to the problem; and such effects can vary according to the types of policy, the structure of the economy, the price elasticity of wages, and the mechanisms through which the financial sector is linked with prices and household income.

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APPENDIX 1: BLANCHARD-QUAH DECOMPOSITION

Let Δy and π denote output growth and inflation rate, and $\varepsilon^{\Delta y}$ and $\varepsilon^{\Delta \pi}$ are the two innovations. Following B-Q decomposition technique, the moving average (MA) is obtained by inverting the unrestricted vector autoregression representation:

$$\begin{bmatrix} \Delta y \\ \pi \end{bmatrix} = \begin{bmatrix} c_{11}(L) & c_{12}(L) \\ c_{21}(L) & c_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon^{\Delta y} \\ \varepsilon^{\Delta \pi} \end{bmatrix} \quad (1)$$

where ε 's are mean zero innovations with covariance matrix Ω . B-Q decomposition requires that the variable subject to decomposition, i.e., output growth rate, is I(1). The second (stationary) variable, which undergoes the same orthogonal shocks, is the inflation rate. Given a matrix of coefficients $C(L)$ with lag operator $c_{ij}(L)$, the impulse response function of disturbances shows the effect of shocks (i.e., $\varepsilon^{\Delta y}$ and $\varepsilon^{\Delta \pi}$) in period t on Δy and π in period $t+j$ ($j = 0, 1, 2, \dots$). Note that $C(0)$ is the identity matrix representing contemporaneous responses. It is known that the impulse responses generated by MA form in (1) do not exhibit the responses to the orthogonal innovations because the innovation ε 's are generally correlated (Cooley and LeRoy, 1985). Thus, an alternative MA is:

$$\begin{bmatrix} \Delta y \\ \pi \end{bmatrix} = \begin{bmatrix} a_{11}(L) & a_{12}(L) \\ a_{21}(L) & a_{22}(L) \end{bmatrix} \begin{bmatrix} u^{\Delta y} \\ u^{\Delta \pi} \end{bmatrix} \quad (2)$$

where u 's are uncorrelated innovations with covariance matrix Σ (a diagonal matrix).

The MA representations in (1) and (2) are linked by:

$$A(j) = C(j)A(0), \quad j = 0, 1, 2, \dots \quad (3)$$

$$A(0)A(0)' \Sigma = \Omega \quad (4)$$

Hence, if one can identify each element of $A(0)$, the MA form in (2) can be obtained. Let ω_{ij} and σ_{ij} denote elements in matrix Ω and Σ so that (4) is:

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} a_{11} & a_{21} \\ a_{12} & a_{22} \end{bmatrix} \begin{bmatrix} \sigma_{11} & 0 \\ 0 & \sigma_{22} \end{bmatrix} = \begin{bmatrix} \omega_{11} & \omega_{12} \\ \omega_{21} & \omega_{22} \end{bmatrix} \quad (5)$$

From which three elements of $A(0)$ are identified:

$$(a_{11}^2 + a_{12}^2)\sigma_{11} = \omega_{11} \quad (6)$$

$$(a_{21}^2 + a_{22}^2)\sigma_{22} = \omega_{22} \quad (7)$$

$$(a_{11}a_{21} + a_{12}a_{22})\sigma_{22} = \omega_{12} \quad (8)$$

Following B-Q, σ_{11} and σ_{22} are set to equal unity. That is, AS and AD shocks are normalized with standard deviation equal to 1. Considering the neutrality of the long run effect of AD shock on output, the following applies:

$$\Sigma c_{11}(L)a_{11}(0) + \Sigma c_{12}(L)a_{12}(0) = 0 \quad (9)$$

Solving (6) to (9) gives the four elements in $A(0)$, based upon which the impulse responses of the orthogonal shocks can be generated by (3). Thus, the unrestricted VAR with n lags is:

$$\Delta^2 y_t = b_0 + \sum_{i=1}^n b_{1i} \Delta^2 y_{t-i} + \sum_{i=1}^n b_{2i} \Delta^2 p_{t-i} + \varepsilon_t^{\Delta y} \quad (10)$$

$$\Delta^2 p_t = d_0 + \sum_{i=1}^n d_{1i} \Delta^2 y_{t-i} + \sum_{i=1}^n d_{2i} \Delta^2 p_{t-i} + \varepsilon_t^{\Delta p} \quad (11)$$

where $\Delta^2 y_t$ and $\Delta^2 p_t$ are the second-difference log of real output and CPI, respectively.

The MA form shown in (1) is generated by inverting the above VAR representation. To insure that the residuals $\varepsilon_t^{\Delta y}$ and $\varepsilon_t^{\Delta p}$ in (1) are orthogonal, not correlated, we use (6) – (9) and multiply $A(0)$ with $C(j)$ – as shown in (3). This gives a new MA representation of (2), which has orthogonal residuals ($u_t^{\Delta y}$ and $u_t^{\Delta p}$):

$$\Delta^2 y_t = \sum_{s=0}^{j-1} a_{11}(s) u_{T+j-s}^{\Delta y} + \sum_{s=0}^{j-1} a_{12}(s) u_{T+j-s}^{\Delta p} \quad (12)$$

$$\Delta^2 p_t = \sum_{s=0}^{j-1} a_{21}(s) u_{T+j-s}^{\Delta y} + \sum_{s=0}^{j-1} a_{22}(s) u_{T+j-s}^{\Delta p} \quad (13)$$

where $u_t^{\Delta y}$ and $u_t^{\Delta p}$ are the orthogonal residuals.

To generate the decomposed series of output growth as a result of AD shocks, we assign zero to $u_t^{\Delta p}$ in (12). This results in second-difference log of real GDP $\Delta^2 y_t^{AD}$ due to AD shocks. Similarly, to obtain second-difference log of CPI ($\Delta^2 p_t^{AD}$), the value of $u_t^{\Delta p}$ in (13) is set to zero. Converting the second-difference log data into the first second-difference is similar to integrating the second derivative to obtain the first derivative in continuous domain (obtained by cumulatively summing the values of second-difference log data):

$$\Delta y_t^{AD} = \sum_{i=0}^t \Delta^2 y_{t-i}^{AD} \quad (14)$$

$$\Delta p_t^{AD} = \sum_{i=0}^t \Delta^2 p_{t-i}^{AD} \quad (15)$$

Using the above procedure, I generated the scatter plot of Δy_t^{AD} , Δp_t^{AD} , and the corresponding slope of the linearized trend:

$$\Delta p_t^{AD} = g + h \Delta y_t^{AD} + v \quad (16)$$

where g , h and v are the intercept, slope and residual, respectively. This captures the responses of real GDP growth and inflation to the AD shocks. Since theoretically the short-run response of Δy_t and Δp_t to the AD shock is in the same direction, the slope (h) of the AS curve should be positive.

A similar approach is applied to generate the decomposed series of output growth and inflation due to AS shocks, i.e., setting the value of $u_t^{\Delta y}$ in (12) and (13) to zero, and compute the series of $\Delta^2 y_t^{AS}$ and $\Delta^2 p_t^{AS}$.

APPENDIX 2: RESULTS OF AUGMENTED DICKEY-FULLER (ADF) TEST**Null Hypothesis: $\Delta^2 \ln$ (RGDP) has a unit root**

Country	T-Statistic	P-Value
Thailand	-5.1517	0.0001
Indonesia	-11.5323	0.0000

Null Hypothesis: $\Delta^2 \ln$ (CPI) has a unit root

Country	T-Statistic	P-Value
Thailand	-7.5725	0.0000
Indonesia	-8.3888	0.0000

APPENDIX 3: RESULTS OF LJUNG-BOX TEST

The Q-statistic at lag k is a statistical test for the null hypothesis that there is no autocorrelation up to lag k .

Thailand

Lag	$\varepsilon_t^{\Delta y}$		$\varepsilon_t^{\Delta p}$	
	Q-Statistic	P-Value	Q-Statistic	P-Value
1	0.033	0.856	0.000	0.998
2	0.226	0.893	0.056	0.972
3	2.512	0.473	0.433	0.933
4	2.561	0.634	1.139	0.888
5	3.127	0.680	4.079	0.538
6	3.596	0.731	4.943	0.551
7	7.643	0.365	5.747	0.570
8	13.268	0.103	5.749	0.675
9	13.735	0.132	9.518	0.391
10	13.879	0.179	9.681	0.469

Indonesia

Lag	$\varepsilon_t^{\Delta y}$		$\varepsilon_t^{\Delta p}$	
	Q-Statistic	P-Value	Q-Statistic	P-Value
1	0.123	0.725	0.251	0.616
2	0.278	0.870	0.256	0.880
3	1.091	0.779	0.262	0.967
4	1.191	0.880	1.645	0.801
5	1.258	0.939	4.994	0.417
6	1.284	0.973	5.464	0.486
7	1.341	0.987	9.567	0.214
8	1.493	0.993	9.567	0.297
9	2.987	0.965	9.568	0.387
10	3.959	0.949	9.585	0.478