

## A SIMULATION ANALYSIS OF THE URBAN INFORMAL SECTOR

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### I. INTRODUCTION

THE term "informal sector" indicates those firms which are not formal, and covers all small, cottage, and family firms. It was first used by the British anthropologist Keith Hart (1973) as a way of organizing his fieldwork carried out among poor city dwellers in Ghana in 1973, and was later used in the ILO/UNDP Employment Mission Report (Peattie 1987, p. 853; Sethuraman 1976, p. 69; House 1984b, p. 277). Right from the start, a series of discussions took place regarding the definition, empirical estimation, and theoretical understanding of this sector, but no concrete answers were ever reached. Some criticized it as a fuzzy concept (Peattie 1987), and others defended it as a useful portmanteau concept (Chandavarkar 1988).

Despite the lack of an exact definition, the urban informal sector accounts for a big part of urban employment (20-60 per cent) in many primal cities in the developing world. It offers various outputs and services to the formal sector, sometimes through subcontracting arrangements, and also to the general population. Anyone can enter the informal sector with only minimum amounts of capital and without sector-specific professional skills. Through this automatic employment, it absorbs overtly unemployed people, and serves as a cushion to mitigate social frustration. On the other hand, the very low wage and income levels of the informal sector suppress workers' standard of living to a bare minimum level, forcing people to live in squatter communities and creating much misery in many developing countries. The actual standard of living in these communities is even lower than that in rural areas. Therefore the improvement of living conditions in the urban informal sector is one of the urgent policy agenda. A full understanding of the informal sector is also important analytically and politically because if one looks at only the formal sector of a developing country, it implies that he assumes that the economy behaves

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in a Neoclassical sense, and he virtually neglects a vast idiosyncratic region of the real economy.

Because the urban informal sector is made up of greatly differing economic activities and institutional entities, and because its dynamic change is sometimes of an involutory or evolutionary nature (Weeks 1975, p. 4), the overall picture of this sector is very misty and hard to grasp. In the statistics, the urban informal sector can be defined only as the residual difference between total national economic activity and the well-recorded activity of the formal sector. Like Solow's residual, we may characterize the urban informal sector as Hart's residual. There are many portmanteau concepts used in economics, such as fundamental disequilibrium. The informal sector is an example of a portmanteau concept (Chandavarkar 1988, p. 1260). I also take this view. Therefore, beyond ad hoc and partial equilibrium analyses, an integrated scheme of analysis through various possible simulation exercises is badly needed for an overall description of the issues and for a sufficient understanding of the working mechanism.

The Hart's residual is expected to deepen discussions in development economics in the same way that the Solow's residual greatly stimulated discussion in growth theory (Griliches 1996). This paper is a first step in that direction. Three matters are taken up in this paper: (i) to survey the methodological issues about the informal sector, (ii) to construct a simulation model with detailed decomposition of urban activities, and (iii) to quantitatively clarify the basic workings of the urban informal sector based on various simulation studies. I confine my analysis only to the developing countries although the informal sector also exists in developed economies.<sup>1</sup>

The structure of the paper is as follows. In Section II, I discuss some basic tendencies of the urban informal sector in relevant countries, and survey previous analyses of the informal sector. In Section III, I construct a simulation model. In Section IV, I apply this model for various simulations. Section V contains the summary and conclusions.

<sup>1</sup> There are two differing aspects to the informal sector between developing countries and developed countries like Japan: size and legality. In Japan a small firm is defined as an establishment not exceeding twenty employees (manufacturing) or five (service or trade). The government has maintained broad protection policies (Iwamoto 1995). In developing countries an informal enterprise is usually defined as one not exceeding ten employees (Mead and Morrisson 1996, p. 1615), and many of them evade governmental intervention. For Japan there exists a series of modeling studies of a segmented dual economy. For example, Fukuchi and Oguchi (1969) constructed a dual economy model for 1955–65 which contained three sector divisions (manufacturing, wholesale and retail, other services) and simulated output, sales, inventory, borrowing, employment, wages, and capital in combination with a macro model. Fukuchi and Oguchi (1972) provided their core theoretical model, and showed the condition of the backwash effect. Yoshimura (1987) constructed an econometric model for the prewar period (1888–1934) and postwar period (1953–68) following the two-sector model of Ranis and Fei.

## II. METHODOLOGICAL ISSUES ABOUT THE URBAN INFORMAL SECTOR

The existence of the informal sector in developing countries poses many important theoretical, empirical, and political issues. Let us take up some complex issues in order to analyze it.

### A. *The Multi-dimensional Definition of the Informal Sector*

#### 1. *Criteria*

- (a) The legal status of firms. In every society there exist a group of established rules. "The characteristics of each distinct informal economy are determined by the particular set of institutional rules that its members circumvent" (Feige 1990, p. 990). Maldonado (1995), for example, stressed the high economic price of registration in Peru. The unregistered character of informal firms overlaps with the rules of illegal or black markets as described by Bevan, Collier, and Gunning (1989). Stressing this aspect, the informal sector is sometimes referred to as "hidden, gray, shadow, informal, clandestine, illegal, unobserved, unreported, unrecorded, second, parallel, and black" (Feige 1990, p. 991),<sup>2</sup> and as an "economy of the poor" or "backyard economy" (Hemmer and Mannel 1989, p. 1543).
- (b) Illegality is related to firm size.<sup>3</sup> We have to distinguish two subsectors in the informal sector.
  - (i) One consists of small-scale enterprises which employ capital and labor and have a rather similar production function to firms in the formal sector. They avoid paying taxes and social costs and thus want to remain unregistered (or unprotected). They obtain their investment funds from the informal fund market. Employees with higher education obtain higher remunerations.
  - (ii) Another subsector consists of cottage and family businesses and independent workers like small under-tree repair shops, petty traders, *becha*-drivers, housemaids, street vendors, etc. In general they do not have strict production functions and do not require any investment. They get remunerations by offering services. Higher education does not guarantee a higher remuneration.
 These two subsectors are informal in the sense that they are small scale and illegal. In the model building, I designated these two subdivisions as the 3M

<sup>2</sup> In Latin American countries "the size criterion yields a smaller informal sector than the benefits criterion does" (Marcouiller, Castilla, and Woodruff 1997, p. 369).

<sup>3</sup> The concept of the underground economy can be wider than the informal sector. The agents in the informal sector want to evade taxes. But the agents in the underground economy may have more aggressive incentives like drug transactions. Lindauer (1989) gave a semantic survey of parallel, fragmented, and black markets.

and 3S sectors, respectively. In the early years of discussion on the informal sector, Guy Standing suggested dividing it into an irregular sector and the informal sector proper (Sethuraman 1976, p. 73). House (1984b) suggested decomposing it into the intermediate sector and the community of the poor based on his observation of the informal sector in Nairobi. I adopt a similar distinction and designate these two as the 3M and 3S sectors. The former has a formal production function using capital and labor, although it avoids formal registration and tax payments. The latter is equated with the community of the poor which has inadequate capital to start businesses and also inadequate skills.

- (c) Differing characteristics and poor status of workers. Based on the differing characteristics of production technologies, informal jobs do not require sector-specific skills. Therefore, workers are mainly landless farmers with relatively low education who are newly arrived in urban areas.
- (d) Cross-checking criteria. Because of the complex nature of the informal sector, Sethuraman (1976, p. 81) proposed a list of suggested criteria for identifying informal sector enterprises as follows. A manufacturing enterprise may be classified as in the informal sector if it satisfies one or more of the following conditions:
  - (i) it employs ten persons or less (including part-time and casual workers),
  - (ii) it operates on an illegal basis, contrary to government regulation,
  - (iii) household members of the head of the enterprise work in it,
  - (iv) it does not observe fixed hours/days of operation,
  - (v) it operates in semi-permanent/temporary premises, or it shifts locations,
  - (vi) it does not use any electricity in the manufacturing process,
  - (vii) it does not depend on formal financial institutions for its credit needs,
  - (viii) its output is normally distributed direct to the final consumer, and
  - (ix) most those working in it have fewer than six years of formal schooling.
 Sethuraman also proposed similar lists for activities in which many informal activities take place, like construction, transport, trade, and service. In his view, a self-employed person is also considered to be an enterprise.

## 2. *Big size of the informal sector*

According to the United Nations' estimates about Latin American countries, the size of the informal sectors in these countries ranged from 20 to 60 per cent. Todaro (1994) noted the high percentage (26–79 per cent) of the slum population in the big cities of developing countries.<sup>4</sup>

<sup>4</sup> United Nations' Regional Employment Program for Latin America and the Caribbean (PREALC) estimated 60 per cent for Bogota, including workers not covered by social security, 40 per cent for Peru, 28 per cent for Mexico and Colombia, 23 per cent for Argentina, and 20 per cent for Venezuela (Feige 1990, p. 999). Ghate (1992) noted that the informal credit market in Asian countries accounted for 38–76 per cent of the market.

### 3. *Low wage level and automatic employment*

The wage level of the informal sector is lower than that of the formal sector. But there is no barrier to entry, so everybody can join. Therefore it serves as a cushion by converting openly explicit unemployment into implicit hidden (or disguised) unemployment. Thus “the informal urban sector absorbs all workers released from the other urban sectors” (Bodart and Le Dem 1996, pp. 427–28). Marcouiller, Castilla, and Woodruff (1997) analyzed the formal-informal wage gap in Mexico, El Salvador, and Peru. One reason for lower wages in the informal sector is the fact that “the young and the old are more likely to be in the informal sector than are prime-aged workers” (pp. 387–88). But Marcouiller and others also showed the substantial returns to education and experiences. So it is important to consider such a human capital element when analyze the wage gap.

### 4. *Mixed interpretation of trends*

According to the estimation by the International Labour Organisation and the United Nations’ Regional Employment Program for Latin America and the Caribbean (PREALC), GDP in Argentina grew by 60 per cent during 1950–80, while the urban informal sector increased by 9 per cent. In Venezuela GDP grew by 70 per cent, while the urban informal sector decreased by 50 per cent (Feige 1990). Why did such a big difference occurred? Naturally the tendency is related to the historical development process of each society. For example, in China “the growing informal activity in the urban economy does not reflect the marginalization of urban labor, but rather reflects significant income earning opportunities” (Bhalla 1990, p. 1107).

### 5. *Intrinsic relationship between rural and urban migration and its political implications*

There is a strong trend toward urbanization in every developing country. The primal city differs by country, but usually the capital city absorbs the major inflow of population. The rapid growth of the capital city causes strong fiscal pressure on the government because the mass of people in the informal sector who are without adequate public services easily creates social turmoil. Sometimes the existence of a big urban informal sector causes an urban bias in policy formation as described by Braverman and Kanbur (1987). But some empirical studies (including this paper) show that direct welfare policy for the informal sector (for example, wage subsidy policy) actually worsens the employment condition in the informal sector. Adequate theoretical as well as empirical studies are of key importance for relevant policy formation.

## 6. *Market failures*

The dynamics of the informal sector is closely connected with many market failures in the product market, capital market, and labor market. Tax evasion, segmented market, and sticky prices are among such examples. Another cause can be government failures like a skewed infrastructure supply, a skewed educational system, and a skewed technology policy.

## 7. *Class struggle*

When society is interpreted on the basis of class struggle, urban marginal groups, or the urban informal sector, are classified as part of subsumed sectors (Gibson, Lustig, and Taylor 1986).

## B. *Methodological Issues*

Below I discuss some selected methodological issues.

- (a) The distinction between rational immigration behavior and the existence of urban misery. The Harris-Todaro equation is usually interpreted as the equality between the rural wage and the expected urban wage which is calculated as the weighted average of urban wage rates by their shares. But in poverty studies, the poverty lines in urban and rural areas are set differently in consideration of the difference in price levels in each area. For example, Ravallion and Huppi (1991) set the poverty line income in Indonesia at Rp 11,000 in urban and Rp 10,000 in rural areas because of the 10 per cent higher price level in urban areas (in 1985 PPP, Rp 10,000 equals 31 U.S. dollars). Therefore in my model I assume different rural and urban prices, and reinterpret the formula as equating the real rural and urban wages. But if the Harris-Todaro equation implies rational immigration behavior, then the welfare position in rural and urban sectors must be equated, and there is no room for urban misery, which implies that migrated labor to urban areas is sometimes worse-off than under the working conditions in rural areas. I interpret that in this case, the comparison should be made between the migrant's condition in the urban informal sector and his condition while he stayed in the rural sector, and compare the wages in the urban informal sector with those in the rural sector. Therefore I will define another index of urban misery, and distinguish the rational migration concept of the Harris-Todaro equation from the concept of the possible urban misery. Another alternative specification of the Harris-Todaro equation is to require the equality of expected utility levels of the two areas as suggested by Quibria (1988). However, such a specification will largely change the framework.
- (b) Definition of urban unemployment equivalent. In reality, overt unemployment cannot persist in the long run. People must get some income to sustain themselves, even if they register for job search and in a sense are recorded as openly

unemployed. I define the concept of urban unemployment equivalent as follows. In the 3S sector,  $L_{3S}$  works at a wage rate lower than the wage rate of the formal sector ( $W_2$ ), so their wage payment is  $W_{3S} \cdot L_{3S}$ . If this wage payment will be spent to  $X$  persons when they work with  $W_2$ , then  $X$  equals  $(W_{3S} \cdot L_{3S} / W_2)$ . Then we can define  $(L_{3S} - X)$  as a part of the urban unemployment equivalent. I make a similar calculation also for the 3M sector, and define the sum in these sectors as the urban unemployment equivalent (*UUEMP*). This implies that this amount of labor force can be deducted without reducing output if all the people work at the formal sector wage. The size of this variable somehow indicates the size of the relative deprivation of informal workers when they are sensitive to their lower income than the formal sector wage; thus it has an important implication for the welfare of urban workers.<sup>5</sup> There have been many discussions about the segmented market (Piñera and Selowsky 1978; Roemer 1986). The wage gap due to various economic and social factors has been discussed and analyzed by a number of authors: Tan and Batra (1997) for Colombia, Mexico, and Taiwan; House (1987) for Sudan; Gindling (1991) for Costa Rica; and Marcouiller et al. (1997) for Mexico, El Salvador, and Peru.

There are a series of modeling exercises of the urban informal sector: the input-output-type conceptual framework between urban formal, informal, and government sectors by Weeks (1975); the informal sector model with 8 equations by Chaudhuri (1989); Hemmer and Mannel's model (1989); the model with 14 equations by Nakanishi (1991); Gupta's model (1993); and Kelley's CGE model (1994) with 128 equations (12 equations for the urban informal sector) for Peru which had a solid production function. In these models the demand for the products of the informal sector was linked to the one of the formal sector through relative prices. Thus there exists the possibility of a substitutability between the two sectors in which the informal sector could flourish while the formal sector declines. Bodart and Le Dem's CGE model (1996) with 40 equations (4 equations for the urban informal sector) for Côte d'Ivoire stressed the residual character of the informal sector, so its activity is relatively independent from the formal sector. But the formal and informal sectors are linked through factor (especially labor) markets, so they cannot be completely independent (Hemmer and Mannel 1989). Fukuchi (1995) constructed a dual financial market model for Indonesia.<sup>6</sup>

Labor absorption by the formal sector is an important collateral subject. Kubo and Yamagata (1990) measured labor absorption in Malaysia, Indonesia, and the Philippines. They showed that each country passed the turning point and entered

<sup>5</sup> Stark (1984) discussed a relative deprivation approach in detail.

<sup>6</sup> Fukuchi (1995) offers a list of informal credit markets. Timberg and Aiyar (1984) pointed out another example in India.

into the period of labor shortage as the real wage increased, and confirmed that the capital accumulation in the manufacturing sector accelerates the absorption. But whether the speed of absorption is sufficient or not remained as an open question.

### III. CONSTRUCTION OF A SIMULATION MODEL

Due to the wide variety of urban informal activities, a typical dualistic model of the urban informal sector does not suffice (Kannappan 1985). Therefore I constructed a simulation model with three urban sectors. The basic purposes of this model building are to construct a multi-equational model which contains important basic relationships between variables of four sectors, and to clarify the effects of various shocks and check the different hypotheses about the urban informal sector. These four sectors I term as the first, second, 3M, and 3S. The first sector consists of various traditional agricultural and nonagricultural activities in the rural area. The second sector consists of various formal manufacturing and service activities in the urban area. The 3M and 3S sectors compile various informal activities in the urban area. The 3M (3S) sector consists of informal manufacturing and service activities with (without) the input of capital. So in many cases, the wage level of the 3S sector is depressed to the subsistence level.<sup>7</sup> It is an interesting empirical question whether the substitutability between the formal and informal sectors still exists after we subdivide the informal sector into 3M and 3S subsectors. I have tried to set the initial conditions which reflect the reality of the urban area in developing countries, and to construct as general a model as possible. I have set down each equation, and its functional form and the parameter values assumed.  $B(i, j)$  shows the  $j$ th parameter in the  $i$ th equation group. I assume that the second sector cannot employ the whole graduates from higher and middle education ( $L_2 < LS_H + LS_M$ ).

#### *Four Sector Model including the Urban Informal Sector*

(1: First Sector: Rural Sector)

1. First (Rural) Sector Employment Function ( $L_1$ )

$$L_1 = F_1(P_1, W_1) = (B(1, 1)P_1/W_1)^{1/(1-B(1, 2))}. \quad (\text{A-1})$$

2. First Sector Production Function ( $Y_1$ )

$$Y_1 = F_2(L_1) = B(1, 1)(L_1)^{B(1, 2)}. \quad (\text{A-2})$$

$$B(1, 1) = 8.7; B(1, 2) = 0.8.$$

<sup>7</sup> Therefore the definitions of first, second, 3M, and 3S sectors are different from the traditional designation of primary, secondary, and tertiary sectors. Sharif (1986) provided a literature survey on the measurement of subsistence. Thus the wage level of the 3S sector,  $P_{3S} \cdot B(4, 1)$  in (A-15), is close to the urban subsistence level. This specification is similar to the description of "the 'classic' secondary labour market, with a low mean and little variation in wages. Education and experience are not rewarded in this sector" (Osberg, Apostle, and Clairmont 1987, p. 1609).



(2: Second Sector: Urban Modern Big Business Sector)

3. Demand Function for Second Sector Output ( $Y_2$ )

$$Y_2 = F_3(GDP, P_2) = B(2, 1)(GDP/P_2)^{B(2, 5)} + B(2, 2) \cdot (P_2)^{B(2, 6)}. \quad (A-3)$$

4. Second Sector Employment Function ( $L_2$ )

$$L_2 = F_4(Y_2, K_2, SL_2) = (Y_2/B(2, 3))^{1/B(2, 4)} (K_2)^{1/(1-B(2, 4))}/SL_2. \quad (A-4)$$

5. Second Sector Wage Rate Function ( $W_2$ )

$$W_2 = F_5(Y_2, P_2, L_2, SL_2, T) = B(2, 4)(1 - B(2, 7))P_2Y_2/L_2/SL_2. \quad (A-5)$$

6. Second Sector Interest Rate Function ( $R_2$ )

$$R_2 = F_6(Y_2, P_2, K_2) = (1 - B(2, 4))P_2Y_2/K_2. \quad (A-6)$$

$$B(2, 1) = 0.17; B(2, 2) = 70; B(2, 3) = 3.0; B(2, 4) = 0.7; B(2, 5) = 1; \\ B(2, 6) = -0.9; B(2, 7) = 0.1.$$

(3: 3M Sector: Urban Small Firm Sector)

7. 3M Sector Output Price Function ( $P_{3M}$ )

$$P_{3M} = F_7(P_2) = B(3, 1)P_2. \quad (A-7)$$

8. Demand Function for 3M Sector Output ( $Y_{3M}$ )

$$Y_{3M} = F_8(GDP, Y_2, P_{3M}) = B(3, 2)Y_2 + B(3, 3)(GDP/P_{3M})^{B(3, 4)}. \quad (A-8)$$

9. 3M Sector Employment Function ( $L_{3M}$ )

$$L_{3M} = F_9(Y_{3M}, P_{3M}, K_{3M}, SL_{3M}) \\ = (Y_{3M}/B(3, 5))^{1/B(3, 6)}(K_{3M})^{1/(B(3, 6)-1)}/SL_{3M}. \quad (A-9)$$

10. 3M Sector Wage Rate Function ( $W_{3M}$ )

$$W_{3M} = F_{10}(Y_{3M}, P_{3M}, L_{3M}, SL_{3M}) = B(3, 6)P_{3M}Y_{3M}/L_{3M}/SL_{3M}. \quad (A-10)$$

11. 3M Sector Interest Rate Function ( $R_{3M}$ )

$$R_{3M} = F_{11}(Y_{3M}, P_{3M}, K_{3M}) = (1 - B(3, 6))P_{3M}Y_{3M}/K_{3M}. \quad (A-11)$$

$$B(3, 1) = 0.9; B(3, 2) = 1.3; B(3, 3) = 0.1; B(3, 4) = 0.8; B(3, 5) = 2.2; \\ B(3, 6) = 0.9.$$

(4: 3S Sector: Urban Cottage and Family Business Sector)

12. Definition of 3S Sector Employment ( $L_{3S}$ )

$$L_{3S} = L_U - L_2 - L_{3M}. \quad (A-12)$$

13. 3S Sector Production Function ( $Y_{3S}$ )

$$Y_{3S} = F_{13}(L_{3S}) = B(4, 1)L_{3S}. \quad (A-13)$$

14. 3S Sector Output Price Function ( $P_{3S}$ )

$$P_{3S} = F_{14}(GDP, Y_{3S}) = (GDP)/(Y_{3S}/B(4, 2))^{1/B(4, 3)}. \quad (A-14)$$

15. 3S Sector Wage Rate Function ( $W_{3S}$ )

$$W_{3S} = F_{15}(P_{3S}) = B(4, 1)P_{3S}. \quad (\text{A-15})$$

$$B(4, 1) = 3.6; B(4, 2) = 3.6; B(4, 3) = 0.7.$$

(GDP)

16. GDP Definition ( $GDP$ )

$$\begin{aligned} GDP &= F_{16}(P_1, Y_1, P_2, Y_2, P_{3M}, Y_{3M}, P_{3S}, Y_{3S}), \\ &= P_1Y_1 + P_2Y_2 + P_{3M}Y_{3M} + P_{3S}Y_{3S}. \end{aligned} \quad (\text{A-16})$$

(5: Urban Sector)

17. Definition of Urban Population ( $L_U$ )

$$L_U = L - L_1. \quad (\text{A-17})$$

18. Definition of Urban Cost-of-Living Index ( $P_U$ )

$$\begin{aligned} P_U &= F_{21}(P_1, Y_1, P_2, Y_2, P_{3M}, Y_{3M}, P_{3S}, Y_{3S}), \\ &= \{B(5, 1)P_1Y_1 + B(5, 2)P_2Y_2 + B(5, 3)P_{3M}Y_{3M} \\ &\quad + [1 - B(5, 1) - B(5, 2) - B(5, 3)]P_{3S}Y_{3S}\} / \{B(5, 1)Y_1 \\ &\quad + B(5, 2)Y_2 + B(5, 3)Y_{3M} \\ &\quad + [1 - B(5, 1) - B(5, 2) - B(5, 3)]Y_{3S}\}. \end{aligned} \quad (\text{A-18})$$

19. Harris-Todaro Wage Rate Arbitrage Equation ( $W_I$ )

$$\begin{aligned} W_I &= F_{22}(W_2, W_{3M}, W_{3S}, P_1, P_U, L_2, L_{3M}, L_{3S}), \\ &= (W_2L_2 + W_{3M}L_{3M} + W_{3S}L_{3S}) / L_U \cdot P_1 / P_U. \end{aligned} \quad (\text{A-19})$$

20. Definition of Employment in Urban Informal Sector ( $L_{INF}$ )

$$L_{INF} = L_{3M} + L_{3S}. \quad (\text{A-20})$$

21. Definition of Wage Rate in Urban Informal Sector ( $W_{INF}$ )

$$W_{INF} = (W_{3M}L_{3M} + W_{3S}L_{3S}) / L_{INF}. \quad (\text{A-21})$$

22. Definition of Wage Rate Difference between Urban Informal Sector and Rural Sector ( $D$ )

$$D = W_{INF} / P_U - W_I / P_1. \quad (\text{A-22})$$

$$B(5, 1) = 0.4; B(5, 2) = 0.1; B(5, 3) = 0.2.$$

(6: Supply of Funds)

23. Supply of Funds Function ( $TD$ )

$$TD = B(6, 2)(R_2)^{B(6, 3)}. \quad (\text{A-23})$$

24. Supply of Funds to Second Sector ( $K_2$ )

$$K_2 = F_{17}(TD) = (1 - B(6, 1))TD. \quad (\text{A-24})$$

25. Supply of Funds to 3M Sector ( $K_{3M}$ )

$$K_{3M} = AS - K_2. \quad (\text{A-25})$$

$$B(6, 1) = 0.05; B(6, 2) = 900; B(6, 3) = -0.1.$$

(7: Labor Skills)

26. Definition of Labor Force with High Skills ( $LS_H$ )

$$LS_H = B(7, 1)L. \quad (A-26)$$

27. Definition of Labor Force with Medium Skills ( $LS_M$ )

$$LS_M = B(7, 2)L. \quad (A-27)$$

28. Definition of Labor Force with Low Skills ( $LS_L$ )

$$LS_L = [1 - B(7, 1) - B(7, 2)]L. \quad (A-28)$$

29. Definition of Labor Skills Index of Second Sector ( $SL_2$ )

$$\begin{aligned} SL_2 = & \Pi(LS_H - L_2) + \langle \Pi(L_2 - LS_H) \{ \Pi(L_2 - LS_H - LS_M) \cdot \\ & [LS_H + B(7, 3)LS_M + B(7, 4)(L_2 - LS_H - LS_M)] \} \\ & + \Pi(LS_H + LS_M - L_2)[LS_H + B(7, 3)(L_2 - LS_H)] \rangle / L_2. \end{aligned} \quad (A-29)$$

30. Definition of Labor Skills Index of 3M Sector ( $SL_{3M}$ )

$$\begin{aligned} SL_{3M} = & \{ \Pi(LS_H - L_2)[LS_H - L_2 + B(7, 3)(L_2 + L_{3M} - LS_H)] \\ & + \Pi(L_2 - LS_H)B(7, 3)L_{3M} + \Pi(L_2 + L_{3M} - LS_H - LS_M) \cdot \\ & (L_2 + L_{3M} - LS_H - LS_M)[B(7, 4) - B(7, 3)] \} / L_{3M}. \end{aligned} \quad (A-30)$$

31. Definition of Labor Skills Index of 3S Sector ( $SL_{3S}$ )

$$\begin{aligned} SL_{3S} = & B(7, 4)\Pi(L_2 + L_{3M} - LS_H - LS_M) \\ & + \{ \Pi(LS_H + LS_M - L_2 - L_{3M}) \cdot [B(7, 3)(LS_H + LS_M - L_2 - L_{3M}) \\ & + B(7, 4)(L_2 + L_{3M} + L_{3S} - LS_H - LS_M)] \} / L_{3S}. \end{aligned} \quad (A-31)$$

$$B(7, 1) = 0.09; B(7, 2) = 0.23; B(7, 3) = 0.95; B(7, 4) = 0.90.$$

(Wage Rates of Labor Force with Different Skills)

32. Wage Rate of Labor Force with High Skills ( $WLS_H$ )

$$\begin{aligned} WLS_H = & \Pi(L_2 - LS_H)W_2 + \Pi(LS_H - L_2)[W_2L_2 \\ & + W_{3M}(LS_H - L_2)] / LS_H. \end{aligned} \quad (A-32)$$

33. Wage Rate of Labor Force with Medium Skills ( $WLS_M$ )

$$\begin{aligned} WLS_M = & \Pi(LS_H - L_2 - L_{3M})W_{3S} \\ & + \Pi(L_2 + L_{3M} - LS_H)[W_{3M}(LS_H - L_2 - L_{3M}) \\ & + W_{3S}(LS_H + LS_M - L_2 - L_{3M})] / LS_M. \end{aligned} \quad (A-33)$$

34. Definition of Average Wage Rate ( $AVW$ )

$$AVW = (W_1L_1 + W_2L_2 + W_{3M}L_{3M} + W_{3S}L_{3S}) / L. \quad (A-34)$$

35. Wage Rate of Labor Force with Low Skills ( $WLS_L$ )

$$WLS_L = (AVW \cdot L - WLS_H \cdot LS_H - WLS_M \cdot LS_M) / LS_L. \quad (A-35)$$

36. Coefficient of Variation of Wage Rate (*CVW*)

$$\begin{aligned} (CVW)^2 = & [(W_1 - AVW)^2 \cdot L_1 + (W_2 - AVW)^2 \cdot L_2 \\ & + (W_{3M} - AVW)^2 \cdot L_{3M} \\ & + (W_{3S} - AVW)^2 \cdot L_{3S}] / L \cdot AVW. \end{aligned} \quad (A-36)$$

37. Urban Unemployment Equivalent (*UUEMP*)

$$UUEMP = (W_2 - W_{3S}) / W_2 \cdot L_{3S} + (W_2 - W_{3M}) / W_2 \cdot L_{3M}. \quad (A-37)$$

38. Urban Unemployment Rate (*RUEMP*)

$$RUEMP = UUEMP / L_U. \quad (A-38)$$

(Welfare of Urban Households)

39. Definition of Urban Average Wage (*AVUW*)

$$AVUW = (W_{INF} \cdot L_{INF} + W_2 \cdot L_2) / L_U. \quad (A-39)$$

40. Gini Coefficient of Urban Households (*GINI*)

$$\begin{aligned} GINI = 1 - 2 \cdot [ & W_{3S} L_{3S} \cdot (L_{3S} / 2 + L_{3M} + L_2) + W_{3M} L_{3M} \cdot (L_{3M} / 2 + L_2) \\ & + W_2 \cdot (L_2)^2 / 2] / AVUW L_U^2. \end{aligned} \quad (A-40)$$

41. Sheshinski-Sen-Yitzhaki's Welfare Index of Urban Households (*WEL<sub>U</sub>*)

$$WEL_U = AVUW \cdot (1 - GINI). \quad (A-41)$$

42. Relative Income Share of Informal Sector (*RY<sub>INF</sub>*)

$$RY_{INF} = (P_{3M} \cdot Y_{3M} + P_{3S} \cdot Y_{3S}) / GDP. \quad (A-42)$$

43. Relative Employment Share of Informal Sector (*RL<sub>INF</sub>*)

$$RL_{INF} = L_{INF} / L_U. \quad (A-43)$$

The symbol  $\Pi(x)$  implies an indicator function. The suffixes (*1, 2, 3M, 3S, U, INF*) indicate the first (rural), second (urban formal), 3M and 3S (two urban informal) sectors.  $Y_1, Y_2, Y_{3M}$ , and  $Y_{3S}$  indicate the real output of each sector, and *GDP* shows the nominal GDP.  $L_1, L_2, L_{3M}$ , and  $L_{3S}$  indicate the employment of each sector.  $L_U, L_{INF}$ , and  $L$  indicate the labor in the urban and urban informal sectors and total labor force.  $K_2$  and  $K_{3M}$  are capital stocks in the second and 3M sectors.  $W_1, W_2, W_{3M}, W_{3S}$ , and  $W_{INF}$  are wage rates in each sector.  $P_1, P_2, P_{3M}$ , and  $P_{3S}$  are the output price of each sector, while  $P_U$  is the cost-of-living index in the urban sector.  $R_2$  and  $R_{3M}$  are interest rates for the second and 3M sectors. *TD* and *AS* are the investment funds for the second sector and total amount. The coefficient  $B(2, 7)$  in (A-5) implies the social insurance payment with wage in the formal sector.<sup>8</sup> I treat

<sup>8</sup> Hoddinott (1996) discussed the Shapiro-Stiglitz's effect (Stiglitz 1974) that in the African labor market wages have to be higher in the big city to prevent shirking by workers. Basically I treat a one-city model, so such an effect when it exists, is absorbed by one of the parameters. The social game between firms, labor unions, and the government can be specified in more detail as suggested by Svejnar (1989).

four variables ( $P_1$ ,  $P_2$ ,  $AS$ , and  $L$ ) are given, then the model solves 43 endogenous variables ( $Y_1$ ,  $Y_2$ ,  $Y_{3M}$ ,  $Y_{3S}$ ,  $GDP$ ,  $P_{3M}$ ,  $P_{3S}$ ,  $P_U$ ,  $L_1$ ,  $L_2$ ,  $L_{3M}$ ,  $L_{3S}$ ,  $L_U$ ,  $L_{INF}$ ,  $K_2$ ,  $K_{3M}$ ,  $W_1$ ,  $W_2$ ,  $W_{3M}$ ,  $W_{3S}$ ,  $W_{INF}$ ,  $TD$ ,  $R_2$ ,  $R_{3M}$ ,  $D$ ,  $LS_H$ ,  $LS_M$ ,  $LS_L$ ,  $SL_2$ ,  $SL_{3M}$ ,  $SL_{3S}$ ,  $WLS_H$ ,  $WLS_M$ ,  $WLS_L$ ,  $AVW$ ,  $CVW$ ,  $UUEMP$ ,  $RUEMP$ ,  $AVUW$ ,  $GINI$ ,  $WEL_U$ ,  $RY_{INF}$ ,  $RL_{INF}$ ). In this model, only 25 endogenous variables are determined simultaneously, while the remaining 18 endogenous variables do not exert any repercussions on other variables. The model contains in total 29 parameters, so it is possible to do 33 different simulations by changing 4 exogenous variables and 29 parameters.

The new aspects of this model are: (1) the two subdivisions of the informal sector, and the specification of four sectors, (2) the specification of demand and supply equations for each sector, (3) the introduction of various labor skills into the production function, (4) the specification of different skill distributions, (5) the refinement of the Harris-Todaro formula through the explicit consideration of the urban cost-of-living, (6) the specification of subcontracting between the second and 3M sectors,<sup>9</sup> and (7) the addition of the Sheshinski-Sen-Yitzhaki's welfare index.

Past models can be considered as a reduced version of my model. For example, the formal and informal sectors in Chaudhuri's model (1989), Nakanishi's model (1991), Gupta's model (1993), and Kelley's model (1994) correspond to the second and 3M sectors in my model. Based on the residual character of the informal sector, 3S employment (A-12) assures the automatic employment of low skilled labor. The Bodart and Le Dem's model (1996) stressed the residual character, thus their formulation is close to the specification of the 3S sector in my model. Ghate (1992) noted that the nature of the credit market is not completely separated between the formal and informal sectors, but rather is continuous. My specification of three urban subsectors can be useful to avoid the complete separation of credit markets. Two equations, (A-32) and (A-33), try to adequately treat the important role of human capital in the formation of wages (House 1987). The Sheshinski-Sen-Yitzhaki's welfare index is added to the model in accordance with Gupta (1988) to assess the overall welfare effects of various shocks on urban household welfare.<sup>10</sup>

Some additional remarks:

- (i) Equation (A-14) implies that the products of the 3S sector are inferior goods; therefore when  $GDP$  and  $Y_{3S}$  grow in parallel, prices ( $P_{3S}$ ) decrease.
- (ii) If the 3M sector shares the same technology with the formal second sector, the vitality of the 3M sector is guaranteed even with lower prices ( $P_{3M}$ )

<sup>9</sup> It is specified by  $B(3, 2)$  in equation (A-8). The actual relationship between firms in two sectors is more complex. Portes and Sassen-Koob (1987, p. 39) showed four typical patterns in Latin America. Kiso (1987) showed a diverse relationship between two sectors in India.

<sup>10</sup> I would like to refer the Sheshinski-Sen-Yitzhaki's index (Bishop, Chakraborti, and Thistle 1991, p. 423) simply as SSS's index. Gupta (1988) discussed the shadow wage rate ( $SWR$ ) based on SSS's index. In my model the  $SWR$  of each subsector can be assessed through simulation studies. Stark (1984, p. 481) also used  $AVW \cdot G$  as the deprivation measure. Yunker (1989, p. 115) is another example of the application of Sen's measure.

because it does not incur taxes and social security burdens.<sup>11</sup>

$$(1 - T) \cdot P_2 Y_2 / L_2 = W_2 + K_2 \cdot F_2'(K_2/L_2). \quad \text{(second sector wage)} \quad (\text{A-5})$$

$$P_{3M} Y_{3M} / L_{3M} = W_{3M} + K_{3M} \cdot F_2'(K_{3M}/L_{3M}). \quad \text{(3M sector wage)} \quad (\text{A-10})$$

Quibria (1988) specified the production function as in equation (A-13). The separation of the 3M and the 3S sectors thus combined the different specifications by different authors.

- (iii) Devarajan, Ghanem, and Thierfelder (1997) introduced the concepts of active and passive unions, and the sectoral wage is distorted by the relative strength of labor unions. They noted that labor unions in Indonesia are relatively weak compared to those in Bangladesh, so trade liberalization in the former would benefit more workers than would minimum wage policy. In my model, I tentatively ignore the wage distortion caused by labor unions.
- (iv) The Sheshinski-Sen-Yitzhaki's index is a convenient index of overall welfare judgment even when the Lorenz curves intersect.
- (v) The urban-rural misery gap is defined by the equation (A-22). But the sign is not determined a priori.

$$D = (W_{INF}/P_U) - (W_I/P_I) \leq 0.$$

Ravallion and Huppi (1991) stated that absolute poverty in Indonesia is higher or lower in the urban area compared with the rural area depending upon the demarcation of the absolute poverty line. This point is related to the ambiguous sign discussed above.

#### IV. SIMULATION EXPERIMENTS

The initial values of four exogenous variables are set as follows:

$L$  (total labor) = 800;  $P_I$  (rural output price) = 1.0;  $P_2$  (second sector output price) = 1.7;  $AS$  (total monetary funds) = 1,260.

The standard constellation of variables represents the typical situation in an urban area surrounded by the rural area in a developing country. The constellation roughly referred to Jakarta and its surrounding area, but the exact quantification will be done in the future. The nominal average labor productivity of the second sector (1.80) is about double compared with that in the first (rural) sector (0.96), and also in the urban informal sector. In this example, the informal sector accounts for 85.34 per cent of employment, and 73.62 per cent of GDP in the urban area.

<sup>11</sup> Gibson and Kelley (1994) also discussed the situation of the same technology. But the additional burden of taxes or social security changes the situation of the informal sector more favorable. Loayza (1996) analyzed the size of the informal sector using a two-sector endogenous growth model that also assumed tax avoidance and resulting congestion in public services.

Sector	Real GDP		Nominal GDP			Employment		Labor Pro- ductivity
	Variables (1)	Value (2)	Variables (3)	Value (4)	Share (%) (5)	Figure (6)	Share (%) (7)	(5)/(7) (8)
First	$Y_1$	599.78	$PY_1$	599.78	0.2391	198.65	0.2483	0.9629
Second	$Y_2$	296.10	$PY_2$	503.37	0.2007	88.81	0.1110	1.8081
3M	$Y_{3M}$	419.53	$PY_{3M}$	641.88	0.2558	200.52	0.2506	1.0207
3S	$Y_{3S}$	1138.6	$PY_{3S}$	786.77	0.3041	312.00	0.3900	0.7797
Sum	—	—	$GDP$	2505.1	1.0000	800.00	1.0000	1.0000

I repeated simulations by changing the values of the exogenous variables and structural parameters. The specification of 17 simulation cases are as follows:

(Case 1): Increase in total investment funds ( $AS + 10$ )

(Case 2): Increase in total labor force ( $L + 10$ )

(Case 3): Increase in wage tax for the second sector ( $T + 0.01$ )

(Case 4): Increase in output price of the rural sector ( $P_1 + 0.01$ )

(Case 5): Increase in output price of the second sector ( $P_2 + 0.01$ )

(Case 6): Increase in productivity of the rural sector ( $B(1, 1) + 0.1$ )

(Case 7): Increase in productivity of the second sector ( $B(2, 3) + 0.1$ )

(Case 8): Increase in productivity of the 3M sector ( $B(3, 5) + 0.1$ )

(Case 9): Increase in productivity of the 3S sector ( $B(4, 1) + 0.1$ )

(Case 10): Increase in foreign demand ( $B(2, 2) + 5$ )

(Case 11): Minimum wage policy ( $W_{3M} = 3.1$ )

(Case 12): Wage subsidy policy ( $W_{3S} = W_{3S} + 0.1$ )

(Case 13): Wage subsidy to the second sector ( $W_2 = 3.8$ )

(Case 14): Interest rate subsidy to the second sector ( $R_2 = 0.12$ )

(Case 15): Increase in reserve ratio ( $B(6, 1) = 0.05$  up)

(Case 16): Increase in the share of high skilled labor ( $LS_H/L + 0.03$ )

(Case 17): Increase in the share of high and medium skilled labor ( $LS_H/L + 0.03$ ;  $LS_M/L + 0.05$ )

The results of these simulations are compiled in Table I. The figures in the second column show the value of the variables in the base case. The other figures under the case headings show the per cent of change of the variables compared with the base values.

The basic purpose of these experiments was to repeat every possible simulation by changing all the exogenous variables and structural parameters, and to confirm the following several effects by checking for the existence of positive quadrant relationships.

(a) Sectoral development pattern. When  $GDP$  increases, sectoral output is usual-

TABLE  
RESULTS OF

Variables	Base Case	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
$Y_1$	599.78	-0.29	0.97	0.52	0.74	-0.38	1.96	-0.59	-0.30
$Y_2$	296.10	-0.69	-0.41	0.84	2.48	-1.58	3.11	-1.38	-0.73
$Y_{3M}$	419.53	-0.69	-0.41	0.84	2.46	-1.58	3.09	-1.37	-0.72
$Y_{3S}$	1,138.61	1.37	2.98	-1.40	-3.48	2.15	-4.73	2.80	1.42
$GDP$	2,505.10	-0.81	-0.49	1.00	2.92	-1.18	3.66	-1.62	-0.85
$P_1$	1.000	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
$P_2$	1.700	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00
$P_{3M}$	1.530	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00
$P_{3S}$	0.691	-2.72	-4.58	3.05	8.26	-4.14	11.07	-5.43	-2.84
$P_U$	0.944	-1.24	-2.06	1.36	4.00	-1.80	4.82	-2.49	-1.29
$L_1$	198.65	-0.37	1.22	0.65	0.93	-0.47	1.73	-0.74	-0.37
$L_2$	88.81	-1.06	-0.69	1.29	3.80	-2.38	4.77	-4.48	-1.11
$L_{3M}$	200.52	-1.29	-0.56	0.96	2.81	-1.82	3.53	-1.62	-1.35
$L_{3S}$	312.00	1.37	2.98	-1.40	-3.48	2.15	-4.73	2.80	1.42
$L_U$	601.34	0.12	1.26	-0.21	-0.31	0.15	-0.57	0.24	0.12
$L$	800.00	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00
$L_{INF}$	512.52	0.32	1.59	-0.47	-1.02	0.59	-1.49	1.06	0.33
$K_2$	1,036.63	0.07	0.04	-0.09	-0.27	0.11	-0.34	0.15	0.08
$K_{3M}$	223.36	4.11	-0.21	0.43	1.26	-0.52	1.57	-0.72	-0.37
$W_1$	3.019	0.07	-0.24	-0.13	0.81	0.09	0.23	0.14	0.07
$W_2$	3.605	0.32	0.19	-1.49	-1.12	1.31	-1.40	3.05	0.34
$W_{3M}$	3.081	0.52	0.02	-0.04	-0.13	0.70	-0.16	0.07	0.54
$W_{3S}$	2.488	-2.72	-4.58	3.05	8.26	-4.14	11.07	-5.43	-2.84
$W_{INF}$	2.720	-1.44	-2.76	1.78	4.75	-2.24	6.32	-3.27	-1.50
$TD$	1,091.19	0.07	0.04	-0.09	-0.27	0.11	-0.34	0.15	0.08
$R_2$	0.146	-0.77	-0.46	0.94	2.75	-1.11	3.46	-1.53	-0.81
$R_{3M}$	0.289	-4.61	-0.20	0.41	1.20	-0.47	1.50	-0.66	-0.34
$AS$	1,260.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$D$	-0.138	5.82	9.43	-11.45	-19.09	11.40	-24.76	19.68	6.07
$LS_H$	72.00	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00
$LS_M$	184.00	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00
$LS_L$	544.00	0.00	1.25	0.00	0.00	0.00	0.00	0.00	0.00
$SL_2$	0.991	0.04	0.08	-0.05	-0.15	0.10	-0.18	0.19	0.04
$SL_{3M}$	0.942	0.08	0.12	-0.07	-0.20	0.13	-0.26	0.18	0.08
$SL_{3S}$	0.900	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$WLS_H$	3.605	0.32	0.19	-1.49	-1.12	1.31	-1.40	3.05	0.34
$WLS_M$	3.129	0.42	-0.11	-0.10	0.04	0.56	0.05	-0.05	0.43
$WLS_L$	2.718	-1.55	-2.76	1.69	4.93	-2.40	6.19	-3.21	-1.62
$AVW$	2.892	-0.85	-1.77	0.88	3.04	-1.25	3.81	-1.72	-0.89
$CVW$	0.126	10.49	16.01	-13.10	-27.77	17.43	-36.31	24.49	10.93
$UUEMP$	158,826	7.12	12.39	-10.70	-21.94	12.66	-29.27	19.59	7.42
$RUEMP$	0.264	6.99	10.99	-10.51	-21.70	12.49	-28.86	19.29	7.29
$AVUW$	2.850	-1.17	-2.30	1.23	3.80	-1.71	5.06	-2.35	-1.22
$GINI$	0.075	10.44	15.80	-12.79	-28.29	17.22	-37.31	23.57	10.88
$WEL_U$	2.636	-2.00	-3.55	2.28	6.19	-3.08	8.24	-4.22	-2.09
$RY_{INF}$	0.563	-0.26	-0.64	0.25	0.62	-0.40	0.88	-0.52	-0.27
$RL_{INF}$	0.852	0.24	0.36	-0.22	-0.67	0.47	-0.93	0.81	0.21

Note:  $D < 0$ , thus the rate of change is positive when  $D$  decreases.



## I

## SIMULATIONS

Case 9	Case 10	Case 11	Case 12	Case 13	Case 14	Case 15	Case 16	Case 17	Variables
-1.39	-0.26	-0.52	-5.45	-1.97	0.58	-1.09	0.40	0.46	$Y_1$
-2.92	3.64	-0.82	-7.51	-2.87	1.36	-2.42	0.12	0.11	$Y_2$
-2.90	3.53	-0.81	-7.48	-2.85	1.35	-2.41	0.12	0.10	$Y_{3M}$
5.94	-3.97	1.37	12.97	4.89	-2.63	4.87	0.38	0.48	$Y_{3S}$
-3.43	3.06	-0.97	-8.84	-3.41	1.60	-2.83	0.14	0.13	$GDP$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$P_1$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$P_2$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$P_{3M}$
-11.06	9.19	-2.87	-23.39	-9.74	5.54	-9.23	-0.41	-0.55	$P_{3S}$
-5.20	4.11	-1.31	-11.69	-4.58	2.45	-4.31	-0.17	-0.24	$P_U$
-1.73	-0.33	-0.65	-6.76	-2.46	0.72	-1.36	0.50	0.57	$L_1$
-4.41	5.60	-1.25	-11.25	-4.33	1.42	-1.84	-0.77	-0.79	$L_2$
-3.30	4.03	-0.93	-8.49	-3.25	2.74	-5.41	-0.76	-0.97	$L_{3M}$
4.48	-3.97	1.37	12.97	4.89	-2.63	4.87	0.36	0.48	$L_{3S}$
0.57	0.11	0.21	2.23	0.81	-0.24	0.45	-0.16	-0.19	$L_U$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$L$
1.43	-0.84	0.46	4.57	1.70	-0.52	0.85	-0.06	-0.08	$L_{INF}$
0.33	-0.39	0.09	0.87	0.32	1.95	-5.57	-0.01	-0.01	$K_2$
-1.52	1.84	-0.42	-4.04	-1.49	-9.09	25.86	0.06	0.05	$K_{3M}$
0.34	0.06	0.12	1.39	0.46	-0.14	0.27	-0.10	-0.11	$W_1$
1.37	-1.64	0.38	3.67	5.41	0.00	-0.66	-0.05	-0.05	$W_2$
0.15	-0.18	0.62	0.41	0.16	-1.20	2.86	0.00	0.00	$W_{3M}$
-9.82	9.19	-2.87	-19.37	-9.74	5.54	-9.23	-0.41	-0.55	$W_{3S}$
-5.97	5.29	-1.46	-12.56	-5.94	2.75	-4.68	-0.29	-0.39	$W_{INF}$
0.33	-0.39	0.09	0.87	0.32	1.95	-0.32	-0.01	-0.01	$TD$
-3.23	4.05	-0.91	-8.31	-3.16	-17.63	3.33	0.13	0.12	$R_2$
-1.41	1.67	-0.40	-3.62	-1.48	11.52	-22.46	0.05	0.05	$R_{3M}$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$AS$
24.27	-21.93	5.88	50.95	39.55	-9.15	14.03	0.23	0.62	$D$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	33.33	$LS_H$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.73	$LS_M$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	-4.41	-11.76	$LS_L$
0.18	-0.21	0.05	0.51	0.18	-0.05	0.07	0.95	0.95	$SL_2$
0.25	-0.29	0.07	0.70	0.25	-0.15	0.29	0.90	1.09	$SL_{3M}$
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	$SL_{3S}$
1.37	-1.64	0.38	3.67	5.41	0.00	-0.66	-1.24	-1.24	$WLS_H$
-0.10	0.06	0.49	-0.36	0.24	-0.95	2.37	-2.25	-5.00	$WLS_M$
-5.79	5.14	-1.60	-12.52	-5.76	3.00	-5.44	-0.65	-0.37	$WLS_L$
-3.57	3.12	-0.85	-7.67	-3.01	1.68	-2.96	-0.22	-0.28	$AVW$
38.19	-31.56	11.17	83.78	45.49	-18.48	35.99	1.14	1.65	$CVW$
26.41	-25.16	7.71	56.34	34.27	-12.81	20.21	0.72	1.03	$UUEMP$
25.69	-25.24	7.48	52.92	33.19	-12.60	19.67	0.89	1.23	$RUEMP$
-4.88	4.19	-1.18	-10.45	-4.14	2.30	-4.05	-0.27	-0.35	$AVUW$
36.53	-32.03	11.11	76.38	43.73	-19.58	34.89	1.15	1.66	$GINI$
-7.70	6.90	-2.07	-16.00	-7.55	3.93	-6.76	-0.36	-0.48	$WEL_U$
-1.07	1.16	-0.24	-2.08	-0.82	0.51	-0.90	-0.10	-0.12	$RY_{INF}$
0.86	-0.95	0.25	2.28	0.88	-0.28	0.39	0.10	0.10	$RL_{INF}$

- ly expected to increase. But different patterns emerged in the experiments. (i) All sectoral output changes paralleled *GDP* except in two cases (16, 17). (ii) In most cases (1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15), the output of the first, second, and 3M sectors changed in the same direction as *GDP*, while the 3S sector changed inversely. (iii) In two cases (2, 10), only the second and 3M sectors changed with *GDP*, while the first and 3S sectors changed inversely. Two cases (16, 17) were those of higher education dissemination. Thus the general conclusion is that the second and 3M sectors change in parallel and the 3S sector changes inversely with *GDP*, while the first (rural) sector changes in a mixed way. This implies that when *GDP* grows, the 3S sector will shrink.
- (b) Backwash effect. The increase of *GDP* is expected to increase the welfare of labor by increasing employment and wage rate. When a welfare loss happens for certain labor groups, this phenomenon is called the backwash effect. The welfare loss can be measured by the decrease in wage rate of the relevant labor group. We are especially interested in an inverse relationship between *GDP* and the average wage rate of the informal sector ( $W_{INF}$ ). The changes of *GDP* and  $W_{INF}$  were parallel (or of the same signs) in most of the model cases, except in two cases (16, 17) of higher education dissemination. Thus, in general the informal sector labor group benefits from the increase in *GDP*.
- (c) Immiserizing wage subsidization policy. In cases (11) (12) (13), the wage rate of the second, 3M, and 3S sectors was kept at a higher level than the standard case based on the enforced minimum wage policy. By this policy,  $Y_{3S}$ ,  $W_2$ ,  $W_{3M}$ ,  $L_{3S}$ , and  $L_U$  increased, while  $Y_1$ ,  $Y_2$ ,  $Y_{3M}$ , *GDP*,  $W_{3S}$ ,  $W_{INF}$ ,  $L_2$ , and  $L_{3M}$  decreased. The subsidization of  $W_{3S}$  ultimately results in the decrease of  $W_{3S}$  based on the fact that the increase in *GDP* is mainly absorbed by the increase in  $Y_{3S}$  and only partly by the increase in  $W_{3S}$ . Sometimes it is claimed that the minimum wage restriction exerts a disemployment effect (Agénor 1996, p. 280), but in case (12) the wage subsidy for the 3S sector resulted in an increase in 3S sector employment. The fact that  $L_U$  (urban employment) increased but  $W_{INF}$  (informal sector wage) decreased implies that wage subsidization policies are a mixed blessing for the urban workers. The decrease in *GDP* implies that these policies immiserize the society as a whole.
- (d) Depolarization effect of interest rate subsidy to the formal sector. This results in the increase (decrease) of capital funds to the second (3M) sector, bringing an increase (decrease) in capital stock. This induces an increase (decrease) in wages in the second (3M) sector. The total effect results in the increase of employment and output in the second and 3M sectors, and of *GDP*, while the employment and output of the 3S sector decrease. As a whole, it results in the increase of the average level and the decrease of the coefficient of variation in urban wages. This means that the workers in the second and 3M sectors benefit while those in the 3S sector are hurt. The decrease in the reserve ratio

shows similar effects on the second sector. Therefore the elimination of financial repression or the development of the financial sector and the resulting lower interest rate would generally benefit urban workers.

- (e) Inverse direction of changes in informal sector wage ( $W_{INF}$ ) and urban unemployment equivalent ( $UUEMP$ ). In every case, two indices show the inverse direction of change, and can be interpreted as similar indices of informal sector employment conditions.
- (f) Pushing-down effect. Two experiments, case (16) (increase in the share of high-skilled labor) and case (17) (increase in the share of high- and medium-skilled labor) showed that: (i)  $L_2$  and  $L_{3M}$  decreased and  $L_{3S}$  increased, while urban employment as a whole decreased; (ii) the price of 3S products and urban prices decreased because of increased supply; and (iii) the wage rate of every sector and of every labor group (high-, medium-, and low-skilled) decreased. Before these experiments,  $L_2$  exceeded  $LS_H$ , so high-skilled labor was totally employed in the formal sector. But after increasing the share of high-skilled labor, the formal sector could not absorb all this labor, so a part of it had to work in the 3M sector. Thus the dissemination of higher education resulted in the deterioration of the welfare of all the labor groups. Thus a pushing-down effect happened.<sup>12</sup> This supports the observation of Keyfitz (1989, p. 47) for Indonesia.
- (g) Subsidies for primary products (price). Deaton (1989) analyzed the impact of the rice price on income distribution in Thailand taking into account the different production and consumption patterns of rice in urban and rural areas. He concluded that the distributional impact of a higher rice price is very minor and because of this there was “no support for keeping prices artificially low” (p. 23). In Indonesia rice output quickly increased from 11.666 million tons in 1968 to 25.825 million tons in 1984, thereby achieving the target of trend-self-sufficiency. But the domestic price was subsidized and kept higher than the international price. Dick (1985, p. 26) noted that a falling rice price would benefit the urban and rural poor, which “is completely in accordance with the historical mission of agriculture as set out in development texts: by raising pro-

<sup>12</sup> In a sense, the existence of the pushing-down effect implies an overinvestment in education. In my model, the production function of the second sector is linear homogeneous in physical labor and capital, while the increase in labor skill causes an additional increase in output. An alternative setting is to assume an economy of specialization through investment in education. Shea and Woodfield (1996) noted a similar point in the international labor movement where the immigration of skilled workers hurts local unskilled workers and not skilled workers. Kuroda (1997) showed a model of urbanization with higher education in which a portion of the people from the rural area obtains higher education and pushes an economy of specialization. Such a model assumes perfect foresight, and that people stop the investment in education at a certain limit so that the pushing-down effect never happens. When a CGE model is used to experiment on wage hikes, the result differs according to the choice closure rule (Gibson, Lustig, and Taylor 1986, p. 50).

ductivity and reducing the real price of food and raw materials, income and employment are stimulated in other sectors of the economy." The result of the experiment in case (4) shows the decreases in employment and output in the 3S sector, and is in agreement with Dick's observation.

- (h) The inverse relationship between the average wage level ( $AVW$ ) and the coefficient of variation ( $CVW$ ) was observed in all the experiments. This suggests the trade-off between growth and equality among wage earners.
- (i) A parallel relationship can be observed between the informal sector wage and the real wage gap ( $D$ ), except in case (3). Thus an increase in the informal sector wages also generally implies a relative improvement in the standard of living of the urban informal sector compared with the rural sector.
- (j) Policy packages can clearly be divided into three groups based on the direction of change in the four basic indicators: two indices of growth ( $GDP$  and  $AVUW$ ), an index of equality ( $GINI$ ), and the overall evaluation index ( $WEL_U$ ).

Group	$GDP$	$AVUW$	$GINI$	$WEL_U$	Case
(1)	(-)	(-)	(+)	(-)	1, 2, 5, 7, 8, 9, 11, 12, 13, 15
(2)	(+)	(+)	(-)	(+)	3, 4, 6, 10, 14
(3)	(+)	(-)	(+)	(-)	16, 17

As the direction of change in each indicator is reversed between the policy in groups (1) and (2), the policy effects of the two groups are qualitatively the same. Thus the effects of policy in groups (1) or (2) are equity-improving when growth-enhancing, and are therefore welfare-improving based on the Sheshinski-Sen-Yitzhaki's index. When some results are seen as counter-intuitive, the 3S sector variables ( $Y_{3S}$  and  $L_{3S}$ ) show big changes and contribute to decide the sign of policy effects.

- (k) The policy effects are summarized below by groups.
  - (k-1) (labor force growth: case 2). The growth of the labor force deteriorates  $GDP$  and average urban wage and wage distribution. The elimination of population pressure is one of the important development policies.
  - (k-2) (education: cases 16 and 17). The dissemination of higher education increases  $GDP$ , but deteriorates the welfare of urban workers.
  - (k-3) (exports: case 10). The increase in demand in the second sector, which is a negative function of price but independent of domestic demand (typically the feature of exports), accelerates growth and improves distribution.
  - (k-3) (rural sector: cases 4 and 6). The increase in productivity and decrease in price are growth-enhancing and welfare-improving for urban workers.
  - (k-4) (second sector: cases 3, 5, 7, 13, 14, and 15). Among the recommendable policies, some packages aim at increasing capital, such as a de-

- crease in reserve ratio or interest rate, or increasing wage tax and suppressing wage, or suppressing price and productivity.
- (k-5) (3M sector: cases 1, 8, and 11). Among the recommendable policies, some packages aim at increasing capital supply, or suppressing wage and productivity.
- (k-6) (3S sector: cases 9 and 12). Among the recommendable policies, some packages aim at suppressing wage and productivity.
- (l) The relative size of the urban informal sector. Loayza (1996) showed that the size of the informal sector increases with higher tax burdens,<sup>13</sup> greater labor market restrictions, and the lower efficiency of government institutions, and decreases with the higher growth rate of per capita GDP. I defined income size as  $RY_{INF}$  ( $GDP$  of 3M and 3S sectors over  $GDP$ ) and employment size as  $RL_{INF}$  (employment of 3M and 3S sectors over urban employment). When  $RL_{INF}$  increases (decreases),  $RY_{INF}$  and  $GDP$  decrease (increase). Thus, the increase of the relative employment size in the informal sector generally depresses  $GDP$  and the relative income size. This inverse relationship also happens in the case of higher education dissemination, (16) and (17); the relative decrease in  $W_{3S}$  results in increases in  $L_{3S}$  and of  $RL_{INF}$ , while  $GDP$  increases and  $RY_{INF}$  decreases.<sup>14</sup> Based on these findings it can be said that the relative size of the informal sector is sensitive to the method of estimation such as whether it is defined in terms of income or employment.

## V. SUMMARY AND CONCLUSIONS

### 1. *Importance of Hart's residual*

The Solow's residual (technological progress) represents a part of economic growth which cannot be explained by the Neoclassical production function and which accounts for about 40 per cent of economic growth. The Hart's residual (informal sector) represents a part of the economy which cannot be explained by the Neoclassical model and which accounts for about 40 per cent of the urban population. Although its implications were vague when initially proposed, the former concept contributed to the theory of economic growth. The latter concept (informal sector) also captures an essential feature of developing countries, and might be the key concept of development economics.

### 2. *Importance of subdividing the informal sector (four sector model)*

The reaction of sectoral employment and output to an exogenous shock was

<sup>13</sup> In case (3), the increase in wage tax resulted in an increase in the income share of the informal sector. This coincides with the findings of Loayza (1996).

<sup>14</sup> The influence of the addition of skilled workers was also discussed by Funkhouser (1996) and by Shea and Woodfield (1996). They also showed the depressing effects on informal workers.

quite different among the four sectors. In general, the welfare of the informal sector (employment and wage level) can be improved by overall economic growth (increase in GDP) and the development of the financial sector. But direct development policies, like productivity increases or wage subsidies, targeted at specific sector, cannot achieve their set targets, and enlarge the wage and productivity gaps between sectors. Thus the general policy guideline for the informal sector development is not to effect specific direct policies, but to undertake an indirect development policy toward the informal sector through further expansion of the formal sector and development of the financial sector.

### 3. *Importance of overall welfare judgment*

As various indices of evaluation show different tendencies, it is necessary and useful to make an overall judgment based on a welfare index like the Sheshinski-Sen-Yitzhaki's index, which considers the growth (average wage level) and the equity (GINI measure) components and gives an overall evaluation of urban workers.

### 4. *Flexible specification*

Naturally the above conclusions depend heavily on the specification of functional forms and the parameter values of the basic relationships. This paper has aimed at establishing a general specification which can serve as a typology for the informal sector in developing economies after fixing the special parameter values. It also has aimed at clarifying the various informal sectors, such as the African-type informal sector, the Latin American-type informal sector, and the Asian-type informal sector. There are two different possibilities for approaching future research. One is the generalization of model specification by further subdividing the relationships. The other is the empirical study of the actual situation in each developing country, because there are many idiosyncratic features in the informal sector of different countries.

Some additional points relevant for the further expansion of the current model.

- (a) Different ways of specifying the formal sector and the informal sector. One way is by institutional or legal distinction (incorporated and unincorporated businesses). Another way is whether businesses are registered or not (protected or unprotected). A model based on the former will resemble the dual structure model, while a model based on the latter will resemble the legal and illegal market model. I ignored many relevant features of the black market model in this paper (for example, Bevan, Collier, and Gunning [1989, p. 1958] indicated that "the black market does not clear").
- (b) Different specifications of the dual development. Hideki Imaoka proposed another concept of "dual-industrial growth" by emphasizing the coexistence of a consumption goods export sector and a heavily protected capital goods

sector which supplies intermediate and capital goods to the export sector (see for example the formulation by Kubo [1989]). In this paper the formal second sector is assumed to be internationally competitive, and an informal 3M sector is partially connected to the second sector through subcontracting relationships. But the 3M sector also serves other purposes (mainly fulfilling domestic demand). Different specifications (complementarity or substitutability) between products of the second sector and the 3M sector induce different policy conclusions. Especially the validity of direct welfare policy for the informal sector depends on this specification. In some cases, like experiments (11) and (12), a wage subsidy policy for the informal sector exerts a deteriorating effect on the informal sector as a whole.

- (c) Extension of the model to nonemployment. The problem of the informal sector is not restricted to developing countries. For example, Murphy and Topel (1997) noted that in the United States the rate of nonemployment (unemployed plus discouraged people who have dropped out of the labor force) increased steadily from 6 to 13 per cent during 1970–90 while the rate of the unemployed stayed almost constant at 3–4 per cent. If we interpret the unemployed and the discouraged dropouts as explicit and implicit pools of labor waiting for formal employment, we can say that there are also two (formal and informal) working statuses and accompanying markets in the developed countries. The proper handling of the nonemployment issue necessitates formal modeling work which can be an extension of the informal sector model.
- (d) Integration with interindustry wage differentials. When wage levels largely differ among different industries, as suggested by Gatica, Mizala, and Romaguera (1995) for Brazil and discussed by Beladi and Naqvi (1987), we do need to extend the current modeling of the informal sector in which the wage differential mainly comes from the different scales of firms or from the different skills of the workers.
- (e) Historical background of cities. In the future, a taxonomic approach will become possible through collecting data on the cities in different regions, such as Asia, Latin America, and Africa, and through estimating the values of basic parameters and identifying the idiosyncratic types of the urban informal sector in these regions. Different backgrounds of cities, such as historical development and physical and social infrastructure, should be carefully taken into consideration in the study.<sup>15</sup>

For further sophistication of the model it is useful to take up the following points: linking my model with the household production model of Maruyama (1994, 1996); introducing into my model the rural nonagricultural informal sector as emphasized by Hymer and Resnick (1969) and Torii (1979); linking the model

<sup>15</sup> This point was correctly pointed out by Professor Reeitsu Kojima.

with the time allocation model like that of Juster and Stafford (1991); linking the model with the household-producer-combined model of Maruyama (1984); adding to the model a variable on trade unions behavior in the formal sector as emphasized by Quibria (1988); introducing into the model the concept of mixed employment described by Portes et al. (1986, p. 733); and introducing the public sector into the model.<sup>16</sup>

In some countries, the formation of the urban informal sector is partly accelerated by ethnic factors. In Peru the indigenous population makes up 25–40 per cent of total population and accounts for 50.1 per cent of the people in agriculture, 12.9 per cent of those in the public sector, 21.9 per cent of those in the private sector, and 15.1 per cent of the independent workers, meanwhile non-indigenous groups make up a relatively high portion of nonagricultural activities (MacIssac and Patrinos 1995). Simon and Birch (1992) referred to the informal sector in South Africa as a pool of black workers.

Many countries are confronted with the trade-off between employment and growth (see Eriksson 1997). Many developing countries are confronted with a pair of difficult development targets: (i) a balance-of-payment target, meaning the improvement of international competitiveness and export promotion of nontraditional goods, and (ii) a welfare target, meaning the creation of a sufficient number of employment opportunities and higher wages. However, there is a trade-off because (1) on many occasions the former requires the adoption of labor-saving technology and as a result the export promotion suppresses employment creation, and (2) increases in the wage level suppress international competitiveness.<sup>17</sup> The optimum wage level and the desirable factor proportions can be discussed only with a sufficient understanding of the plural structure of developing countries.<sup>18</sup> Until now, most studies of the labor market, like Agénor (1996), have been based on two-sector (rural and formal) setting. The specification of the informal sector and its inclusion into the total framework would greatly enhance the analytical capability of the labor market model in discussing these basic issues within the proper background of realities in developing countries. Portes and Sassen-Koob (1987) asked three basic questions: whether the informal sector is a transitory phenomenon in

<sup>16</sup> Bodart and Le Dem's model (1996) consists of three sectors (urban formal, urban informal, and public) for Côte d'Ivoire. Agénor (1996) provided a survey of the size and importance of public sector employment as an "employer of last resort" (p. 270). Gindling (1991) showed that the public sector offered higher wages than the private-formal sector for observationally equivalent workers in Costa Rica, while Yamada (1996) gave a different picture for Latin America. Sometimes the government sector engages in employment and purchases, and does not carry on manipulative or predatory behavior as suggested by Marcouiller and Young (1995).

<sup>17</sup> Riveros (1992) showed the export-suppressing effect of wage increases based on studies of twenty less developed countries.

<sup>18</sup> Horowitz (1974) tested the optimum wage in India. Hill and Phillips (1997) discussed the factor proportions in East Asian countries.



capitalistic development, whether it is merely the social pool of redundant labor, whether it is a typical phenomenon in periphery countries. They negated these three questions empirically. However, there is still the important question of whether we should interpret the informal sector as an involuntary or evolutionary part of capitalistic development of the world economy.

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