A Simulation Analysis of Urban Informal Sector

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1. Introduction

In 1972, ILO Report first used the terminology" informal sector" (House,1984,p.277). After that continuous discussions were made about the adequate definition, empirical estimation, and theoretical understanding of this sector, but concrete answers were not yet reached. On the other hand, apart from the exact definition, the urban informal sector occupies a big part of urban employment (40-60%) in many primal cities in the developing world. It offers various outputs and services to formal sector, sometimes through subcontracting arrangement, and also to general people. Everybody can enter to informal sector without essential amount of capital or sector-specific professional skills. Through this automatic employment, it absorbs open unemployed persons, and serves as a cushion to mitigate social frustration. On the other hand, very low level of wage or of income of informal sector suppressed the people's standard-of-living to a bare minimum level, and forced to live in squatters, and created a vast urban miseries in many developing countries. Based on a standard, the actual standard-of-living there is even lower than the one in rural area. So the improvement of living condition of urban informal sector is one of the urgent policy agenda.

Because the urban informal sector consists with very different economic activities, and different institutional entities, the overall picture of urban informal sector is very misty and hard to grasp. Therefore, beyond ad hoc and partial equilibrium analyses, an integrated scheme of analysis is badly needed to overall description of issues and to sufficient understanding of working mechanism through various possible simulation exercises. This paper is a trial of first step to that direction. So, the contents of this paper are three: (i)to make a survey of methodological issues about the informal sector, (ii) to construct a simulation model with detailed decomposition of urban activities, (iii) to quantitatively clarify the basic working of urban informal sector based on various simulation

studies.

The structure of the paper is as follows. In section 2, I discuss some basic tendency of urban informal sector in relevant countries, and survey the preceding analyses of informal sector. In section 3, I construct a simulation model. In section 4, I apply this model for various simulations. Section 5 contains summary and conclusions.

2. Methodological Issues about Urban Informal Sector

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

(1) The multi-dimensional definition of informal sector.

(1a) Legal status of firms. In each 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) stressed a high economic price of registration in Peru. Such a unregistered character of informal firms overlaps with the rules of illegal or black markets as described by Bevan-Collier-Cunning (1989). Stressing this aspect, the informal sector is sometimes called as "hidden, gray, shadow, informal, clandestine, illegal, unobserved, unreported, unrecorded, second, parallel, and black (Feige, op.cit, p.991),[1]and "economy of the poor" or "backyard economy"(Hemmer-Mannel,1989,p.1543).

(1b) Illegality is related to the firm size.[2] We have to distinguish two subsectors in informal sector. (i) A subsector which consists of small scale enterprises. They have a rather similar production function like the formal sector, and employ capital and labor. They avoid to pay tax and social security burden of labor, so want to be unregistered (or unprotected), and obtains the investment fund from the informal fund market. A employee with higher education obtains a higher remuneration.(ii) Another subsector which consists of cottage and family business and independent workers like small under-tree repairshop, petty traders, becha-drivers, housemaids, street vendors, etc.). Nakanishi (1990) gave a concrete picture of this subsector

in Manila. In general they don't have any formal production function, so don't require any investment. They get some remuneration by offering services. The educational career does not guarantee a higher remuneration. These two subsectors are informal in the double senses: small scale activity and illegality. In the model building, we nominate as 3M and 3S sectors, respectively. Based on his observation of informal sector in Nairobi, House (1984) suggested to decompose into the intermediate sector and the community of the poor. I adopt a similar distinction, and nominate these two as 3M and 3S sectors. The former has a formal production function with capital and labor, although it avoids to make the formal registration and attached tax payment. The latter equals to the community of the poor without adequate capital to start a business and also the necessary skill.

(ic) Different characters and status of workers. Based on the different characters of production technologies, the informal jobs do not require sector-specific skills. Therefore, the workers are mainly the new comers of landless farmers from rural area with relatively low educational career.

(2) Big size of informal sector.There are many estimates of size of informal workers ranged from 20-60 per cent in several countries.[3]

(3) Low wage level and automatic employment.The wage level of informal sector is comparatively low than the one in formal sector. But there is no barrier for entry, so everybody can join. So it serves as a cushion to convert the open explicit unemployment to implicit hidden (or disguised) unemployment. Thus "the informal urban sector absorbs all workers released from the other urban sectors"(Bodart-Dem,1996,p.427).Marcouiller-Castilla-Woodruff (1997) showed a concrete analysis of formal-informal wage gap in Mexico, El Salvadore and Peru. One reason of lower wage level in informal sector is the fact that "the young and old are more likely to be in the informal sector than are prime-aged workers"(MCW, op.cit,pp.387-8).But they also showed the substantial returns to education and experiences. So it is important to consider such a human capital element to analyze the wage gap.

(4) Complex tendency of overtime changes. According to PRELALC data, GDP grew by 60% in 1950-80, while the urban informals increased by 9% in

Argentina. In Venezuela, GDP grew by 70%, and urban informals decreased by 50% (Feige,1990). Why such a big difference occurred ? Naturally the tendency is related with 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 force, but rather reflects significant income earning opportunities(Bhalla, 1990, p.1107).

(5) Intrinsic relation with rural-urban migration and important political implications. There exists a strong tendency of urbanization in every developing country. The law of primal city differs by country, but usually the capital city absorbs its major part. The rapid growth of population in capital city causes a strong fiscal pressure to the government because the mass people in informal sector will easily create social turmoil without an adequate public service. Sometimes the existence of a big urban informal sector causes an urban bias in policy formation as described by Braverman-Kanbur (1987). But some empirical studies (even including this paper as well) show that the direct welfare policy for informal sector (for example, wage subsidy policy) would really worsen the employment condition in informal sector. The adequate theoretical as well as empirical studies are of key importance to relevant policy formation.

I note some selected methodological issues below.
(A) Distinction between a rational immigration behavior and existence of urban misery. Usually, Harris-Todaro equation is interpreted as the equality between rural wage and expected urban wage, which is calculated as the weighted average of urban wage rates by their shares. But in the poverty studies, the poverty lines in urban and rural areas are set differently, considering the changes in price levels in both areas. For example, Ravallion-Huppi (1991) set the poverty line income as Rp11,000 in urban and Rp10,000 in rural areas in Indonesia because of 10% higher price level in urban area (in 1985 PPP,Rp 10,000 equals to $31). So I assume the different rural and urban prices, and reinterpret the formula as equating the real rural and urban wages. But if H-T equation implies a rational immigration behavior, then the welfare position in rural and urban sectors must be equated, and there is no room for an urban misery, which implies that the migrated labor to urban area is sometimes worse-off than

the working condition of rural area. I interpret that in this case, the comparison is made when a person migrates and stays in the urban informal sector, and compare the wages in urban informal sector and rural sector. So I will define another index of urban misery, and distinguish the rational migration concept by H-T equation and a possible urban misery.

(B) Definition of urban unemployment equivalent. In reality, the open unemployment cannot persist in long-run. People must get some income to sustain the life even if they register to job search, so in a sense he is recorded as an open unemployed. So I defined a concept of urban unemployment equivalent as follows. In 3S sector, L3S work with a wage rate lower than the average wage rate(WAV) , so their wage payment is (W3S)*(L3S). If this wage payment will be spent to X persons when they work with average wage, then X equals to (W3S)*(L3S)/(WAV). Then we can define (L3S-X) as urban unemployment equivalent(UUEMP). This implies that this amount of labor force can be deducted without reducing output if all the people work with average wage. The size of this variable somehow indicates the size of relative deprivation of informal workers when they are keen with their lower income than average, so it has an important implication for the urban workers welfare.(4)

There are many discussions about the segmented market (Pinera-Selowsky (1978), Romer(1986)). As for Japanese economy, Fukuchi-Oguchi(1969) constructed a dual economy model for 1955-65 which contained three sector division (manufacturing, wholesale and retail, other services) and simulated output, sale, inventory, borrowings, employment, wage and capital in combination with a macro model. Fukuchi-Oguchi(1972) showed its core theoretical model,and showed the condition of backwash effect. Yoshimura(1987)constructed an econometric model for pre-war period (1988-1934) and post-war period (1953-68) following the scheme of two-sectors model by Ranis-Fei. The wage gap by scale was discussed and analyzed in various countries: Tan-Batra(1997) measured wage differentials in Colombia, Mexico and Taiwan.

There are a series of modeling exercises of urban informal sector: the informal sector in Chaudhuri(1989) with 8 equations, Hemmer-Mannel (1989),

Nakanishi(1991) with 14 equations, Gupta's model (1993), Kelly's CGE model(1994) with 128 equations (12 equations for urban informal sector) for Peru had a solid production function. In these models, the demand for the product of informal sector was linked to the one of formal sector through relative prices. So there exists a possibility of a substitutability between two sectors in which the informal sector could flourish while formal sector declines. Bodart-Dem's CGE model(1996) with 40 equations (4 equations for urban informal sector) for Cote d'Ivoire stressed the residual character, 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-Mannel,1989). Fukuchi(1995) constructed a dual financial market model for Indonesia.

The labor absorption by formal sector is an important accompanying subject. Kubo-Yamagata (1990) measured the labor absorption in Malaysia, Indonesia and Philippines. They showed that every country passed the turning point and entered into the period of labor shortage as the real wage increased, and confirmed that the capital accumulation in manufacturing sector accelerates the absorption. But whether the speed of absorption is sufficient or not remained as an open question into the future.

3. Construction of Simulation Model

Based on the consideration above, I constructed a simulation model with 36 equations. The basic purposes of this model building is to construct a multi-equational model which contains important basic relationships between variable of four sectors, and to clarify the effects of various shocks, and to check the different hypotheses about the urban informal sector. I call four sectors as first, second and 3M and 3S. The first sector consists of various traditional agricultural and non-agricultural activities in rural area. The second sector consists of various formal manufacturing and service activities in urban area. 3M and 3S sectors compile various informal activities in urban area. 3M(3S) sector consists of informal manufacturing and service activities with (without) the input of capital.[5] It is an interesting empirical question whether the substitutability between formal and informal sectors still exists after

we subdivide the informal sector into 3M and 3S subsectors. I tried to set the initial conditions which reflect the reality of an urban area in developing country, and to construct a model as general as possible. I write down each equation, and its functional form and the parameter values assumed.

Four Sector Model Including Urban Informal Sector

(First Sector: Rural Sector)

1. First (Rural) Sector Employment Function(L1)

$$L1=F1(P1,W1)=(B(1,1)P1/W1)^{(1/(1-B(1,2))} \quad \text{(A-1)}$$

2. First Sector Production Function(Y1)

$$Y1=F2(L1)=B(1,1)(L1)^{B(1,2)} \quad \text{(A-2)}$$

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

(Second Sector: Urban Modern Big Business Sector)

3. Demand Function For Second Sector Output(Y2)

$$Y2=F3(GDP,P2)=B(2,1)(GDP/P2)^{B(2,5)}+B(2,2)*(P2)^{B(2,6)} \quad \text{(A-3)}$$

4. Second Sector Employment Function(L2)

$$L2=F4(Y2,K2,SL2)=(Y2/B(2,3))^{(1/B(2,4))}\ (K2)^{(1/(1-B(2,4))}/SL2 \quad \text{(A-4)}$$

5. Second Sector Wage Rate Function(W2)

$$W2=F5(Y2,P2,L2,SL2,T)=B(2,4)(1-T)P2Y2/L2/SL2 \quad \text{(A-5)}$$

6. Second Sector Interest Rate Function(R2)

$$R2=F6(Y2,P2,K2)=(1-B(2,4))P2Y2/K2 \quad \text{(A-6)}$$

$$B(2,1)=.17: B(2,2)=70: B(2,3)=3.0: B(2,4)=0.7: B(2,5)=1:$$

$$B(2,6)=-0.9$$

7. 3M Sector Output Price Function(P3M)

$$P3M=F7(P2)=B(3,1)P2 \quad \text{(A-7)}$$

8. Demand Function For 3M Sector Output(Y3M)

$$Y3M=F8(GDP,Y2,P3M)=B(3,2)Y2+B(3,3)(GDP/P3M)^{B(3,4)} \quad \text{(A-8)}$$

9. 3M Sector Employment Function(L3M)

$$L3M=F9(Y3M,P3M,K3M,SL3M)=(Y3M/B(3,5))^{(1/(b(3,6))}(K3M)^{(i/(b(3,6)-1))}/SL3M) \quad \text{(A-9)}$$

10. 3M Sector Wage Rate Function(W3M)

$$W3M=F10(Y3M,P3M,L3M,SL3M)=B(3,6)P3MY3M/L3M/SL3M \quad \text{(A-10)}$$

11. 3M Sector Interest Rate Function(R3M)

$$R3M=F11(Y3M,P3M,K3M)=(1-B(3,6))P3MY3M/K3M \quad \text{(A-11)}$$

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

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

12. Definition of 3S Sector Employment(L3S)

L3S=LU-L2-L3M (A-12)

13. 3S Sector Production Function(Y3S)

Y3S=F13(L3S)=B(4,1)L3S (A-13)

14. 3S Sector output Price Function(P3S)

$P3S=F14(GDP,Y3S)=(GDP)/(Y3S/B(4,2))^{(1/B(4,3))}$ (A-14)

15. 3S Sector Wage Rate Function(W3S)

W3S=F15(P3S)=B(4,1)P3S (A-15)

B(4,1)=3.6:B(4,2)=3.6:B(4,3)=0.7

(GDP)

16. GDP Definition(GDP)

GDP = F16(P1,Y1,P2,Y2,P3M,Y3M,P3S,Y3S)
= P1Y1+P2Y2+P3MY3M+P3SY3S (A-16)

(Urban Sector)

17. Definition of Urban Population (LU)

LU= L - L1 (A-17)

18. Definition of Urban Cost-of-living Index(PU)

PU=F21(P1,Y1,P2,Y2,P3M,Y3M,P3S,Y3S)=(B(5,1)P1Y1+B(5,2)P2Y2
+B(5,3)P3MY3M+(1-B(5,1)-B(5,2)-B(5,3))P3SY3S)/(B(5,1)Y1+
+B(5,2)Y2+B(5,3)Y3M+(1-B(5,1)-B(5,2)-B(5,3))Y3S) (A-18)

19. Harris-Todaro Wage Rate Arbitrage Equation(W1)

W1=F22(W2,W3M,W3S,P1,PU,L2,L3M,L3S)
=(W2L2+W3ML3M+W3SL3S)/LU*P1/PU (A-19)

20. Definition of Employment in Urban Informal Sector(LINF)

LINF = L3M +L3S (A-20)

21. Definition of Wage Rate in Urban Informal Sector(WINF)

WINF = (W3ML3M + W3SL3S)/LINF (A-21)

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

D = WINF/PU - W1/P1 (A-22)

B(5,1)=0.4:B(5,2)=0.1:B(5,3)=0.2

(Supply of Fund)

23. Supply of Fund Function(TD)

$TD = B(6,2)(R2)^{B(6,3)}$ (A-23)

24. Supply of Fund to Second Sector(K2)

$K2 = F17(TD) = (1-B(6,1))TD$ (A-24)

25. Supply of Fund to 3M Sector(K3M)

$K3M = AS - K2$ (A-25)

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

(Labor Skill)

26. Definition of Labor Force With High Skill(LSH)

$LSH = B(7,1)L$ (A-26)

27. Definition of Labor Force With Medium Skill(LSM)

$LSM = B(7,2)L$ (A-27)

28. Definition of Labor Force With Low Skill(LSL)

$LSL = (1-B(7,1)-B(7,2))L$ (A-28)

29. Definition of Labor Skill in Second Sector(SL2)

$$SL2 = \Pi(LSH-L2) + \Pi(L2-LSH)(\Pi(L2-LSH-LSM)(LSH+B(7,3)LSM+B(7,4)(L2-LSH-LSM)) + \Pi(LSH+LSM-L2)(LSH+B(7,3)(L2-LSH)) \quad (A-29)$$

30. Definition of Labor Skill in 3M Sector(SL3M)

$$SL3M = (LSH-L2)\Pi(LSH-L2) + B(7,3)(L2+L3M-LSH)\Pi(LSH+LSM-L2-L3M) + (B(7,3)(LSH+LSM-L2) + B(7,4)(L2+L3M-LSH-LSM)\Pi(L2+L3M-LSH-LSM) \quad (A-30)$$

31. Definition of Labor Skill in 3S Sector(SL3S)

$$SL3S = B(7,4)\Pi(L1+L2-LSH-LSM) + \Pi(LSH+LSM-L2-L3M)(B(7,3)(LSH+LSM-L2-L3M) + B(7,4)(L2+L3M+L3S-LSH-LSM)) \quad (A-31)$$

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

(Wage Rates of Labor Force With Different Skills)

32. Wage Rate of Labor Force With High Skill(WLSH)

$$WLSH = \Pi(L2-LSH)W2 + \Pi(LSH-L2)(W2L2+W3M(LSH-L2))/LSH \quad (A-32)$$

33. Wage Rate of Labor Force With Low Skill(WLSM)

$$WLSM = \Pi(LSH-L2-L3M)W3S + \Pi(L2+L3M-LSH)(W3M(LSH-L2-L3M) + W3S(LSH+LSM-L2-L3M))/LSM \quad (A-33)$$

34. Definition of Average Wage Rate(AVW)

$$AVW = (W1L1+W2L2+W3ML3M+W3SL3S)/L \quad (A-34)$$

35. Wage Rate of Labor With Low Skill(WLSL)

$$WLSL = (AVW*L-WLSH*LSH-WLSM*LSM)/LSL \quad (A-35)$$

36. Coefficient of Variation of Wage Rate(CVW)

$$CVW=SQR(((W1-AVW)^2*L1+(W2-AVW)^2*L2+(W3M-AVW)^2*L3M1+(W3S-AVW)^2*L3S)/L)/AVW \quad (A-36)$$

37. Urban Unemployment Equivalent(UUEMP)

$$UUEMP=(WINF-W3S)/WINF*L3S \quad (A-37)$$

38. Urban Unemployment Rate (RUEMP)

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

The symbol(Π) implies a step function. The suffix(1,2,3M,3S,U,INF) indicate 1(rural),2(second: urban formal sector),3M and 3S(two urban informal sector).Y1、Y2、Y3m, Y3S indicate the real output of each sector, and GDP shows the nominal GDP. L1、L2、L3M ,L3S indicate the employment of each sector. LU,LINF,L indicate the labor in urban, urban informal sector and total labor force. k2、k3M are capital stocks in 2nd and 3M sectors.W1、W2,W3M,W3S,WINFare wage rates in each sector.P1,P2,P3M,P3S are output price of each sector, while PU is the cost-of-living index in urban sector.R2,R3Mare interest rates for 2nd and 3M sectors. TD and AS are investment fund for 2nd sector and total amount. T implies the social insurance payment with wage in the formal sector.(7) When four exogenous variables (P1,P2,AS,L) are given, then the model solves 36 endogenous variables(Y1,Y2,Y3M,Y3S,GDP,P3M,P3S,PU,L1,L2,L3M,L3S,LU,LINF,K2,K3M,W1,W2,W3M,W3S,WINF,TD,R2,R3M,D,LSH,LSM,LSL,SL2,SL3M,SL3S,WLSH,WLSM,WLSL,AVW,CVW). But 11 endogenous variables (after D) do not exert any repercussions to other variables, so 25 variables are first decided in a simultaneous matter. The model contains in total 29 parameters. So 33 different simulations are possible by changing 4 exogenous variables and 29 parameters.

The original features of this model are: (1) two subdivision of informal sector, and specification of four sectors model, (2) specification of demand and supply equations for each sector, (3) introduction of various labor skills into production function, (4) specification of different skill distribution, (5) refinement of Harris-Todaro formula by explicit consideration of urban cost-of-living. The past models can be considered as a reduced version of this model. For example, the formal and informal sectors in Chaudhuri's model (1989),Nakanishi's model (1991),Gupta's model (1993), Kelly's model (1994) correspond to 2- and 3M-sectors in my model. Based on the residual character of informal sector, 3S employment (A-12)

assures the automatic employment of low skilled labor. Bodart-Dem's model (1996) stressed the residual character, so his formulation is near to the specification of 3S-sector in my model. Ghate (1992) noted that the nature of the credit market is not completely separated between formal and informal sectors, but is rather continuous. Our specification of three urban subsectors may be useful to avoid the complete separation of credit market.

There are some additional remarks:
(1) If 3M-sector shares a same technology with the formal 2-sector, the going concern of 3M-sector is guaranteed even with a lower price(P_{3M}) , because it does not incur the tax and social security burdens.

$$(1-t)*P_2Y_2 = W_2+K_2*F_2'(K_2) \qquad \text{(2-sector wage) (A-4)}$$

$$P_{3M}Y_{3M} = W_{3M} + K_{3M}*F_2'(K_{3M}) \qquad \text{(3M-sector wage) (A-10)}$$

(2) Devajaran-Ghanem-Thierfelder (1997) introduced the concepts of active and passive unions, and the sectoral wage is distorted by the relative strength of labor union. He compared that the labor union in Indonesia is relatively weak compared with Bangladesh, so the trade liberalization would benefit more workers than the minimum wage policy. In this model, I tentatively neglect the wage distortion set by the labor union.
(3) The urban-rural misery gaps defined by equation (24). But the sign is not determined a priori.

$$D = (W_{inf}/P_0)-(W_1/P_1) \quad <=> \quad 0$$

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

4. Simulation Experiments

The initial values of four exogenous variables are set as follows:
L (total labor) =800 : P1 (rural output price) =1.0 : P2 (2nd sector output price) =1.7: AS(total monetary fund) =1260

The standard constellation of variables represents a typical situation of an urban area surrounded by rural area in a developing countries. The nominal average labor productivity in formal sector(1.80) is about the doubled

compared with the one in rural sector(0.96), and also in urban informal sectors. So in the urban area, the informal sector occupies 85.34 % of employment, and 73.62% of GDP.

No.	(1)Real GDP		(2)NOMINAL GDP		(%)	(3)EMOPLOYMENT(%)		(4)(2)/(3)
1	Y1	599.78	P1Y1	599.78	23.91	198.65	24.83	0.9629
2	Y2	296.10	P2Y2	503.37	20.07	88.81	11.10	1.8081
3M	Y3M	419.53	P3MY3M	641.88	25.58	200.52	25.06	1.0207
3S	Y3S	1138.61	P3SY3S	786.77	30.41	312.00	39.00	0.7797
SUM	GDP	---	---	2505.10	100.00	800.00	100.00	1.0000

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

(Case－1) Increase of total investment fund (AS + 10)
(Case－2) Increase of total labor force (L+ 10)
(Case－3) Increase of wage tax for second sector(T + 0.01)
(Case－4) Output price of rural sector up(P1 + 0.01)
(Case－5) Output price of second sector up(P2 + 0.01)
(Case－6) Productivity of rural sector up(B(1,1) + 0.1)
(Case－7) Productivity of second sector up(B(2,3) + 0.1)
(Case－8) Productivity of 3M sector up(B(3,5) + 0.1)
(Case－9) Productivity of 3S sector up(B(4,1) + 0.1)
(Case－10) Increase of foreign demand(B(2,2) + 5)
(Case－11) Minimum wage policy (W3M = 3.1)
(Case－12) Wage subsidy policy(W3S = W3S + 0.1)
(Case－13) Share of high skill labor up (SLH + 0.03)
(Case－14) Share of high & medium skill labor up (SLH+0.03, SLM+0.05)
(Case－15) Interest rate subsidy to sector-2 (R2=0.12)
(Case－16) Wage subsidy to sector-2 (W2=3.8)
(Case- 17) Reserve ratio up (B(6,1)=0.05 up)

The results of these simulations are compiled in the following tables. The number of first column shows the value of variable in the base case. The other figures under the headings of cases show the percent change of variable

from the base value.

Name	Base	Case(1)	Case(2)	Case(3)	Case(4)	Case(5)
Y1	599.78	-0.29	0.97	0.52	0.74	-0.38
Y2	296.10	-0.69	-0.41	0.84	2.48	-1.58
Y3M	419.53	-0.69	-0.41	0.84	2.46	-1.58
Y3S	1138.61	1.37	2.98	-1.40	-3.48	2.15
GDP	2505.10	-0.81	-0.49	1.00	2.92	-1.18
P1	1.000	0.00	0.00	0.00	1.00	0.00
P2	1.700	0.00	0.00	0.00	0.00	0.58
P3M	1.530	0.00	0.00	0.00	0.00	0.58
P3S	0.691	-2.72	-4.58	3.05	8.26	-4.14
PU	0.944	-1.24	-2.06	1.36	4.00	-1.80
L1	198.65	-0.37	1.22	0.65	0.93	-0.47
L2	88.81	-1.06	-0.69	1.29	3.80	-2.38
L3M	200.52	-1.29	-0.56	0.96	2.81	-1.82
L3S	312.00	1.37	2.98	-1.40	-3.48	2.15
LU	601.34	0.12	1.26	-0.21	-0.31	0.15
L	800.00	0.00	1.25	0.00	0.00	0.00
LINF	512.52	0.32	1.59	-0.47	-1.02	0.59
K2	1036.63	0.07	0.04	-0.09	-0.27	0.11
K3M	223.36	4.11	-0.21	0.43	1.26	-0.52
W1	3.019	0.07	-0.24	-0.13	0.81	0.09
W2	3.605	0.32	0.19	-1.49	-1.12	1.31
W3M	3.081	0.52	0.02	-0.04	-0.13	0.70
W3S	2.488	-2.72	-4.58	3.05	8.26	-4.14
WINF	2.720	-1.44	-2.76	1.78	4.75	-2.24
TD	1091.19	0.07	0.04	-0.09	-0.27	0.11
R2	0.146	-0.77	-0.46	0.94	2.75	-1.11
R3M	0.289	-4.61	-0.20	0.41	1.20	-0.47
AS	1260.00	0.79	0.00	0.00	0.00	0.00
D	-0.138	5.82	9.43	-11.45	-19.09	11.40
LSH	72.00	0.00	1.25	0.00	0.00	0.00
LSM	184.00	0.00	1.25	0.00	0.00	0.00

LSL	544.00	0.00	1.25	0.00	0.00	0.00
SL2	0.991	0.04	0.08	-0.05	-0.15	0.10
SL3M	0.942	0.08	0.12	-0.07	-0.20	0.13
SL3S	0.900	0.00	0.00	0.00	0.00	0.00
WLSH	3.605	0.32	0.19	-1.49	-1.12	1.31
WLSM	3.129	0.42	-0.11	-0.10	0.04	0.56
WLSL	2.718	-1.55	-2.76	1.69	4.93	-2.40
AVW	2.892	-0.85	-1.77	0.88	3.04	-1.25
CVW	0.126	10.49	16.01	-13.10	-27.77	17.43
UUEMP	43,651	13.15	21.13	-14.40	-33.55	20.55
RUEMP	0.073	13.01	19.63	-14.21	-33.34	20.36

(note) D<0, so the rate of change is positive when D decreases.

Name	Case-6	Case-7	Case-8	Case-9	Case-10	Case-11
Y1	1.96	-0.59	-0.30	-1.39	-0.26	-0.52
Y2	3.11	-1.38	-0.73	-2.92	3.64	-0.82
Y3M	3.09	-1.37	-0.72	-2.90	3.53	-0.81
Y3S	-4.73	2.80	1.42	5.94	-3.97	1.37
GDP	3.66	-1.62	-0.85	-3.43	3.06	-0.97
P1	0.00	0.00	0.00	0.00	0.00	0.00
P2	0.00	0.00	0.00	0.00	0.00	0.00
P3M	0.00	0.00	0.00	0.00	0.00	0.00
P3S	11.07	-5.43	-2.84	-11.06	9.19	-2.87
PU	4.82	-2.49	-1.29	-5.20	4.11	-1.31
L1	1.73	-0.74	-0.37	-1.73	-0.33	-0.65
L2	4.77	-4.48	-1.11	-4.41	5.60	-1.25
L3M	3.53	-1.62	-1.35	-3.30	4.03	-0.93
L3S	-4.73	2.80	1.42	4.48	-3.97	1.37
LU	-0.57	0.24	0.12	0.57	0.11	0.21
L	0.00	0.00	0.00	0.00	0.00	0.00
LINF	-1.49	1.06	0.33	1.43	-0.84	0.46
K2	-0.34	0.15	0.08	0.33	-0.39	0.09
K3M	1.57	-0.72	-0.37	-1.52	1.84	-0.42
W1	0.23	0.14	0.07	0.34	0.06	0.12
W2	-1.40	3.05	0.34	1.37	-1.64	0.38

W3M	-0.16	0.07	0.54	0.15	-0.18	0.62
W3S	11.07	-5.43	-2.84	-9.82	9.19	-2.87
WINF	6.32	-3.27	-1.50	-5.97	5.29	-1.46
TD	-0.34	0.15	0.08	0.33	-0.39	0.09
R2	3.46	-1.53	-0.81	-3.23	4.05	-0.91
R3M	1.50	-0.66	-0.34	-1.41	1.67	-0.40
AS	0.00	0.00	0.00	0.00	0.00	0.00
D	-24.76	19.68	6.07	24.27	-21.93	5.88
LSH	0.00	0.00	0.00	0.00	0.00	0.00
LSM	0.00	0.00	0.00	0.00	0.00	0.00
LSL	0.00	0.00	0.00	0.00	0.00	0.00
SL2	-0.18	0.19	0.04	0.18	-0.21	0.05
SL3M	-0.26	0.18	0.08	0.25	-0.29	0.07
SL3S	0.00	0.00	0.00	0.00	0.00	0.00
WLSH	-1.40	3.05	0.34	1.37	-1.64	0.38
WLSM	0.05	-0.05	0.43	-0.10	0.06	0.49
WLSL	6.19	-3.21	-1.62	-5.79	5.14	-1.60
AVW	3.81	-1.72	-0.89	-3.57	3.12	-0.85
CVW	-36.31	24.49	10.93	38.19	-31.56	11.17
UUEMP	-45.69	26.64	13.69	46.17	-38.74	14.02
RUEMP	-45.38	26.33	13.55	45.33	-38.81	13.78

Name	Case-12	Case-13	Case-14	Case-15	Case-16	Case-17
Y1	-5.45	0.40	0.46	0.58	-2.01	-1.10
Y2	-7.51	0.12	0.11	1.36	-2.95	-2.48
Y3M	-7.48	0.12	0.10	1.35	-2.94	-2.47
Y3S	12.97	0.38	0.48	-2.63	4.66	4.65
GDP	-8.84	0.14	0.13	1.60	-3.53	-2.92
P1	0.00	0.00	0.00	0.00	0.00	0.00
P2	0.00	0.00	0.00	0.00	0.00	0.00
P3M	0.00	0.00	0.00	0.00	0.00	0.00
P3S	-23.39	-0.41	-0.55	5.54	-10.79	-10.16
PU	-11.69	-0.17	-0.24	2.45	-4.80	-4.50
L1	-6.76	0.50	0.57	0.72	-2.52	-1.38
L2	-11.25	-0.77	-0.79	1.42	-4.52	-1.88

L3M	-8.49	-0.76	-0.97	2.74	-3.36	-5.72
L3S	12.97	0.36	0.48	-2.63	4.66	4.65
LU	2.23	-0.16	-0.19	-0.24	0.80	0.45
L	0.00	0.00	0.00	0.00	0.00	0.00
LINF	4.57	-0.06	-0.08	-0.52	1.67	0.84
K2	0.87	-0.01	-0.01	1.95	0.32	-5.90
K3M	-4.04	0.06	0.05	-9.09	-1.51	20.55
W1	1.39	-0.10	-0.11	-0.14	0.45	0.27
W2	3.67	-0.05	-0.05	0.00	5.13	-0.67
W3M	0.41	-0.00	-0.00	-1.20	0.16	2.78
W3S	-19.37	-0.41	-0.55	5.54	-10.79	-10.16
WINF	-12.56	-0.29	-0.39	2.75	-6.31	-4.91
TD	0.87	-0.01	-0.01	1.95	0.32	-0.32
R2	-8.31	0.13	0.12	-17.63	-3.26	3.22
R3M	-3.62	0.05	0.05	11.52	-1.51	-28.96
AS	0.00	0.00	0.00	0.00	0.00	0.00
D	50.95	0.23	0.62	-9.15	28.34	12.31
LSH	0.00	33.33	33.33	0.00	0.00	0.00
LSM	0.00	0.00	21.73	0.00	0.00	0.00
LSL	0.00	-4.41	-11.76	0.00	0.00	0.00
SL2	0.51	0.95	0.95	-0.05	0.18	0.07
SL3M	0.70	0.90	1.09	-0.15	0.25	0.29
SL3S	0.00	0.00	0.59	0.00	0.00	0.00
WLSH	3.67	-1.24	-1.24	0.00	5.13	-0.67
WLSM	-0.36	-2.25	-5.00	-0.95	0.24	2.32
WLSL	-12.52	-0.65	-0.37	3.00	-6.11	-5.75
AVW	-7.67	-0.22	-0.28	1.68	-3.11	-3.05
CVW	83.78	1.14	1.65	-18.48	31.27	26.46
UUEMP	100.935	1.54	2.17	-25.40	33.16	31.74
RUEMP	96.541	1.71	2.36	-25.22	32.61	31.43

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

(a) Sectoral development pattern. When GDP increases, the sectoral output is usually expected to increase. But the different patterns emerged in experiments. (1) But only in two cases (13,14), all sectoral output change parallel with GDP, and (2) in most cases (1,3,4,5,6,7,8,9,11, 12,15,16,17), the output of 1st,2nd and 3M sectors change in the same direction with GDP, while the one of 3S sector changes inversely. (2) In two cases (2,10), only 2 and 3M sectors change with GDP, while 1st and 3S sectors change inversely. Two cases (13,14) are special cases of wage subsidization. So the general conclusion is that 2nd and 3M sectors change in parallel and 3S sectors changes inversely with GDP, while 1st(rural) sector changes in a mixed way. It implies that when GDP grows, 3S sector would shrink accordingly.

(b) Backwash effect. The increase of GDP is expected to increase the welfare of the labor group by increasing employment and wage rate.When a welfare loss happens for certain groups, this phenomenon is called as the backwash effect (to relevant groups).The welfare loss can be measured by the decrease of wage rate of relevant labor group.We are especially interested in an inverse relation ship between GDP and average wage rate of informal sector (WINF).The changes of GDP and WINF were parallel (or of same signs) in most of the cases, except two cases (13,14) of institutional wage subsidy . So generally the informal sector group is benefited by the increase of GDP.

(c) Immiserizing minimum wage policy. In case (11) or case (16), the wage rate of 3M or of 2nd sector was kept at a higher level than standard case based on the enforced minimum wage policy. This resulted in (1) increase of wage rate in 2nd and 3M sectors, while ones in 3S and average informal sector decreased, and (2) the employment of 2nd and 3M sectors decreased while the one of 3S sector and total urban employment increased. A similar tendency was observed in case (12), where the wage rate in 3S sector was subsidized over the market wage rate. So the results of these experiments imply that the direct welfare policies to maintain a higher than market wage rate result in the decreases of GDP and of employment of targeted labor group, so does not increase

the welfare of the target group.

(d) Depolarization effect of interest rate subsidy to the formal sector. It results in the increase (decrease) of capital fund to 2nd (3M) sector, so the increase (decrease) of capital stock. It induces the increase (decrease) of wage in 2nd (3M)sector. The total effects in result in the increase of employment and output in 2nd and 3M sectors, and of GDP, while the employment and output of 3S sector decrease. As a whole, it results in the increase of average level and the decrease of coefficient of variation of urban wage. The decrease of the reserve ratio shows similar effects. So the elimination of financial repression or the financial sector development and the resulted lower interest rate would improve the wage distribution in urban areas.

(e) Inverse direction of changes of informal sector wage (WINF) and urban unemployment equivalent(UUEMP). Except only case(1) urban unemployment equivalent (UUEMP) increases(decreases) when informal sector wage (WINF) decreases (increases). So these two indices are generally interpreted as similar indices of informal sector employment conditions. In case 1, the increase of investment fund resulted in adoption of capital-using and labor-saving technology, and increased wage level while the labor demand decreased.

(f) Pushing-down effect. Two experiments, case.13(increase of share of high skill labor) and case.14(increase of shares of high and medium skill labors) showed that :(1) the employment in formal (L2) and 3M sectors decreased, and the employment in 3S sector increased, while the urban employment as a whole decreased, and (2) the price of 3S product and urban price decreased because of increased supply, and (3) the wage rate of every labor group decreased. Before these experiments, the number of formal employment exceeded the number of high skill labor, so the high skilled labor was totally employed in formal sector. But after increasing the share of high skilled labor, the formal sector could not absorb all the high skilled labor, so a part of it had to work in 3M sector. Thus the dissemination of higher education resulted in the deterioration of welfare of all the labor groups. So the

pushing-down effect happened.[6]
Sometimes it is claimed that the minimum wage restriction exerts a disemployment effect (Agenor,1996,p.280), but in case (12) the wage subsidy for 3S-sector resulted in the increase of 3S-sector employment.

(g) Subsidy for primary product (price). Deaton (1989) analyzed the impact of rice price on income distribution in Thailand taking into account the different production and consumption patters of rice in urban and rural areas, and concluded that the distributional impacts of higher rice price is very minor, so that "no support for keeping prices artificially low"(p.23).In Indonesia, the rice output quickly increased from 11,666 (1968) to 25,825 (1984, thousand tons), and achieved the target of trend-self-sufficiency, but through a subsidized higher than international price. Dick (1985, p.26) noted that the falling rice price would benefit the poor urban as well as rural households, so "is completely in accordance with the historical mission of agriculture as set out in development texts: by raising productivity and reducing the real price of food and raw materials, income and employment are stimulated in other sectors of the economy". The result of experiment(4) shows the decreases of the employment and output of 3S sector, and in harmony with this observation.

(g) Inverse relation between average wage level(AVW) and coefficient of variation (CVW) is observed in all experiments. It suggests the trade-off between growth and equality among the wage earners.

(h) A parallel relation is observed between the informal sector wage and the real wage gap (D), except experiment (3). So the increase of informal sector wage also generally implies a relative improvement of the standard-of-living of urban informal sector compared with the rural sector.

5. Summary and Conclusions.

The several experiments by the simulation model clarified various interesting effects. The reaction of sectoral employment and output to an

exogenous shock was quite different among four sectors. In general, the welfare of the informal sector (employment and wage level) can be improved by the overall economic growth (increase of GDP) and the financial sector development. But the direct development policies targeted to as specific sector like productivity increase or wage subsidy policies could not achieve the set target, and enlarge the wage and productivity gaps between sectors. So the general policy guideline for informal sector development is not the specific direct policies, but the indirect development policy of informal sector through further expansion of formal sector and financial development. Naturally these conclusions heavily depend on the specification of four sector and their interactions. There are two different possibilities for future tasks. One is the generalization of model specification by further subdivision of relations. Another one is an empirical study based on the actual situation of each developing country, because there are many idiosyncratic features in informal sector in different countries.

I note some additional points relevant to the further expansion of the current model.

(1) Different specifications of formal and informal sector. A possibility is by the institutional or legal distinction (corporate and incorporate business), and another by with and without the registration(protected or unprotected). The model by the former one will resemble with the model of dual structure, while the model based on the latter notion will resemble to legal and illegal markets model. I neglected many relevant features of black market model in this paper (see for example, Bevan-Collier-Gunning (1989, p.1958),"the black market does not clear").

(2) Different specifications of dual development. Imaoka proposed another concept of "dual-industrial growth" by emphasizing the coexistence of consumption-goods-export sector and heavily-protected-capital-goods sector, which supplies the intermediate and capital goods to export sector (see for example, formulation by Kubo (1989). In this paper, the formal 2-sector is assumed to be internationally competitive, and an informal 3M-sector is partially connected with 2-sector through a subcontracting relation. But 3M-sector also serves for other purposes (mainly for domestic demand).

Different specifications (complementarity or substitutability) between products of 2-sector and 3M-sector induce different policy conclusions. Especially the validity of direct welfare policy of informal sector depends on this specification. In some cases, like the experiments (11) and (12), the wage subsidy policy for informal sector exerts a deteriorating effects to informal sector as a whole.

(3) Extension of the model to nonemployment. The informal sector issue is not genuine to developing countries. For example, Murphy-Topel (1997) noted that in U.S.A, the rate of nonemployment (unemployed plus discouraged out-of-labor force people) increased steadily from 6 to 13 per cent in 1970-90 while the rate of unemployed stayed almost constant as 3-4 per cent. If we interpret the unemployed and discouraged people as explicit and implicit waiting pool for formal employment, we can say that there two (formal and informal) working status and accompanying markets also in the developed countries. The proper handling of nonemployment issue necessitates the formal modeling work which can be an extension of informal sector model.

(4) Integration with interindustry wage differentials. When wage level largely differs among different industries suggested by Gatia-Mizala-Romaguera (1995) for U.S.A and discussed by Beladi-Naqvi (1987), we do need to extend the current modeling of informal sector, in which the wage differential mainly came from the different firm scale or different skills of workers.

Many further problems remain: the interconnection with the household production model by Maruyama (1994,1996),the introduction of rural informal sector emphasized by Torii(1979), the combination with the time allocation model like Juster-et-al(1991), the integration with household-producer combined model by Maruyama(1984), the specification of independent workers in the informal sector, and the introduction of public sector.[8] In some countries, the formation of urban informal sector is partly accelerated by ethnic factor. In Peru, the indigenous population occupies 25-40 per cent, and its share in each sector was agriculture (50.1), public (12.9), private (21.9) and independent workers (15.1), while non-indigenous groups occupies relatively high shares in non-agricultural activities (MacIssac-Patrinos,1995).

Many countries confront with the trade-off between employment and growth (see Eriksson,1997). Then many developing countries confront with a difficult pair of development targets: (i) Balance-of-payment target or improvement of international competitiveness and export promotion of non-traditional goods, and (ii) welfare target, that is, the creation of sufficient number of employment opportunities, and of higher wages. There is a trade-off, because (a) in many occasions the former requires the adoption of labor-saving technology, so the export promotion suppresses the employment creation, and (b) the increase of wage level suppresses the international competitiveness.[9] The optimum wage level and the desirable factor proportions can be discussed only with a sufficient understanding of plural structure of developing countries.[10] Until now, the most of the study of labor market like Agenor(1996) based on two-sector (rural and formal) setting. The specification of informal sector and inclusion into the total framework would greatly enhance the analytical capability of the labor market model to discuss these basic issues with the proper background of realities of developing countries.

Technical notes:

(1) In Latin American countries "the size criterion yields a smaller informal sector than the benefit criterion does" (Marcouiller-Castilla-Woodruff,1997, p.369) .

(2) The concept of underground economy can be wider than informal sector. The agents in informal sector wants the tax evasion. But the agents in underground economy may have more aggressive incentive like drug transaction.

(3) United Nations' Regional Employment Program for Latin America (PREALC, 1987) estimated 60%(Bogota, including workers not covered by social security), 40% (Peru), 28% (Mexico, Colombia), 23% (Argentina), 20% (Venezuela). Ghate (1992) noted that the share of informal credit market in Asian countries is 38-76 per cent.

(4) Stark (1984) discussed a relative deprivation approach in detail.

(5) So the definition of first, second,3M and 3S sectors are different from the traditional nomination of primary, secondary and tertiary sectors.

(6) In a sense, the existence of pushing down effect implies an

overinvestment in education. In our setting, the production function of second sector is linear homogeneous in physical labor and capital, while the increase of labor skill causes an additional increase of output. An alternative setting is to assume the economy of specialization by educational investment. Kuroda (1997) showed a model of urbanization with higher education, in which a part of the people joined from rural area obtains the higher education, and exerts an economy of specialization. Such a model assumes perfect foresight, and people stops the educational investment beyond a certain limit, so the pushing down effect never happen.
(7) Hoddinott (1996) discussed the Shapiro-Stiglitz's effect that the wage must be higher in a big city to prevent the shirking of workers in African labor market. Basically I treat one-city model, so such an effect when it may exist, is absorbed in one of the parameters.
(8) Bodart-Dem's model(1996) consists of three sectors(urban formal, urban informal, public sectors) for Cote d'Ivoire. Agenor (1996) gave a survey of size and importance of public sector employment as "employer of last resort"(p.270).
(9) Riveros(1992) showed the export-suppressing effect of wage increase based on 20 less-developed countries.
(10) Horowitz(1974) tested the optimum wage in India. Hill-Phillips(1997) discussed the factor proportions in East Asian countries.

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