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A THEORY OF TWO-TIER INTERLINKAGE IN THE AGRICULTURAL CREDIT MARKET: COMMENTS

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Abstract: In the Keio Economic Studies, Volume XXX, No. 2, 1993, Gupta presented a theory of co-existence of interlinked credit-labour contract and interlinked credit-product contract in backward agriculture using the consumption efficiency hypothesis' of Leibenstein (1957). In this paper, we present an alternative theory of the two-tier interlinkage in terms of credit market imperfection. This paper also shows that product market imperfection, alone or coupled with credit market imperfection, may not be able to explain this type of interlinkage.

1. INTRODUCTION

One of the important empirical findings of the village survey reports of Bardhan and Rudra (1978) and Rudra (1982) is the existence of different types of interlinked contracts in many villages of India. Credit-product interlinkage and credit-labour interlinkage are only two examples of such interlinkages. In a credit-labour interlinkage, an agricultural land-less worker takes a loan from his employer to finance his consumption in the lean season against the commitment of labour service to render for the employer in the peak season. There are three explanations available in the literature explaining this type of interlinkage. Bardhan (1984) and Basu (1983, 1987) have explained the existence of credit-labour interlinkage in terms of employer's risk hypothesis and lender's risk hypothesis, respectively while Gupta (1987) has explained it in terms of "Consumption Efficiency Hypothesis" (CEH). On the other hand in a credit-product interlinkage the producer (farmer) takes a loan from the trader to whom he is bound to sell at least a part of his output. There are a few theoretical papers in the literature, which explain this type of interlinkage. Gangopadhyay and Sengupta (1987) and Chaudhuri and Gupta (1995a) have explained the optimality of the trader-farmer interlinkage in terms of credit market imperfections. On the contrary, Chaudhuri and Gupta (1995b), Fabella (1992) and Chaudhuri (1996a) have explained the existence of this type of interlinkage in terms of product market imperfections or price uncertainty in the product market.

However, in reality it is often found that the famer (producer) takes a loan from the trader with the commitment that he will sell at least a part of his product to the latter and then uses the loan in giving consumption loan to the workers against commitment of getting labour services from them in the peak season. So the same employer-cum-producer is on the one hand involved in interlinked credit-labour contract, and on the other hand, involved in interlinked credit-product contract. This, we call a two-tier interlinkage because the same producer uses production loans obtained from the trader to extend credit to his workers, and thus acts as financial intermediary. Such inter-mediation happens to be the basis of the two-tier interlinkage. The empirical support of the co-existence of the two types of contracts is available in section 2 of Gupta (1993) paper.

Gupta (1993) explained the co-existence of the two types of contracts in backward agriculture using the CEH of Leibenstein (1957). The CEH states that the nutritional efficiency of the worker is a positive function of his level of consumption. The existing literature[1] on CEH considers a one-period world and hence assumes an instantaneous relationship between the level of consumption of the worker and his efficiency. However, it is more plausible to consider that the level of consumption of a worker in a particular period influences his nutritional efficiency more in the future than in the current period. It is this lagged relationship that explains the long-term labour contracts to be advantageous over the short-term labour contracts from the employer's point of view and also the wage in a long-term labour contract to be higher than that in a short-term labour contract.[2] Although the relevance of the CEH has been questioned by many economists, notably by Rosenzweig (1988), however, it appears that the criticisms are more appropriate to the one-period models than the two-period model of Gupta (1993) where there is a one period lag between the worker's consumption level and his nutritional efficiency which is closer to reality. We in this paper, however, provide an alternative theory of the two-tier interlinkage in terms of credit market imperfections. The paper also shows that the two-tier interlinkage cannot be explained in terms of product market imperfections alone.

2. THE MODEL

Let us consider a backward monetised agricultural economy consisting of a finite number of landless workers, a landlord-cum-capitalist farmer, a grain merchant (trader) and a moneylender. An agricultural worker works only in the peak season but consumes both in the lean and the peak seasons. So he has to take a loan either from the moneylender or from the landlord-cum-capitalist farmer[3] to finance his consumption in the lean season. If he takes a loan from the moneylender, he is free to sell his labour services in the labour market in the peak season. This is called a non-interlinked credit-labour contract (NICLC). But if he takes his consumption loan from the farmer, he is bound to sell his labour services to the latter at a pre-contracted wage rate. This is called an interlinked credit-labour contract (ICLC).

The landlord-cum-capitalist farmer, on the other hand, can lend his own funds or

[1] See for xample, Leibenstein (1957), Stiglitz (1976), Bliss and Stern (1978), Dasgupta and Ray (1986).

[2] See Bliss and Stern (1978), page 361.

[3] The traders in the rural society do not generally advance loans to the agricultural workers.

borrow funds from the trader to re-lend it to the land-less workers. In the former case, he is free to sell his product directly in the free market. This is called a non-interlinked credit-product contract (NICPC). But in the latter case, he is bound to sell at least a part of his product to the trader at a pre-contracted price. This is called an interlinked credit-product contract (ICPC).

Labour is the only input[4] of production. So $Q(L)$ with $Q'(L)>0$ and $Q''(L)<0$ is the production function. Any loan is paid back with interest after the crop-cycle.

2.1 *The Reservation Utility*

The reservation utility of the worker is derived from the NICLC. In an NICLC, the worker takes C_1 amount of loan from the moneylender at an interest rate, g per period to finance his consumption in the lean season. In the peak season selling his labour services he earns W amount of wage income. His inter-temporal utility function and the budget equation are respectively,

$$U=U(C_1, C_2) \tag{1}$$

and

$$C_2=W-(1+g)C_1 \tag{2}$$

where, C_2 is his consumption level in the peak season. $U(\cdot)$ is maximized with respect to C_1 and subject to equation (2). The first-order condition of maximization is given by

$$U_1=(1+g)\cdot U_2 \tag{3}$$

Solving equations (2) and (3) simultaneously, we get the optimum values of C_2 and C_1. Putting these values into (1), we get the indirect utility function of the worker derived from an NICLC as

$$U^*=U^*(W,g) \tag{4}$$

This indirect utility function plays the role of 'reservation utility' of the worker when the capitalist farmer offers him an ICLC.

2.2 The ICLC and NICPC

In this case the farmer gives consumption loan to the workers from his own funds or by borrowing from some source at an interest rate r_1 per period while his opportunity cost of loan is r per period. Here $r<g$. So the capitalist farmer has a better accessibility to the credit market than the workers. He hires labour at the wage rate W_1 per worker and sells his product directly to the open market at a price P_c per unit. The values of r_1 and W_1 are determined by the capitalist farmer. In this case equations (3) and (4) are replaced by

[4] One can introduce land as a specific input in the production function. The qualitative results of the model will remain unaltered.

$$U_1=(1+r)\cdot U_2 \tag{3.1}$$

$$U°=U°(W_1,r_1) \tag{4.1}$$

The worker will not accept an ICLC if the terms of the contract (W_1,r_1) fail to give him at least U^* level of utility. We, therefore, write the reservation utility constraint as

$$U^*(W,g)\leq U°(W_1,r_1) \tag{5}$$

The income of the capitalist farmer is now given by

$$Y_c=P_c\cdot Q(L)-W_1\cdot L+(r_1-r)\cdot C_1^{\circ}\cdot L \tag{6}$$

where, L is the number of labourers engaged in the production process and C_1° is the demand for consumption loan of each worker in the ICLC.

The farmer maximizes equation (6) with respect to r_1, W_1 and L and subject to the reservation utility constraint of each worker given by equation (5). The Lagrangian expression is given by

$$Z=P_c\cdot Q(L)-W_1\cdot L+(r_1-r)\cdot C_1^{\circ}\cdot L+\beta_1\cdot[U°(W_1,r_1)-U^*(W,g)] \tag{7}$$

where, β_1 is the Lagrangian multiplier and $\beta_1\geq 0\cdot Z(\cdot)$ is maximized with respect to r_1, W_1, L and β_1. Assuming interior solutions for the choice variables r_1 and W_1, from the first-order conditions we can prove[5] the following.

$$r_1=r \tag{8}$$

and

$$\beta_1>0 \tag{9}$$

The latter result together with the Kuhn-Tucker conditions $(\partial Z/\partial\beta_1)\geq 0$ and $(\partial Z/\partial\beta_1)\cdot\beta_1=0$, $\beta_1\geq 0$ implies that

$$U°(r_1, W_1)=U^*(W,g) \tag{10}$$

We have chosen a principal-agent framework with the capitalist farmer as the principal and the worker as the agent. The worker does not possess any bargaining power. Besides, this is also a transferable utility problem. So the principal is able to push the worker down to the latter's reservation utility level using the two control variables W_1 and r_1.

Maximizing (7) with respect to L and using (8) we get the following first-order condition.

$$P_c\cdot Q'(L)=W_1 \tag{11}$$

and its solution is

[5] These results have been proved in Appendix I.

$$L^{\circ}=L^{\circ}(P_c, W_1) \tag{12}$$

The optimum level of income of the capitalist farmer in the ICLC-NICPC case is given by

$$Y_c^{\circ}=P_c \cdot [Q(L^{\circ})-Q'(L^{\circ}) \cdot L^{\circ}] \tag{13}$$

Now we write the following two propositions obtained from equation (8) and (10) as

PROPOSITION 1. *In an ICLC-NICPC, the interest rate is equal to the opportunity cost of funds of the landlord-cum-capitalist farmer.*

PROPOSITION 2. *In an ICLC, the worker is pushed down to his reservation utility level.*

Now we make an important assumption which is very crucial for the subsequent analysis of the paper.

ASSUMPTION. *In any non-interlinked contract, an inter locker cannot be engaged in transactions in the credit market. The moneylender is the sole supplier of credit in this case.*

This assumption has been used implicitly by many authors in their papers, for example, Gangopadhyay and Sengupta (1987), Fabella (1992), Gangopadhyay (1994), Chaudhuri and Gupta (1995a), Chaudhuri (1996b), etc. Using this assumption we obtain the level of income of the capitalist farmer in an NICLC as

$$Y_c=P_c \cdot Q(L)-W \cdot L \tag{14}$$

The farmer hires labour from the labour market at the going wage rate W and carries out production activity. Y_c is maximized through a choice of L and the first-order condition of maximization is

$$P_c \cdot Q'(L)=W \tag{15}$$

So the VMP of labour is equal to its money wage rate in equilibrium. The optimum level of income of the farmer in the NICLC is given by

$$Y_c^{*}=P_c \cdot [Q(L^{*})-Q'(L^{*}) \cdot L^{*}] \tag{16}$$

where, L^* is the solution to equation (15).

Comparing (11) with (15) it is easy to check that $L^{\circ}>L^*$ and from (13) and (16) it then follows that $Y_c^{\circ}>Y_c^*$. This establishes the following proposition.

PROPOSITION 3. *The landlord-cum-capitalist farmer will prefer an ICLC to an NICLC.*

Let us now consider the case of the trader. Suppose that due to product market imperfections, the trader is able to receive a price P_T per unit of the crop sold in the open market and $P_T>P_c$ implies that the trader has a better accessibility to the open market than the farmer. In an NICPC, the trader can appropriate trade profits of the amount

$$Y_T^\circ=(P_T-P_c)\cdot Q(L^\circ) \tag{17}$$

In the NICLC case too, the trader can appropriate trade profits of the amount

$$Y_T^*=(P_T-P_c)\cdot Q(L^*) \tag{17.1}$$

In the NICPC and NICLC both, the trader purchases the crop from the capitalist farmer at a price P_c per unit and resells it in the open market at a price P_T per unit and appropriates[6] trade profits due to the existence of product market imperfections.

2.3 *The ICLC-ICPC*

We consider a Nash-bargaining game[7] between the trader and the capitalist farmer. If the trader and the farmer fail to reach an agreement, the disagreement pay-off is (Y_T°, Y_c°). Now their joint income is given by

$$J=P_T\cdot Q(L)-W_2\cdot L+(r_2-i)C_1\cdot L \tag{18}$$

where, W_2 and r_2 are the wage rate and the interest rate on the loan each worker faces and i is the opportunity cost of loan of the trader. We assume that due to imperfections in the credit market $i<r<g$. $J(\cdot)$ is maximized with respect to W_2, r_2 and L and subject to the reservation utility constraint of the worker, $U^{**}(W_2,r_2)\geq U^*(W,g)$. Maximizing $J(\cdot)$ with respect to W_2, r_2 and L and subject to $U^{**}(\cdot)\geq U^*(\cdot)$, we obtain the following results.

$$r_2=i \tag{8.1}$$

$$U^{**}(W_2,i)=U^*(W,g) \tag{10.1}$$

and,

$$P_T\cdot Q'(L)=W_2 \tag{11.1}$$

Since $r>i$ from (10) and (10.1) it follows that $W_1>W_2$. From (11) and (11.1) it then follows that $L^{**}>L^\circ$ since $P_T>P_c$, where L^{**} is the solution to (11.1). The optimum level of joint income of the trader and the capitalist farmer is given by

$$J^{**}=P_T[Q(L^{**})-Q'(L^{**})\cdot L^{**}] \tag{13.1}$$

Now using (13), (17) and (13.1) we can write

$$(J^{**}-Y_c^\circ-Y_T^\circ)=P_T\cdot[Q(L^{**})-Q'(L^{**})\cdot L^{**}]-[P_T\cdot Q(L^\circ)-P_c\cdot Q'(L^\circ)\cdot L^\circ] \tag{19}$$

[6] The capitalist farmer should be indifferent between selling the product either to the trader or to the open market because in both cases he receives a price P_c per unit of the product sold.

[7] In the case where a trader and a large capitalist farmer are engaged in the ICPC, a Nash bargaining framework between the two is appropriate to describe the power structure in the rural society.

3. ALTERNATIVE EXPLANATION OF THE TWO-TIER INTERLINKAGE

Suppose that there is no imperfection in the product market. However, the credit market is imperfect. So we have $P_c = P_T$ and $i<r<g$.

From (17) and (17.1) we have $Y_T^\circ = Y_T^* = 0$. Since $r>i$ from (10) and (10.1) it follows that $W_1 > W_2$ which in turn from (11) and (11.1) implies that $L^{**} > L^\circ$. From (19) we can now write: $(J^{**} - Y_c^\circ - Y_T^\circ) = P_c \cdot [(Q(L^{**}) - Q'(L^{**}) \cdot L^{**}) - (Q(L^\circ) - Q'(L^\circ) \cdot L^\circ)] > 0$ (since $L^{**} > L^\circ$ and $Q''(L)<0$). So $J^{**} > (Y_c^\circ + Y_T^\circ)$ and there remains scope for improvement through cooperation. Hence, given Nash's axioms, a Nash bargaining solution exists. This is a symmetric bargaining problem. The solution of the game is given by

$$\left.\begin{aligned} &Y_c^{**} = Y_c^\circ + ((J^{**} - Y_c^\circ)/2); \text{ and} \\ &Y_T^{**} = (J^{**} - Y_c^\circ)/2 \\ &(\text{note that in this case } Y_T^\circ = 0) \end{aligned}\right\} \tag{20}$$

Thus the following proposition can be established.

PROPOSITION 4. *In an ICPC-ICLC, the landlord-cum-capitalist farmer derives income, greater than his reservation level.*

This is contrary to the standard result available in the literature on credit-product interlinkage that the farmer earns just his reservation level of income. This is because in the literature on trader-farmer interlinkage, a principal-agent framework is followed. The farmer (generally, small farmer) acts as the agent and does not possess any bargaining capacity. So the trader—the principal is able to push him down to the reservation income level by adjusting his (the trader's) control variables. However, in the present paper we consider the case of a large capitalist farmer and, therefore, follow a Nash bargaining framework. Hence the farmer is here able to get more than his reservation income.

In this case we have $Y_c^{**} > Y_c^\circ > Y_c^*$ and $Y_T^{**} > Y_T^\circ = Y_T^* = 0$. So when there is imperfection in the credit market only, the two-tier interlinkage is preferable to both the farmer and the trader compared to any other combination of contracts.

We then consider the case of imperfect product market and perfect credit market. This implies that $i=r=g$ and $P_T > P_c$. From (10) and (10.1) it follows that $W = W_1 = W_2$. From (11), (11.1) and (15) one can write $L^{**} > L^\circ = L^*$ (since $P_T > P_c$). From (13) and (16) it follows that $Y_c^\circ = Y_c^*$. But from (19) the sign of $(J^{**} - Y_c^\circ - Y_T^\circ)$ is uncertain. However, if $(P_T - P_c)$ is sufficiently small, $(J^{**} - Y_c^\circ - Y_T^\circ)$ may be positive. In that case a Nash bargaining solution exists. This means that if $(P_T - P_c)$ is sufficiently small we have

$$Y_c^{**} > Y_c^\circ = Y_c^*; \text{ and,}$$

$$Y_T^{**} > Y_c^\circ = Y_T^* = 0.$$

So in this case the farmer is indifferent between an NICLC and an ICLC. But if

$(P_T - P_c)$ is sufficiently small, both the trader and the farmer may be better off in the ICLC-ICPC combination. Thus the optimality of the two-tier interlinkage cannot be explained by product market imperfections alone. This establishes the most important result of the model.

PROPOSITION 5. *The existence and optimality of the two-tier interlinkage can be explained in terms of credit market imperfections alone. However, product market imperfections/and credit market imperfections may not be able to explain this type of interlinkage. It depends upon the degree of product market imperfections.*

4. CONCLUDING REMARKS

In this paper, we have presented a theory of two-tier interlinkage in backward agriculture. In such a system, the same employer-cum-capitalist farmer is on the one hand, involved in interlinked credit-labour contract with land-less workers and on the other, involved in interlinked credit-product contract with grain merchants (traders). Gupta (1993) has provided a theory of such a complex system using the "Consumption Efficiency Hypothesis" (CEH) of Leibenstein (1957). However, the relevance of the CEH in the real world has been questioned by many economists, notably by Rosenzweig (1988). Therefore, a more realistic explanation of the two-tier interlinkage is called for.

In this paper, we have provided an explanation of the two-tier interlinkage in terms of credit market imperfections. If the three economic agents—the trader, the farmer and the workers have different accessibility to the credit market and there is no product market imperfection, a two-tier interlinked system is profitable to both the trader and the capitalist farmer. The farmer earns income greater than his reservation level and the trader is better off in an ICPC-ICLC than an ICLC-NICPC. However, the optimality of the two-tier interlinkage cannot be explained by product market imperfections in which the farmer and the trader have differential accessibility to the product market. Moreover, even in the presence of credit market imperfections, the simultaneous existence of product market imperfections may make the two-tier inter-linkage unprofitable to the farmer and the trader. The immediate policy conclusion that follows from the results of the model is that to raise agricultural productivity the government should undertake policy measures, e.g. to improve transports, storage and warehousing facilities, to encourage co-operative marketing, to administer of prices at different levels of marketing etc. All these measures are designed to remove imperfections in the product market.

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APPENDIX I

In the ICLC and NICPC case, the worker's consumption in the peak season is

$$C_2^\circ = W_1 - (1+r_1)\cdot C_1^\circ \tag{2.1}$$

Now totally differentiating equation (3.1) we get

$$U_{11}\cdot dC_1^\circ = U_2\cdot dr_1 + U_{22}\cdot [dW_1 - (1+r_1)\cdot dC_1^\circ - C_1^\circ\cdot dr_1] \text{ (note that } U_{12}=0)$$

$$\text{or,}\quad [U_{11}+(1+r_1)\cdot U_{22}]\cdot dC_1^\circ = [U_2 - U_{22}\cdot C_1^\circ]\cdot dr_1 + U_{22}\cdot dW_1$$

So,

$$\left.\begin{aligned} (\partial C_1^\circ/\partial r_1) &= [\underset{(+)}{U_2} - \underset{(-)}{U_{22}}\cdot C_1^\circ]/[\underset{(-)}{U_{11}} + (1+r_1)\cdot \underset{(-)}{U_{22}}] < 0 \\ \text{and, } (\partial C_1^\circ/\partial W_1) &= \underset{(-)}{U_{22}}/[\underset{(-)}{U_{11}} + (1+r_1)\cdot \underset{(-)}{U_{22}}] > 0 \end{aligned}\right\} \tag{A.1}$$

Now using the envelope theorem from equations (1) and (2.1) we can derive the following results.

$$\left.\begin{array}{l}(\partial U^\circ/\partial r_1) = -U_2 \cdot C_1^\circ < 0 \\ \text{and,} \quad (\partial U^\circ/\partial W_1) = U_2 > 0\end{array}\right\} \tag{A.2}$$

Maximizing $Z(\cdot)$ with respect to r_1 and W_1 and assuming interior solutions we get the following first-order conditions.

$$(\partial Z/\partial r_1) = C_1^\circ \cdot L + (r_1 - r) \cdot L \cdot (\partial C_1^\circ/\partial r_1) + \beta_1 \cdot (\partial U^\circ/\partial r_1) = 0 \tag{A.3}$$

and

$$(\partial Z/\partial W_1) = -L + (r_1 - r) \cdot (\partial C_1^\circ/\partial W_1) \cdot L + \beta_1 \cdot (\partial U^\circ/\partial W_1) = 0 \tag{A.4}$$

Using (A.1) and (A.2) from (A.3) and (A.4) we can write

$$C_1^\circ + \{(r_1 - r) \cdot [U_2 - U_{22} \cdot C_1^\circ]/[U_{11} + (1 + r_1) \cdot U_{22}]\} = U_2 \cdot \beta_1 \cdot C_1^\circ/L \tag{A.3.1}$$

and,

$$-1 + \{(r_1 - r) \cdot U_{22}/[U_{11} + (1 + r_1)U_{22}]\} = -U_2 \cdot \beta_1/L \tag{A.4.1}$$

Multiplying both sides of (A.4.1) by C_1° and then adding with (A.3.1) we get

$$[(r_1 - r) \cdot U_2]/[U_{22} + (1 + r_1) \cdot U_{22}] = 0$$
$$\quad (+) \quad (-) \qquad\qquad (-)$$

or,

$$(r_1 - r) = 0 \text{ or, } \quad r_1 = r \tag{8}$$

Using (A.3.1) and (8) we write

$$\beta_1 = L/U_2 > 0 \tag{9}$$

APPENDIX II

In the ICLC-ICPC, the worker's consumption in the peak season is

$$C_2^{**} = W_2 - (1 + r_1)C_1^{**} \tag{2.2}$$

Totally differentiating the worker's first-order condition of intertemporal utility maximization, $U_1 = (1 + r_2) \cdot U_2$, we can get the following results.

$$\left.\begin{array}{l}(\partial C_1^{**}/\partial r_2) = [U_2 - U_{22} \cdot C_1^{**}]/[U_{11} + (1 + r_2) \cdot U_{22}] < 0 \\ \text{and,} \quad (\partial C_1^{**}/\partial W_2) = U_{22}/[U_{11} + (1 + r_2) \cdot U_{22}] > 0\end{array}\right\} \tag{A.5}$$

In this case the optimum level of utility of the worker is

$$U^{**} = U(C_1^{**}, W_2 - (1 + r_2) \cdot C_1{}^{**}) \tag{A.6}$$

Applying the envelope theorem from (A.6) one can derive

$$\left.\begin{aligned}(\partial U^{**}/\partial W_2) &= U_2^{**} > 0 \quad \text{and,}\\ (\partial U^{**}/\partial r_2) &= -C_1^{**} \cdot U_2^{**} < 0\end{aligned}\right\} \tag{A.7}$$

In the ICLC-ICPC case the capitalist farmer and the trader maximize their joint income with respect to W_2, r_2 and L and subject to the reservation utility constraint of the worker. The relevant Lagrangian function is

$$V = P_T \cdot Q(L) - W_2 \cdot L + (r_2 - i) \cdot C_1^{**} \cdot L + \beta_2 \cdot [U^{**}(r_2, W_2) - U^{*}(W, g)] \tag{A.8}$$

Maximizing $V(\cdot)$ with respect to r_2 and W_2 and assuming interior solutions for the choice variables we get the following two first-order conditions.

$$(\partial V/\partial r_2) = C_1^{**} \cdot L + (r_2 - i) \cdot L \cdot (\partial C_1^{**}/\partial r_2) + \beta_2 \cdot (\partial U^{**}/\partial r_2) = 0 \tag{A.9}$$

and,

$$(\partial V/\partial W_2) = -L + (r_2 - i) \cdot (\partial C_1^{**}/\partial W_2) + \beta_2 \cdot (\partial U^{**}/\partial W_2) = 0 \tag{A.10}$$

Using (A.5) and (A.7) from (A.9) and (A.10) we get

$$C_1^{**} + \{(r_2 - i) \cdot [U_2 - U_{22} \cdot C_1^{**}]/[U_{11} + (1 + r_2) \cdot U_{22}]\} = U_2 \cdot \beta_2 \cdot C_1^{**}/L \tag{A.9.1}$$

and,

$$-1 + \{(r_2 - i) \cdot U_{22}/[U_{11} + (1 + r_2) \cdot U_{22}]\} = -U_2 \cdot \beta_2/L \tag{A.10.1}$$

Multiplying both sides of (A.10.1) by C_1^{**} and then adding with (A.9.1) we get the result

$$r_2 = i \tag{8.1}$$

Using (A.9.1) and (8.1) we can easily find that

$$\beta_2 = L/U_2^{**} > 0 \tag{A.11}$$

Now maximizing $V(\cdot)$ with respect to β_2 we get the following first-order conditions:

$$\left.\begin{aligned}&(\partial V/\partial \beta_2) = U^{**}(r_2, W_2) - U^{*}(r, g) \geq 0\\ &\text{and,} \quad \beta_2 \cdot (\partial V/\partial \beta_2) = 0; \; \beta_2 \geq 0\end{aligned}\right\} \tag{A.12}$$

Since $\beta_2 > 0$ (see A.11), from (A.12) it follows that the reservation utility constraint will be binding, in equilibrium. So we have

$$U^{**}(r_2, W_2) = U^{*}(r, g)$$

or,

$$U^{**}(i, W_2) = U^{*}(r, g) \;\; (\text{note that } r_2 = i) \tag{10.1}$$