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INTERLINKAGES IN RURAL MARKETS

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I. Introduction

INTERLINKAGES among rural markets are widely observed, both in India and in other developing countries. Such interlinkages assume economic significance when the prices of commodities transacted through interlinked markets differ from what their prices would have been if they were not interlinked. Mitra [1983] and Braverman-Stiglitz [1982] have studied the extent of such "distortions" in market value through interlinkages and whether they are beneficial or not. Basu [1983], on the other hand, has maintained that such interlinkages do not always produce price distortions.

Two markets that are often interlinked are the rural land and the rural credit markets. Bhaduri [1973, 1977] and Ghatak [1976] have argued that the rate of interest in rural credit markets is very high while Bardhan-Rudra [1978] have demonstrated that, often, these interest rates are very low. Mitra [1983] and Braverman-Stiglitz [1982] seem to suggest that both high as well as low interest rates can be explained by the phenomena of interlinkages and different attitudes towards risk.

A serious drawback, we feel, in these explanation is that interlinkage is assumed to begin with. The landowner *chooses* the amount of loan to be given to the tenant and the latter either accepts the contract or does not. Choice of loans is not derived as a utility maximizing decision of the tenant. This forces the interlinking of the land and loan markets for the tenant.

Furthermore, loans can be taken for different purposes. For example, a *production* loan may be taken by the tenant to buy inputs for production. A *consumption* loan, on the other hand, can be used to buy consumption items prior to the realization of output. If the landowner keeps a share of the output then a production loan involves two sources of income for him—a direct income from interest payments and an indirect one from increased output. Pure consumption loans, however, give rise to interest income alone. These considerations are important when production is organized by the tenant-cultivator and the amount of loans to be taken from the landowner is also determined by the tenant.

In this paper we, therefore, allow for (i) the tenant to decide the amount of loan to be taken and (ii) the existence of two distinguishable types of loans-for production and for consumption purposes.

We find that for optimality in the usual agricultural production relations model (e.g. in Stiglitz [1974]), the interest rate on consumption loans does not deviate from the "market" rate while it is *lower* than the market rate for production loans. We also derive a simple condition under which the rate of interest on production loans can be non-positive. We are thus able to

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justify, theoretically, the empirical findings of Bardhan and Rudra [1978] which suggest that interest rates are often zero. If the landowner is unable to give production loans, then he may charge a rate of interest on consumption loans different from that of the market rate depending on the rate of change of the absolute risk aversion of the tenant with respect to income. Section II describes the model used and in Section III we derive the above results. In Section III we also discuss our results in the light of the cost-sharing literature.

It can be argued that it may not be possible to distinguish between consumption and production loans. For example, if both loans are transacted in cash, since production loans command a lower interest than consumption loans, the tenant may take only production loans and use part of it for consumption. In other words, there may exist a monitoring problem for the lender. In Section IV we study such a situation and show that the rate of interest is still lower than the market rate.

Section V concludes our paper.

II. The model

Agricultural output is uncertain and there are two states of the world 1 and 2, occurring with probability p and q respectively where $p+q=1$. Output in each state is denoted by Q_j, $j=1, 2,$. Input decisions have to be taken before the state is known and output depends on the amount of production loans (i.e., expenditure on inputs) and the realization of the state. Assuming multiplicative uncertainty,

$$Q_j = \theta_j f(k),^1 \qquad j=1, 2$$
$$f' > 0, \qquad f'' < 0 \tag{1}$$

where k is the expenditure on inputs and θ_j is the value of the random variable in state j. Without loss of generality, we assume

$$p\theta_1 + q\theta_2 = \bar{\theta} = 1$$

with
$$\theta_1 > 1 > \theta_2 > 0. \tag{2}$$

There are only two periods, today and tomorrow. All decisions, including inputs have to be taken today while output and interest payments occur tomorrow. The tenant needs to borrow funds today for consumption as well as expenditure on inputs. Tenant's share in tomorrow's output is given by $\alpha\theta_j f(k) + R$, depending on state j. α is a fraction between 0 and 1 and R is a fixed transfer, independent of the total output. R may be positive, negative or zero. With $R=0$, the output will be shared according to a pure sharecropping rule. (See Mitra [1983]) and Stiglitz [1974] for such output sharing rules). The tenant is an expected utility maximizer where his

[1] It is assumed throughout that the tenant-farmer provides his labour inputs inelastically; i.e., his hours of work are fixed.

expected utility V is given by

$$V = v(c) + pu[\alpha\theta_1 f(k) + R - (1+i_c)c - (1+i_p)k] \\ + qu[\alpha\theta_2 f(k) + R - (1+i_c)c - (1+i_p)k] \quad (3)$$

where c = the consumption loan taken from the landowner
i_c = rate of interest on consumption loans
i_p = rate of interest on production loans.
The tenant maximizes V by choosing c and k, taking as given α, R, i_c, i_p. Assuming an interior solution, i.e., $c>0$, $k>0$, and the relevant second-order conditions, one can write down the necessary and sufficient condition for the maximization of V as follows:

$$v' - (1+i_c)[pu'(1) + qu'(2)] = 0 \quad (4)$$

and
$$pu'(1)[\alpha\theta_1 f' - (1+i_p)] + qu'(2)[\alpha\theta_2 f' - (1+i_p)] = 0 \quad (5)$$

where $u'(j)$ is the marginal utility of income in state j, $j=1, 2$. Totally differentiating (4), (5) and writing in matrix form:

$$\begin{bmatrix} v'' + (1+i_c)^2\bar{u}'' & -(1+i_c)X \\ -(1+i_c)X & \alpha\bar{H}f'' + \beta_1^2 pu''(1) + \beta_2^2 qu''(2) \end{bmatrix} \begin{bmatrix} dc \\ dk \end{bmatrix}$$

$$= \begin{bmatrix} (1+i_c)\bar{u}'' & (1+i_c)f(k)\bar{\bar{H}} & \bar{u}' - (1+i_c)\bar{u}''c & -k(1+i_p)\bar{u}'' \\ -X & -Yf(k) - \bar{H}f' & cX & kX + \bar{u}' \end{bmatrix} \begin{bmatrix} dR \\ d\alpha \\ di_c \\ di_p \end{bmatrix} \quad (6)$$

where
$$\bar{u}' = pu'(1) + qu'(2)$$
$$\bar{u}'' = pu''(1) + qu''(2)$$
$$\beta_j = \alpha\theta_j f' - (1+i_p);\ j = 1, 2$$
$$\bar{H} = p\theta_1 u'(1) + q\theta_2 u'(2)$$
$$\bar{\bar{H}} = p\theta_1 u''(1) + q\theta_2 u''(2)$$
$$X = p\beta_1 u''(1) + q\beta_2 u''(2)$$
$$Y = p\theta_1\beta_1 u''(1) + q\theta_2\beta_2 u''(2).$$

The landowner is assumed throughout to be risk rental. Using (2) one can write down the landowner's objective as:

$$\underset{\{i_c, i_p, \alpha, R\}}{\text{Max}}\, L = \underset{\{i_c, i_p, \alpha, R\}}{\text{Max}}\ (1-\alpha)f(k) + (i_c - r)c + (i_p - r)k - R \\ + \lambda[V - V^*] + \delta[\alpha - \bar{\alpha}] + \eta[1-\alpha] \quad (7)$$

It is being assumed here that there is a legal minimum for the share α so that $1 \geqslant \alpha \geqslant \bar{\alpha} > 0$. Also, for the contract to be acceptable to the tenant, the landowner must provide the latter a reservation utility V^*. The landowner's opportunity cost of lending money to the tenant is 'r' which we term, throughout this paper, the *market* rate of interest on loans. The relevant first-order conditions, assuming an interior solution and second-order conditions, are:

$$-f(k)+[(1-\alpha)f'+i_p-r]\frac{dk}{d\alpha}+(i_c-r)\frac{dc}{d\alpha}+\lambda f(k)\bar{H}+\delta-\eta\leqslant 0 \quad (8)$$

$$-1+[(1-\alpha)f'+i_p-r]\frac{dk}{dR}+(i_c-r)\frac{dc}{dR}+\lambda\bar{u}'=0 \quad (9)$$

$$c+[(1-\alpha)f'+i_p-r]\frac{dk}{di_c}+(i_c-r)\frac{dc}{di_c}-\lambda c\bar{u}'=0 \quad (10)$$

$$k+[(1-\alpha)f'+i_p-r]\frac{dk}{di_p}+(i_c-r)\frac{dk}{di_p}-\lambda k\bar{u}'=0 \quad (11)$$

and $$\lambda\geqslant 0,\ \delta\geqslant 0,\ \eta>-0. \quad (12)$$

Before we go on to study the major results of our paper, it may be instructive to study the situation when both landowners and tenants are risk neutral. If tenants are risk neutral, $u''(j)=0$, $j=1, 2,$ and thus

$$\bar{u}''=X=Y=u''(j)=\frac{dc}{dR}=\frac{dk}{dR}=\frac{dc}{d\alpha}=\frac{dk}{di_c}=\frac{dc}{di_p}=0 \quad (13)$$

We have the following proposition:

Proposition 1: *If both tenants and landowners are risk neutral,* $\alpha=1$, $i_c=i_p=r$ *and* $R\leqslant 0$ *is an optimal solution*:

The proof follows trivially from observing that at $\alpha=1$, $i_c=i_p=r$ all the first order conditions (4), (5) and (8) to (12) are satisfied. Since the landowner's income must be non-negative, it also follows that $R\leqslant 0$.

With risk neutrality, the tenant can bear all the risk and it should be the case since it is the tenant who organizes production. There is thus no "cost" to bearing risk and the tenant left to himself will allocate input expenditure optimally; the landowner need not "distort" prices on production loans for the tenant to achieve optimality. A fixed rent from the tenant; i.e. $R\leqslant 0$, is all the landowner extracts, the exact amount of the rent being determined by the value of V^* to be supported. Thus when both tenants and landowners are risk neutral, a fixed rental contract is *an* optimal solution. *One need not have distorted prices through interlinkages*. However, distorted prices or $i_p\neq r$, may also yield an optimal solution as long as

$$(1-\alpha)f'+i_p-r=0$$

and this will become clear when we derive the results in the next section. Since $\alpha\leqslant 1$, it is clear that $i_p\not> r$.

III. The major results

In this section we assume that tenants are risk averse, so that $u''(.)<0$ but landowners are risk neutral. We have the following proposition:

Proposition 2: *If tenants are risk averse and landowners are risk neutral, then the optimal solution has* $\alpha = \bar{\alpha}$, $i_c = r$, $i_p = r - (1-\alpha)f'$.

[Proof in appendix].

The intuitive reasoning for this proposition is as follows: since tenants are risk averse, efficiency demands that the landowner should bear all the risk as he is risk neutral. This implies α should be as small as possible and it, therefore, hits the legal minimum $\bar{\alpha}$. However, the only reason for the tenant to take production loans is because of some returns from output, namely through the share α. Since α is very small, i_p must be very small too, to give the tenant enough incentive to undertake any expenditure on inputs. Consumption does not affect production so the landowner has no incentive to subsidize consumption loans and will equate the gain $(=i_c)$ to his opportunity cost $(=r)$.

Our result here has a strong analogy with the results arrived at in the cost sharing literature. To see this we can restructure our model as follows. Let the landowner share in the cost of production alone. In other words, he charges a rate of interest r on the production loan while he shares a fraction $(1-\beta)$ of the total cost $(1+r)k$. The tenant's income in state 'j' now becomes: $\alpha\theta_j f(k) + R - (1+i_c)c - \beta(1+r)k$, $j = 1, 2$, and the landowner's income in state j is given by

$$(1-\alpha)\theta_j f(k) - R + (i_c - r)c - (1-\beta)(1+r)k$$

Following the same method of proof as that in Proposition 2, one now can easily show that the optimality requires $\beta < \bar{\alpha}$, i.e., the tenant-farmer's share in the cost is always less than his share in the output.[2]

Coming back to our original formulation, we now provide a simple condition under which i_p may even be zero.

Proposition 3: *Let the landlord be risk-neutral and the tenant be risk-averse*; *if* $\bar{\alpha}(1+r) \leqslant 1$, *then* $i_p \leqslant 0$.[3]

Equation (5) and lemma (1) together imply $\alpha f'(k) > (1+i_p)$. Since $\alpha = \bar{\alpha}$ (from Proposition 2), we obtain,

$$f'(k) > (1+i_p)/\bar{\alpha} \quad \text{and} \quad r = i_p + (1-\bar{\alpha})f'(k)$$

Combining these two we get

$\bar{\alpha}(1+r) - 1 > i_p$ and the result follows immediately.[4]

[2] We thus get an unambiguous result, $\beta < \bar{\alpha}$. Braverman and Stiglitz, however, require additional conditions for this to hold. This is because, in our model, there is a payment R, independent of output and loans taken.

[3] In equilibrium a negative interest rate could be supported only if the farmer used the entire loan for production purposes. Otherwise, he will demand an infinite amount of loans. The landowner would thus be forced either to ration the amount of loans taken or set i_p equal to zero.

[4] We are grateful to an anonymous referee for suggesting this method of proof for this proposition.

It may be worthwhile to consider the situation where $i_p = r$. This could happen if the landowner does not give production loans or the government controls the input market. In that situation, i_c may deviate from r. More precisely, we have the following proposition.

Proposition 4: *Let tenants be risk averse and landowners be risk neutral. Then with i_p fixed at r, $i_c \geqslant r$ if and only if absolute risk aversion is non-increasing with income, equality holding if absolute risk aversion is constant.*

[Proof in appendix].

This is once again to be expected. Being risk averse, the tenant tends to put in less inputs than would be optimal for the landowner. The landowner cannot subsidize the input market directly because i_p is set equal to r. However, the landowner can operate indirectly through the consumption loans market. If i_e is raised, consumption loans decrease and for maintaining the same utility level, second period income must increase. But with increase in income, since absolute risk-aversion decreases, the tenant puts in more of the inputs. The income of the landowner is thereby increased.

IV. Problem of monitoring

We have so far been assuming that consumption loans and production loans are distinguishable. This may be a strong assumption if both loans are given in cash. We have seen in Proposition 2 that interest rates on consumption loans are higher than on production loans. Thus it pays the tenant to take only production loans and then transfer part of it to consumption. In such a situation, where the landowner cannot monitor the use of loans, the optimal policy would be to charge a uniform interest rate on all loans. To see this, restructure the model as follows.

Let L be the total amount of funds borrowed from the landowner by the tenant. An amount L_c may be put to consumption uses and the rest, $L - L_c$, can then be put into production. The tenant now maximizes

$$v(L_c) + pu[\alpha\theta_1 f(L - L_c) + R - (1+i)L] + qu[\alpha\theta_2 f(L - L_c) + R - (1+i)L] \tag{14}$$

where i is the interest rate on loans. The tenant chooses L and L_c. The landowner, on the other hand, maximizes

$$(1-\alpha)f(L - L_c) - R + (i - r)L \tag{15}$$

subject to $V \geqslant V^*$ and $0 < \bar{\alpha} \leqslant \alpha \leqslant 1$, by choosing α, i and R. Once again, it is easy to show, as in Section III, that $i < r$ if tenants are risk averse and $i = r$ if tenants are risk neutral. Furthermore, if tenants are risk averse, α may be greater than $\bar{\alpha}$ but if tenants are risk neutral α must be equal to 1. The latter is true for the same reasons as in Proposition 1. The more interesting situation occurs when tenants are risk averse. Because the landowner cannot monitor loans, and because the tenant is risk averse, the amount of loans going into production may be less than what is optimal for the landowner. The only instrument open to the landowner to increase production is α, the share of output going to the tenant. He may thus find it profitable to increase α beyond $\bar{\alpha}$. [Proofs of all these propositions are omitted as they follow the same pattern as those for Section III].

V. Conclusion

We have thus been able to show that when both production and consumption loans are interlinked with the land market, rate of interest on consumption loans does not deviate from the market rate of interest but the interest on production loans is less than (equal to) the market rate if tenants are risk averse (neutral). On the other hand, if only consumption loans are given by the landowner and the latter cannot operate in the input market, it pays him, as a second best policy, to deviate from the market rate depending on the absolute risk aversion behaviour of the tenant. We have also shown how our framework can be modified to study a situation where production and consumption loans are indistinguishable. In such a situation, also, the rate of interest on loans is less than the market rate. All these lead us to conclude that interlinking may not be a good hypothesis for explaining usurious interest rates.

These results are in contrast to the results arrived at by others in the literature (e.g. Bhaduri [1973, 1977]). These papers seem to suggest that interlinked markets and high interest rates are closely related. We feel that this is due to the lack of sufficient instruments in the hands of the landowner-moneylender. On the other hand, if the lender is as powerful as he is made out to be, it is not clear why he should not have enough instruments to get to a situation which is optimal for him.

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APPENDIX

Lemma 1:

$$\frac{p\theta_1 u'(1) + q\theta_2 u'(2)}{pu'(1) + qu'(2)} \leqslant 1 \quad \text{if} \quad u''(\ ) \leqslant 0$$

with strict inequality holding of $u''(\ ) < 0$ and $\theta_1 > \theta_2$.

Proof: Suppose not, i.e.,

$$\frac{p\theta_i u'(1) + q\theta_2 u'(2)}{pu'(1) + qu'(2)} > 1$$

i.e.
$$pu'(1)[\theta_1 - 1] > qu'(2)[1 - \theta_2],$$

i.e.
$$\frac{pu'(1)}{qu'(2)} > \frac{1 - \theta_2}{\theta_1 - 1}$$

since $\theta_1 \geqslant \theta_2$ income in state 1 is greater than or equal to that in state 2, i.e. $u'(1) \leqslant u'(2)$. Thus $(p/q) \geqslant (p/q)(u'(1)/(u'(2)) > (1-\theta_2/\theta_1 - 1)$ i.e. $p\theta_1 + q\theta_2 > p + q = 1$ which is a contradiction (see equation (2)).

Proof of Proposition 2:

Here let us first assume that $i_c \neq r$. Dividing (10) by c, we get

$$\{(1-\alpha)f' + i_p - r\}\frac{\mathrm{d}k}{\mathrm{d}i_c}\frac{1}{c} + \frac{i_c - r}{c}\frac{\mathrm{d}c}{\mathrm{d}i_c} = \lambda\bar{u}' - 1. \tag{A.1}$$

Adding (9) and (A.1)

$$\{(1-\alpha)f' + i_p - r\}\left[\frac{\mathrm{d}k}{\mathrm{d}R} + \frac{1}{c}\frac{\mathrm{d}k}{\mathrm{d}i_c}\right] + (i_c - r)\left[\frac{\mathrm{d}c}{\mathrm{d}R} + \frac{1}{c}\frac{\mathrm{d}c}{\mathrm{d}i_c}\right] = 0. \tag{A.2}$$

Similarly dividing (11) by k and adding to (9), we get

$$\{(1-\alpha)f' + i_p - r\}\left[\frac{\mathrm{d}k}{\mathrm{d}R} + \frac{1}{k}\frac{\mathrm{d}k}{\mathrm{d}i_p}\right] + (i_c - r)\left[\frac{\mathrm{d}c}{\mathrm{d}R} + \frac{1}{k}\frac{\mathrm{d}c}{\mathrm{d}i_p}\right] = 0. \tag{A.3}$$

Using (6) to expand the terms in the square bracket, one gets

$$(i_c - r)[\alpha f''\bar{H} + \beta_1^2 pu''(1) + \beta_2^2 qu''(2)] = \{(1-\alpha)f' + i_p - r\}[-(1+i_c)X] \tag{A.4}$$

and

$$(i_c - r)[-(1+i_c)X] = \{(1-\alpha)f' + i_p - r\}[v'' + (1+i_c)^2\bar{u}'']. \tag{A.5}$$

Eliminating $(i_c - r)$ from (A.4) and (A.5), one gets

$$\{(1-\alpha)f' + i_p - r\}[(v'' + (1-i_c)^2\bar{u}'')(\alpha f''\bar{H} + \beta_1^2 pu''(1) + \beta_2^2 qu''(2)) - (1+i_c)^2X^2] = 0 \tag{A.6}$$

The term in the square brackets in (A.6) is the value of the determinant on the left hand side of (6) and that from second-order conditions is greater than zero. Thus, from (A.6)

$$i_p = r - (1-\alpha)f' < r.$$

Also, from (A.4), since $[\alpha f''\bar{H} + \beta_1^2 pu''(1) + \beta_2^2 qu''(2)] < 0$,

$$i_c = r.$$

This is a contradiction, therefore, $i_c = r$. But then from (A.4), $(1-\alpha)f' + i_p = r$. Using $i_c = r$ and $i_p = r - (1-\alpha)f'$, in (8), if $\alpha > \bar{\alpha}$, $-f(k) + \lambda f(k)\bar{H} - \eta = 0$. But from (10), $\lambda\bar{u}' = 1$. Thus in (8)

$$-1 + \frac{\bar{H}}{\bar{u}'} - \frac{\eta}{f} = 0 \Rightarrow \frac{\bar{H}}{\bar{u}'} = \frac{\eta}{f} + 1 \geqslant 1.$$

But from Lemma 1, if $u''(.) < 0$, this is not possible. Therefore $\alpha = \bar{\alpha}$.

Proof of Proposition 4:

In this case, the landowner does not choose i_p, and the tenant faces $i_p = r$. Thus the relevant first order conditions now become (for the landowner)

$$-f(k) + \{(1-\alpha)f'\}\frac{\mathrm{d}k}{\mathrm{d}\alpha} + (i_c - r)\frac{\mathrm{d}c}{\mathrm{d}\alpha} + \lambda f(k)\bar{H} + \delta - \eta \leqslant 0 \tag{A.7}$$

$$-1 + \{(1-\alpha)f'\}\frac{\mathrm{d}k}{\mathrm{d}R} + (i_c - r)\frac{\mathrm{d}c}{\mathrm{d}R} + \lambda\bar{u}' = 0 \tag{A.8}$$

$$c + \{(1-\alpha)f'\}\frac{\mathrm{d}k}{\mathrm{d}i_c} + (i_c - r)\frac{\mathrm{d}c}{\mathrm{d}i_c} - \lambda c\bar{u}' = 0 \tag{A.9}$$

Dividing (A.9) by c and adding to (A.8) gives us

$$(1-\alpha)f'\left\{\frac{dk}{dR}+\frac{1}{c}\frac{dk}{di_c}\right\}+(i_c-r)\left\{\frac{dc}{dR}+\frac{1}{c}\frac{dc}{di_c}\right\}=0.$$

Using (6),

$$\begin{aligned}
&(1-\alpha)f'\Big[(v''+(1+i_c)^2\bar{u}'')(-X)+(1+i_c)^2\bar{u}''X\\
&+(v''+(1+i_c)^2\bar{u}'')X+(1+i_c)X\left(\frac{\bar{u}'}{c}-(1+i_c)\bar{u}''\right)\Big]\\
&+(i_c-r)\Big[(+(1+i_c)\bar{u}'')(\alpha\bar{H}f''+\beta_1^2pu''(1)+\beta_2^2qu''(2))-(1+i_c)X^2\\
&+\left(\frac{\bar{u}'}{c}-(1+i_c)\bar{u}''\right)(\alpha\bar{H}f''+\beta_1^2pu''(1)+\beta_2^2qu''(2))+(1+i_c)X^2\Big]=0\\
&\Rightarrow(1-\alpha)f'\frac{\bar{u}'}{c}(1+i_c)X+(i_c-r)\frac{\bar{u}'}{c}(\alpha\bar{H}f''+\beta_1^2pu''(1)+\beta_2^2qu''(2))=0\\
&\Rightarrow(1-\alpha)f'(1+i_c)X+(i_c-r)[\beta_1^2pu''(1)+\beta_2^2qu''(2)+\alpha\bar{H}f'']=0. \qquad \text{(A.10)}
\end{aligned}$$

From second-order condition, term in the square brackets in (A.10) is less than zero.

Clearly, $$i_c \gtreqless r \quad \text{iff} \quad X \gtreqless 0$$

i.e. $$p\beta_1u''(1)+q\beta_2u''(2)\gtreqless 0$$

i.e. $$\alpha f'[pu''(1)\theta_1+qu''(2)\theta_2]\gtreqless(1+i_p)\bar{u}''. \qquad \text{(A.11)}$$

But from (5), $\alpha f'=((1+i_p)\bar{u}'/\bar{H})$. Thus (A.11) holds iff

$$(1+i_p)\frac{\bar{u}'}{\bar{H}}\bar{\bar{H}}\gtreqless(1+i_p)\bar{u}'.$$

i.e. $$[pu'(1)+qu'(2)][pu''(1)\theta_1+qu''(2)\theta_2]\gtreqless$$
$$[pu''(1)+qu''(2)][pu'(1)\theta_1+qu'(2)\theta_2]$$

i.e. $$(\theta_2-\theta_1)u''(1)u''(2)\gtreqless(\theta_2-\theta_1)u''(1)u'(2)$$

i.e. $$(\theta_1-\theta_2)(-u''(2))u'(1)\gtreqless(\theta_1-\theta_2)(-u''(1))u'(2)$$

i.e. $$\frac{-u''(2)}{u'(2)}\gtreqless\frac{-u''(1)}{u'(1)}.$$

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