The Pakistan Development Review
31: 4 Part I (Winter 1992) pp 535–564

Distinguished Lecture

On Measuring the Social Opportunity Cost of Labour in the Presence of Tariffs and an Informal Sector*

M. ALI KHAN

1. INTRODUCTION

Harberger introduced his influential 1971 essay with the following words.

> This paper is intended not as a scientific study, nor as a review of the literature, but rather as a tract – an open letter to the profession, as it were – pleading that three basic postulates be accepted as providing a conventional framework for applied welfare economics. The postulates are:
>
> (a) The competitive demand price for a given unit measures the value of that unit to the demander;
> (b) The competitive supply price for a given unit measures the value of that unit to the supplier; and
> (c) When evaluating the net benefits or costs of a given action (project, programme, or policy), the costs and benefits accruing to each member of the relevant group (e.g., a nation) should normally be added without regard to the individual(s) to whom they accrue.[1]

In a lecture delivered eighteen years later, Harberger stressed the same theme. After reminding his audience not to forget that "many projects [are] carried out just to satisfy the caprice or whim of some powerful figure or clan, [or that] corruption pervades the decision-making and contracting process in many parts of

*Owing to unavoidable circumstances, the second discussant's comments on this paper have not been received.

M. Ali Khan is Professor of Economics at the Department of Economics, The Johns Hopkins University, Baltimore, U.S.A.

Author's Note: The material reported here was presented in invited lectures both at the 8th Annual General Meeting of the Pakistan Society of Development Economists and at the *Academia Sinica.* I would like to acknowledge the Directors of both Institutions for their invitation and for their hospitality. The final version was written at the *Academia Sinica* and benefitted from comments of Kun-Ming Chen, Kee-Nam Cheung, Po-Sheng Lin, Jia-Dong Shea as well as those of Gerry Rodgers, my discussant at Islamabad. I retain sole responsibility for errors, be they of analysis or of interpretation.

[1][See Harberger (1971a), p. 785.]

the world, [or] even when these baser elements are not present, the granting and withholding of projects is used to reward political supporters and to punish enemies, and in electoral situations in winning over constituencies that may be doubtful or wavering,"[2] Harberger saw the three basic postulates as "providing us with a way of insulating the methodology from the banal, crass, even vile pressures just alluded to."[3] "They lead to a sort of professionalism" in that they engender work that can be *reviewed/audited* and *replicated/iterated,* and to work which is neither art, for "that carries too much of a connotation of individuality and inspiration," nor science for that "connotes too much precision."

> A profession (whether medicine or accounting or engineering) embodies a set of tools and practices. As I approach the field of social project evaluation, I see in it the beginning of a new profession. The operative word to guide individuals in their behaviour is to my mind, "professionalism."[4]

It is not that Harberger is unaware of the arguments that can be raised against his three postulates. Consumer and producer surplus analysis underlies the three postulates, and such analyses have been criticised on the grounds of requiring (i) constancy of the marginal utility of income, (ii) neglect of income distribution, (iii) its partial equilibrium nature, (iv) its focus on "small" changes, and (v) by it being rendered obsolete by *revealed preference* analysis.[5] In his (1971a) paper, Harberger squarely faces these criticisms, but the final line of his argument for the "conventionalisation" of his postulates remains that

> they are both *simple* and *robust* and that they underlie a long tradition in applied welfare economics.[6]

In this lecture, I shall argue that Harberger's quest for a consensus, though

[2][Harberger (1988), p. 71.]

[3][Harberger (1988), p. 71.] Earlier in the lecture, Harberger had referred to "the many who demean project evaluation by using it as a device for "justifying" whatever projects their clients and superiors want," and had opposed them to the "honourable people, that largely unsung host of people serving in budget bureaus, planning authorities, and all types of ministries and agencies (among them the World Bank itself) all over the globe, who strive selflessly to see to it, insofar as they can, that projects not meeting adequate standards are rejected, while those in the social interest are accepted." (p. 35).

[4][Harberger (1988), p. 35.] Earlier, he had written, "[There is] a need for a set of standards, of "rules of the game" by which our professional work can be guided and judged. The three basic postulates ... provide a *de minimis* answer to this need: their simplicity, their robustness, and the long tradition that they represent all argue for them as the most probable common denominator on which a professional consensus on procedures for applied welfare economics can be based." See [Harberger (1971a), p. 796.]

[5][See Harberger (1971), p. 786.]

[6][See Harberger (1971a), p. 795.] Italics are mine.

altogether admirable, is somewhat idealistic. I shall not get entangled with the usual criticisms against project evaluation. Thus, I shall assume a single agent's utility function as the relevant maximand so as to avoid questions of income distribution. I shall even specialise it to a linear function by focussing on the international value of GNP – thus implying a constant marginal utility of income. I shall focus on small projects and work with a pure production model and hence very much work within the tradition of partial equilibrium analysis. I shall have nothing to say as regards issues connected with money, time or risk, and thereby stay clear of the difficult problems associated with the *social rate of discount,* or even of the *shadow interest rate* or the *shadow rate of foreign exchange.* I shall confine myself solely to the social opportunity costs of a homogeneous primary factor – labour. Inspite of all of this, I shall argue that even though it may be overstating it to say that Harberger is essentially chasing a *will o' the wisp,* it is difficult to see how the consensus that he strives for can be obtained.

The outline of this lecture is as follows. In the next section, I introduce a model that formalises Harberger's 1971 ideas and which, until Chandra's 1991 dissertation, did not receive the extensive and rigorous analysis it deserved. In the context of this model, I shall focus on Harberger's second postulate and ask how labour should be evaluated in the context of a small project. In Section 3, I shall make what can be seen as a very minor change in Chandra's model, and in this modified setting, reconsider the question of the social opportunity costs of labour. I shall conclude in Section 4 with some methodological remarks and by returning to the issues raised here in the introduction. In particular, I shall contrast my answers with those of Harberger and focus primarily on his criteria of *simplicity* and of *robustness.*

2. CHANDRA'S MODEL

In her unpublished Ph. D. dissertation,[7] V. Chandra proposed a model of an economy with three factors of production. Two of these – labour and capital – are primary factors, whereas the remaining one, henceforth to be referred to as an informal input, is a produced means of production. The economy is segmented into a rural and an urban region and the latter is further subdivided into a formal and an informal sector. The relevant variables of the rural region are subscripted by r but those of the urban region carry the subscript u or i depending on whether they pertain to the formal or the informal sector.

Since the informal input is produced within the economy, it is also an output. In addition to it, there are three other outputs. One of these is produced in the rural region and can be usefully thought of as a composite agricultural commodity, while

[7]See Chandra (1991); also Section 5 in Chandra-Khan (1991).

the other two are produced in the formal sector of the urban region and constitute the manufacturing sector of the economy.

The technologies for all of this are summarised by

$$X_r = F_r(L_r, K_r); \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$X_{uj} = F_{uj}(L_{uj}, X_{ij}, K_{uj}) \; j = 1, 2; \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

$$aX_i = L_i, a > 0, \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where L and K, suitably subscripted, represent the amount of labour and capital input, while X, again suitably subscripted, represent both outputs and inputs, reflecting the fact that the output of the informal sector is also used as an intermediate input in the formal sector. The material balance condition $X_{i1} + X_{i2} = X_i$ eliminates any ambiguity on this score.

The aggregate resources of the economy are summarised by exogenously given and homogeneous amounts of land $\mathcal{T}$, labour $\mathcal{L}$ and capital $\mathcal{K}$ and the material balance equations are given by

$$K_r + K_{u1} + K_{u2} = \mathcal{K} \text{ and } L_{u1} + L_{u2} + L_r + L_i = \mathcal{L}. \quad \ldots \quad \ldots \quad (4)$$

I shall assume that F_{uj}, and F_r are continuously differentiable, exhibit constant returns to scale and diminishing marginal productivity to each factor. There is single technique in the informal sector and $(1/a)$ represents both the average and marginal productivity of informal labour.

I shall assume that the rural and urban formal output is internationally traded at prices which cannot be influenced by the production decisions made in the economy – this is the traditional small country assumption. I shall use p, again suitably subscripted, to denote the relevant international price. I shall not assume that the informal output is internationally traded – its price p_i is determined in equilibrium.

I shall not go into the details of the definition, characteristics, magnitude and importance of the informal sector,[8] and justify its formalisation as a nontraded intermediate input.[9] I have particularly in mind the case prevalent in many LDCs in which certain labour-intensive stages of production are subcontracted from the formal to the informal sector.

By [an] informal sector, I [simply] mean the set of economic activities often,

[8]Such details are available in [Portes *et al.* (1989), Part I, Chapter 1], and further highlighted in [Chandra (1991), Chapters 2 and 3].

[9]A good survey of the voluminous empirical and descriptive literature is available in [Portes *et al.* (1989), Part IV, Chapters 9 – 12].

> but not exclusively, carried out in small firms or by the self employed, which elude government requirements such as registration, tax and social security obligations, and health and safety rules. Informal activities are often illegal, but not necessarily clandestine since lack of coordination between state agencies, lax enforcement and other types of official connivance can permit informally run enterprises to flourish openly.[10]

I shall assume that wages in the urban formal sector are exogenously given by $\bar{w}_u$. This is a standard assumption and it takes special force in my context since it is used as one of the defining characteristics of the informal sector.[11]

I now turn to the equilibrating condition in the labour market. Analytically, what makes my informal sector worthy of its name is that wages are the lowest in this sector and that employment is automatic for all who do not obtain a job in the highest wage formal sector. Since urban labour has two options for employment, in equilibrium the guaranteed rural wage is equated to a weighted sum of the two urban wages, the weights λ and $1 - \lambda$ being the employment rates in the two sectors, and representing proxies for the probability of finding employment in the two sectors. More formally, the equilibrium condition in the labour market is given by

$$w_r = \frac{L_{u1} + L_{u2}}{L_{u1} + L_{u2} + L_i}\bar{w}_u + \frac{L_i}{L_{u1} + L_{u2} + L_i} w_i \equiv \lambda \bar{w}_u + (1 - \lambda) w_i, \quad \ldots \quad (5)$$

where w, suitably subscripted, represent wage rates and λ the proportion of informal employment to the urban labour force.

Note that this equilibrium condition incorporates an endogenous wage differential not only between the rural and urban regions, but also within the urban region. One may usefully quote here Harberger's observations.

> The annual earnings of casual construction workers, household sweepers and ricksha drivers in major Indian cities are about double those of landless agricultural workers in the rural hinterland. The wages of unskilled and low-skilled workers in the highly competitive textile industry of Santiago, Chile

[10]See [Portes *et al.* (1989), p. 41]. Harberger (1972, 1971a) referes to the formal sector as a "protected" sector.

[11]Since there is no money in my model, I am assuming constancy of real, as opposed to nominal, wages in the urban formal sector.

are also about double those of workers of comparable skill levels in rural areas. This type of wage differential (though not always so large) seems to be replicated in country after country.

I shall assume universal marginal productivity pricing. Given the constant returns to scale assumption, this allows me to represent the "price equals unit-cost" conditions as

$$p_r = C_r(W_r, R); \quad \ldots \quad \ldots \quad \ldots \quad \ldots \tag{6}$$

$$p_{uj} = C_{uj}(\bar{w}_u, p_i, R), j = 1, 2; \quad \ldots \quad \ldots \quad \ldots \quad \ldots \tag{7}$$

$$p_i = aw_i, \quad \ldots \quad \ldots \quad \ldots \quad \ldots \tag{8}$$

where R denotes the rentals to land and capital. The properties of the unit-cost functions are by now well understood.[12]

The specification of the model is now complete. I have to determine the allocation of capital, K_{u1}, K_{u2}, K_r and informal input, X_{i1} and X_{i2}, among the two formal sectors in the urban region; the allocation of labour, L_{u1}, L_{u2}, L_r and L_i among all the four sectors in the economy; the probability λ of urban formal employment; the returns to capital and rural and informal labour, R, w_r and w_i; the price of informal output, p_i and, finally, the four outputs, X_{u1}, X_{u2}, X_r and X_i. My parameters are the factor endowments $\mathcal{K}$ and $\mathcal{L}$; the international prices p_r, p_{u1} and p_{u2}; the technologies a, $F_r(.,.)$, $F_{u1}(.,.,.)$ and $F_{u2}(.,.,.)$, and the formal sector wage $\bar{w}_u$. I have to determine eighteen unknowns in terms of the fourteen equations explicitly stated above, and four equations which are implicit in the unit-cost functions.[13] Such a formalisation raises a natural question about the extent to which the formal-informal sector relationship can also allow some degree of substitutability. In this section, we formalise a conception in which the informal output can serve as both a complement and a substitute to the outputs produced in the formal sector.

2.1. The Basic Analysis

The first point to be emphasised is that the decomposition property, reminiscent of HOS theory,[14] holds in a rather straightforward way. I can therefore state the

[12]See Khan - Naqvi (1983) and their references.

[13]There are eight derivatives of the three unit-cost functions; given linear homogeneity of each of the three functions, I am left with five independent equations.

[14]HOS is the conventional abbreviation for Heckscher-Ohlin-Samuelson. In his 1987 *Palgrave* entry on *international trade* Chipman refers to this model under the names of Haberler-Lerner-Samuelson.

following preliminary result.[15]

Lemma 1: *International prices determine domestic factor prices and hence the choice of techniques in the rural and formal urban sectors of the economy. Furthermore, they fix the ratio of the two formal sub-sectors and informal employment, namely*

$$L_i = \frac{1-\lambda}{\lambda}(L_{u1}+L_{u2}) \Leftrightarrow \frac{L_i}{L_{u1}+L_{u2}} = \frac{\bar{w}_u - w_r}{w_r - w_i}$$

The proof follows simply by inspection of the equation system (6) to (8) and the labour market equilibrium condition (5). Figure 1 illustrates an equilibrium configuration in terms of the geometry of the unit-cost curves.

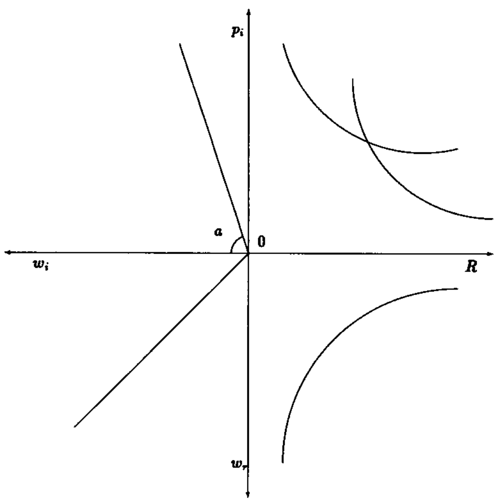

Fig. 1. Equilibrium with a Disaggregated Formal Sector

I turn next to the national income equation. I shall assume that all projects are evaluated in terms what they contribute to GNP measured in international prices. Denote this by *W* and note that it depends on all the parameters of my model. If I ignore the functional representations of the rural and formal urban technologies, I can write it as[16]

$$W(\mathcal{K}, \mathcal{L}; p_r, p_{u1}, p_{u2}; a) = p_r X_r + p_{u1} X_{u1} + p_{u2} X_{u2}. \quad \ldots \quad \ldots \quad (9)$$

[15]This represents Proposition 11 in Chandra-Khan (1991).

[16]This is precisely the *gross national product function* of Samuelson (1953) and the *production function for foreign exchange* of Chipman (1972).

It is easy to see that for every particular equilibrium configuration I obtain one, and only one, value of W. However, I shall ignore Chipman's (1972) warning and assume the differentiability of W in terms of its arguments. On appealing to the marginal productivity pricing conditions that I assume to hold universally and to the material balance equations, I can rewrite W in terms of national income[17]

$$W = R\mathcal{K} + w_r L_r + w_i L_i + \bar{w}_u (L_{u1} + L_{u2}) = R\mathcal{K} + w_r \mathcal{L}. \quad \ldots \quad \ldots \quad (10)$$

Since R is determined by international prices, I obtain

$$\frac{\partial W}{\partial \mathcal{L}} = w_r, \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (11)$$

which allows me to present the following

Proposition 1: *The social opportunity cost of labour is measured by the rural wage which, in equilibrium, also represents the average urban wage.*

I shall relate this to Harberger's prescription in the conclusion; here I briefly draw out its implication for the generalised theory of distortions. Bhagwati's 1971 exposition of this theory emphasises that in the presence of one or more distortions, there is a possibility of immiserising growth, and therefore also of negative social opportunity costs. Proposition 1 shows this not to be the case for Chandra's model, despite the fact that it is ridden with distortions in the labour market. Thus my 1982 results pertaining to the *generalised Harris-Todaro* model[18] with intersectoral capital mobility carry over to the setting studied here.

2.2. A Tariff-Ridden Formal Sector

I now turn to a setting where there are differential tariff rates on the two different outputs produced in the formal sector. As emphasised in the introduction, I shall assume a single agent whose preferences are given by a well-behaved utility function u – in this way, I abstain from all issues connected with income distribution.[19]

$$g(p_r, (1 + t_{u1})p_{u1}, (1 + t_{u2})p_{u2}, u) = p_r X_r + \sum_{j=1}^{2} (1 + t_{uj})p_{uj} X_{uj} + \sum_{j=1}^{2} t_{uj}$$
$$(g_{uj} - X_{uj}). \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (12)$$

[17]Simply note that $w_i L_i + \bar{w}_u (L_{u1} + L_{u2}) = (\mathcal{L} - L_r)(\lambda \bar{w}_u + (1 - \lambda) w_i)$.

[18]See Khan (1987) and the references therein.

[19]For details of such an analysis, see Section 2 in Khan-Lin (1982). The welfare function W used in the subsection above can be seen as one where the utility function is assumed to be linear.

This can be further simplified to yield

$$g_0 \left(1 - \frac{m(t_{u1} + t_{u2})}{1 + (t_{u1} + t_{u2})} \right) \frac{\partial u}{\partial \mathcal{L}} = w_r - t_{u1} \frac{\partial X_{u1}}{\partial \mathcal{L}} - t_{u2} \frac{\partial X_{u2}}{\partial \mathcal{L}}, \quad \dots \quad (13)$$

and by determining what happens to each of the two terms on the right hand side of (13), I can evaluate the extent to which the rural market wage under or overestimates the social opportunity cost of labour. The results revolve on the relevant notions of factor intensities and I substantiate this claim next.

Just as in the proof of Rybczynski's theorem, once the "price equals unit-cost" conditions (7) fix the input-output coefficients, total differentiation of the material balance equations yields[20]

$$\begin{bmatrix} L_{u1} & L_{u2} & L_r & L_i \\ K_{u1} & K_{u2} & K_r & 0 \\ x_{u1} & x_{u2} & 0 & -1 \\ 0 & 0 & (1-\lambda)L_r & L_i \end{bmatrix} \begin{bmatrix} \hat{X}_{u1} \\ \hat{X}_{u2} \\ \hat{X}_r \\ \hat{X}_i \end{bmatrix} = \begin{bmatrix} \mathcal{L}\hat{\mathcal{L}} \\ \mathcal{K}\hat{\mathcal{K}} \\ 0 \\ (1-\lambda)\mathcal{L}\hat{\mathcal{L}} \end{bmatrix}, \quad (14)$$

where the determinant of the (4 × 4)–matrix is denoted by $\mathcal{D}$, and where

$$x_{uj} \equiv \frac{X_{ij}}{X_i} \text{ and } l_{uj} \equiv \frac{L_{uj}}{L_{u1} + L_{u2}} \quad \text{for } j = 1, 2.$$

x_{uj} denotes the proportion of the intermediate informal input utilised in the production of the jth formal output, $j = 1, 2$, and the interpretation of l_{uj} is clear. I can now state

Theorem 1: *In the presence of tariffs, the rural wage underestimates the social opportunity cost of labour if and only if*

$$Sign\ (\mathcal{D})\ (l_{u1} - x_{u1}) > 0.$$

Of course, the interesting questions relates to conditions that go towards determining the sign of $\mathcal{D}$. It is here that we need to bring in explicitly two notions of factor intensities.

[20]Recall Ron Jones' that notation whereby $\hat{x}$ stands for dx/x.

Definition 1: *The first urban commodity is said to be capital intensive with respect to the second if and only if*

$$sign(D) \Leftrightarrow sign \left(\frac{K_{u1}}{L_{u1} + x_1 L_i} - \frac{K_{u2}}{L_{u2} + x_2 L_i} \right) \Leftrightarrow sign(q_{u1} - q_{u2}).$$

Otherwise, the second urban commodity is said to be capital intensive with respect to the first.[21]

Note that in this definition, I measure the capital labour ratio with respect to both the direct and indirect labour requirements of a particular commodity. My second notion is the more conventional definition.

Definition 2: *The first urban commodity is said to be restrictedly capital intensive with respect to the second if and only if*

$$sign(D_p) \Leftrightarrow sign \left(\frac{K_{u1}}{L_{u1}} - \frac{K_{u2}}{L_{u2}} \right) \Leftrightarrow sign(k_{u1} - k_{u2}).$$

Otherwise, the second urban commodity is said to be restrictedly capital intensive with respect to the first.[22]

As I illustrate in Figure 2, the first urban commodity can be capital intensive and yet not be restrictedly capital intensive with respect to the second, though Figure 3 brings out the fact that this need not necessarily be so.[23] I can now make a claim whose proof I leave to the Appendix.

Lemma 2: *$\mathcal{D}$ is positive if $k_{u1} > k_r > k_{u2}$ and $q_{u2} > q_{u1}$, and negative if $k_{u2} > k_r > k_{u1}$ and $q_{u1} > q_{u2}$.*

The lemma prompts the following

Definition 3: *The jth urban commodity is said to be strongly capital intensive with*

[21]I ignore the case when D is zero. Note also that q_{uj} is being defined in the definition.

[22]Again, I ignore the case when D_p is zero. Note also that k_{uj} is being defined in the definition.

[23]In both of these Figures, $(\mathcal{X} - K_r)$ should be substituted for $\mathcal{X}$. I do not make this substitution because I need the figures in their original form for the section to follow.

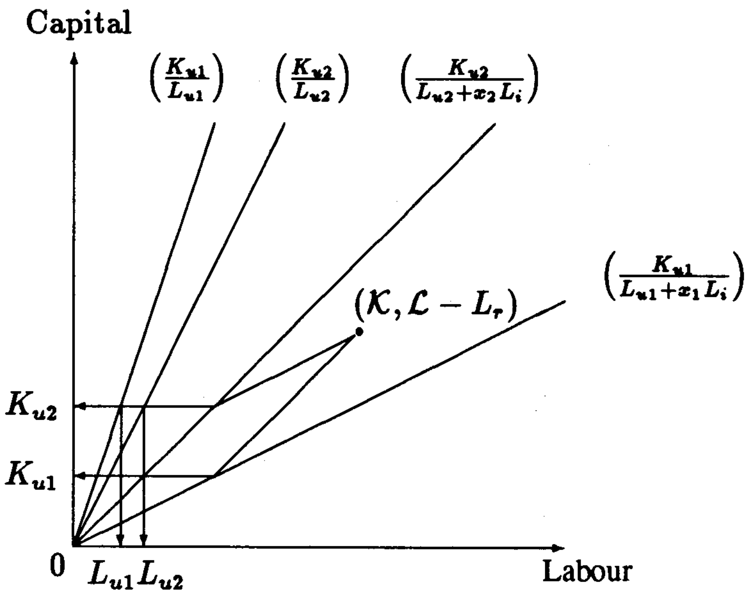

Fig. 2. Intensities and Restricted Intensities Conflict

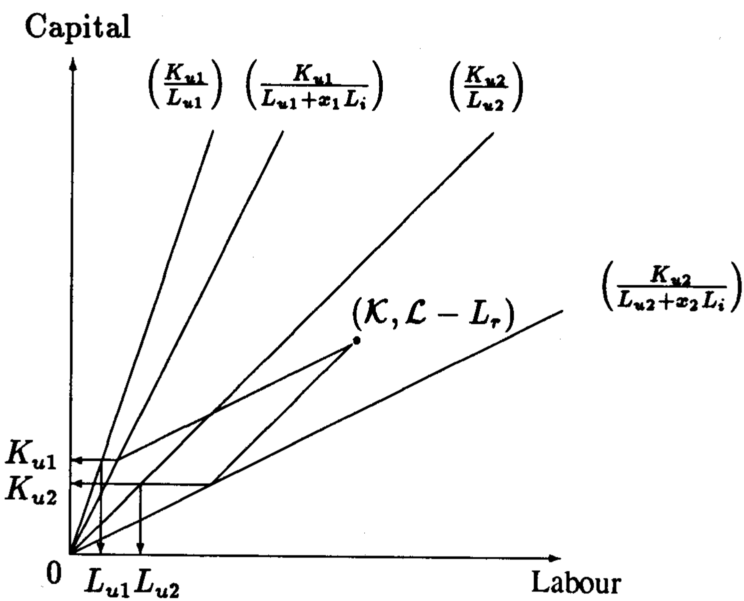

Fig. 3. Intensities and Restricted Intensities Coincide

respect to the lth if and only if $k_{uj} > k_r > k_{ul}$ $j = 1, 2,$ *and* $j \neq l$.

I can now present

Proposition 2: *In the presence of tariffs, the rural wage underestimates the social opportunity cost of labour if*

- *the urban commodity, say the first, that is strongly capital intensive is also the one that employs a larger proportion of the formal labour force as compared to the proportion of the informal input used,*
- *the other urban commodity is restrictedly capital intensive with respect to the first.*

I conclude this subsection by underscoring the fact that Proposition 2 represents only sufficient conditions. Thus, if one is so inclined, one can also write down results which show that the rural wage overestimates the social opportunity costs of labour. I shall return to this remark in Section 4.

3. A VARIANT OF CHANDRA'S MODEL

I now present a model[24] which is identical to Chandra's model other than the one "small" change that capital is nonshiftable between the urban and rural sectors. This change can also be seen as a conception of the rural sector which is land-scarce, with capital simply determining the quality of land. Either interpretation leads me to a model of an economy with four factors of production. Three of these – land, labour and capital,[25] $\mathcal{T}$, $\mathcal{L}$ and $\mathcal{K}$ respectively – are primary factors, whereas the remaining one, henceforth to be referred to as an informal input, is a produced means of production. The only changes from Chandra's model are that the technology for rural output is now given by

$$X_r = F_r(L_r, T), \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (15)$$

where T represents the demand for land; and the corresponding "price equals unit-cost" Equation (6) is changed to

$$p_r = C_r(w_r, \tau), \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (16)$$

[24]A preliminary analysis of this model was presented in Khan (1992).

[25]Or alternatively, two labour and two types of capital.

where τ denotes the rental to land.

3.1. The Basic Analysis

Since in equilibrium the demand for land T is equated to its supply $\mathcal{T}$, and its rate of return τ is endogenously determined, I now have, relative to Chandra's model, an extra equation to determine an extra unknown. This leads me to nineteen equations as opposed to the eighteen analysed earlier. However, this quantitative change is hardly the issue; what is of importance is that the decomposition property of the HOS theory no longer holds, and the familiar Rybczynski and Stolper-Samuelson benchmarks are no longer relevant for the model as a whole. In particular, I no longer have Lemma 1 to rely on, and this makes all the difference.

The primary and basic observation in the context of the model is that the equation system characterising the equilibrium can be sliced so as to enable me to work in the λ – w_r plane with rural wages and the employment rate in the formal sector as the relevant variables. Accordingly, I can decompose the model into two parts – the first consisting of the labour market equilibrium condition (5), and the second consisting of the remaining eighteen equations. Observe that (5) furnishes a linear relationship that can be represented as *LL* in Figures 4 and 5, *LL* being a mnemonic device for equilibrium in the labour market. The slope of the *LL* curve is easily seen to be

$$\frac{d\lambda}{dw_r} \mid LL = \frac{1}{\overline{w}_u - w_i} \cdot \qquad \ldots \qquad \ldots \qquad \ldots \qquad (17)$$

The *LL* curve is independent of p_r, changes with changes in the international prices p_{u1} and p_{u2} as a consequence of (7), and its graph lies in the range of λ between zero and unity.

Next, I turn to the other relationship between λ and w_r. Pick a particular value of w_r. This fixes the value of L_r from the marginal productivity condition[26] $p_r F_r^L (L_r, \mathcal{T}) = w_r$ and determines the supply of labour that is available for the production of urban output, both formal and informal. Since the choice of technique in the urban region has already been determined by the international prices,[27] this supply, along with that of capital, determines both the outputs and the factor inputs.[28] Since

[26]Throughout the sequel, I shall denote partial derivatives by superscripts.

[27]Again, as a consequence of (7).

[28]Material balance for labour, capital and informal input furnishes me with three equations in the three unknowns, X_{u1}, X_{u2} and X_i. Since the input output coefficients are already determined, I can calculate the labour requirements.

the probability of formal employment depends on L_{u1}, L_{u2} and L_r, I obtain my second relationship between λ and w_r, and my second graph in the $\lambda - w_r$ plane. Represent this graph by CC as in Figures 4 and 5.

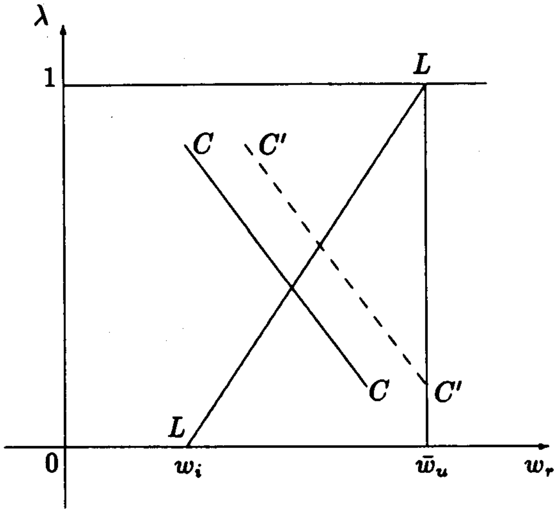

Fig. 4. Intensity Rankings Conflict

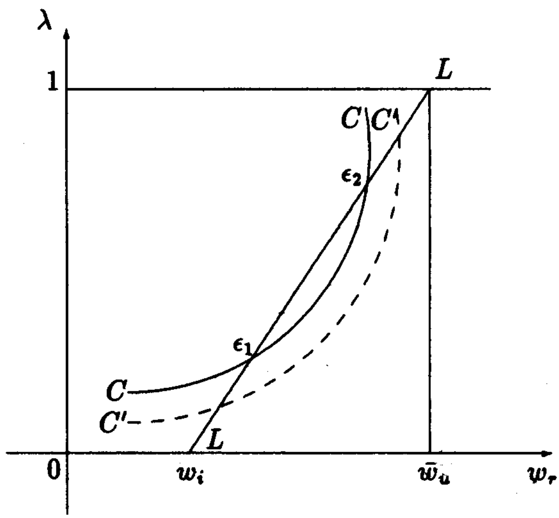

Fig. 5. Intensity Rankings Coincide

The interesting question, of course, concerns the slope of this curve. What I would like to emphasise is that once w_r is given, I am in a position to exploit some of the insights of the HOS theory, not for the model as a whole but in the context of the curve CC. Just as in the proof of Rybczynski's theorem, once the "price equals unit-cost" conditions (7) fix the input-output coefficients, total differentiation of the material balance equations yields.

$$\begin{bmatrix} K_{u1}/L_{u1} & K_{u2}/L_{u2} \\ 1 + a(X_{i1}/L_{u1}) & 1 + a(X_{i2}/L_{u2}) \end{bmatrix} \begin{bmatrix} dL_{u1} \\ dL_{u2} \end{bmatrix} = \begin{bmatrix} d\mathcal{K} \\ d(\mathcal{L} - L_r) \end{bmatrix}. \qquad (18)$$

Let the determinant of the matrix be given by D.

I am now ready to compute the slope of the CC curve. The difficulty lies in the fact that Definitions 1 to 3 are not enough to pin down the slope of CC. As w_r rises, L_r falls and leads to a rise in $\mathcal{L} - L_r$. Now, irrespective of factor intensities as defined in Definition 1, or indeed as in Definition 2, output and employment of one sector rise and those of the other fall.[29] However, since the employment of both sectors goes in the determination of λ, the change in λ cannot be determined without additional information relating to magnification. Thus more computation is unfortunately necessary,[30] and it yields my first foothold.

$$\frac{d\log\lambda}{d\log(\mathcal{L} + L_r)} = \frac{a\mathcal{K}}{D(L_{u1} + L_{u2})} \left(\frac{X_{i1}}{L_{u1}} - \frac{X_{i2}}{L_{u2}} \right) \cdot \quad \dots \quad \dots \qquad (19)$$

This prompts the following

Definition 4: *The first urban commodity is said to be intermediate good intensive with respect to the second if and only if*

$$sign(\Delta) \Leftrightarrow sign \left(\frac{X_{i1}}{L_{u1}} - \frac{X_{i2}}{L_{u2}} \right) \cdot$$

Otherwise, the second urban commodity is said to be intermediate good intensive with respect to the first.[31]

[29] This can be seen most simply in my modification of the Jones' diagram presented as Figures 2 and 3.

[30] See the Appendix.

[31] I again ignore the case when the sign of Δ is zero.

I now obtain

$$\frac{d\lambda}{dw_r} \mid CC = -\left(\frac{1}{p_r F_r^{LL}}\right)\left(\frac{a\mathcal{K}}{(\mathcal{L}-L_r)^2}\right)\frac{\Delta}{D}, \quad \cdots \quad \cdots \qquad (20)$$

Which leads me to conclude that the slope of CC is positive if either urban commodity is *both* capital and intermediate good intensive with respect to the other. More comprehensively, I can state

Definition 5: *Factor intensities are said to conflict if one urban commodity is capital intensive but not intermediate good intensive with respect to the other, which is to say if sign* $(D) \neq$ *sing* (Δ). *Otherwise factor intensities are said to coincide.*

If factor intensities conflict, as in Figure 4, the slope of CC is negative; and if they coincide, as in Figure 5, this slope is positive. Figure 5 highlights the interesting possibility of multiple equilibria.[32]

A question logically prior to the conduct of comparative static exercises is the non-emptiness and the cardinality of the set of equilibria. In terms of non-emptiness, Figure 5 illustrates how an equilibrium can be destroyed by shifting the curve CC outward. It is important to notice that this fragility also extends to the case where the factor intensities conflict – in Figure 4, the curves LL and CC may easily intersect outside the feasible range of λ. Furthermore, even when there does exist an unspecialised equilibrium, as in Figures 2 and 3, it is a very easy matter to find parameter values for which such an equilibrium can be destroyed – simply perturb $\mathcal{K}$ or $\mathcal{L}$ such that the point $(\mathcal{K}, \mathcal{L} - L_r)$ moves out of the analogue of the Chipman-McKenzie cone of diversification.[33] However, I give no existence theorem – given the variety of parameters involved, it would essentially reduce to a statement that *equilibrium exists when it exists.*

I turn next to the question of the cardinality of the set of equilibria. If the CC curve is tangent to the LL curve in Figure 5, and the two equilibria ϵ_1 and ϵ_2 collapse to a unique equilibrium, the situation is not very propitious for comparative static analysis. This is, of course, none other than Debreu's insistence on the existence of an unspecialised equilibrium which is robust enough for local comparative static analysis to be meaningful.[34] This leads me to look for conditions on the

[32]The exact shape of the downward sloping curve CC will depend upon the second derivatives. For my purposes, it suffices to point to the possibility of multiple equilibria.

[33]See, for example, Chipman (1972, 1987) and his references.

[34]On these issues, see Debreu (1976) and the references therein.

parameters of my economy which prevent the occurrence of such non-robust equilibria. Again, given the distortions in my model, it is difficult for me to conceive that any general results on this issue can be obtained.

Definition 6: *An equilibrium is said to be robust if and only if*

$$\frac{\partial \lambda}{\partial w_r} \mid LL \neq \frac{\partial \lambda}{\partial w_r} \mid CC.$$

One final point. Note that Definition 5 is of a second order level – I have already built in the fact that my analogue of the Chipman-McKenzie cone of diversification is not degenerate in the assumption that D is not equal to zero in Definition 1.

3.2. Choice among Equilibria

I now turn to the more conventional enquiry and ask whether there exist intuitively plausible dynamic adjustment processes, stability of whose rest points rule out some of the equilibria in the case when factor intensities coincide. Towards this end, I propose an adjustment process $\mathcal{Q}$ defined by the following differential equations:

$$\mathcal{D}L_r = \pi\{w_r - (\lambda w_u + (1-\lambda)w_i)\} \qquad \pi'(\cdot) > 0,\ \pi(0) = 0,$$

$$D\lambda = \psi\{\frac{L_{u1} + L_{u2}}{(L_{u1} + L_{u2} + L_i)} - \lambda\} = \psi\{\frac{L_{u1} + L_{u2}}{(\mathcal{L} - L_r)} - \lambda\} \qquad \psi'(\cdot) > 0,\ \psi(0) = 0.$$

Note that my process puts the brunt of the adjustment in the informal sector. If the rural wage is greater than the expected urban wage, $\mathcal{Q}$ postulates that there will be a reverse migration to the rural sector, one that releases the pressure on the informal sector and thereby lowers the rural wage and increases the informal sector wage. On the other hand, if the probability of finding a formal sector job is less than the formal sector employment as a proportion of the total urban labour force, a migrant revises upward his probability of finding a job in the formal sector.

It is difficult to place my process $\mathcal{Q}$ within the traditional Marshallian-Walrasian dichotomy. The adjustment of labour is clearly Marshallian in spirit, but that of the (formal) employment rate has Walrasian elements to the extent that it reflects a price – the expected urban wage.

I can now present a theorem which states that stability of equilibrium implies and is implied by the fact that the slope of the CC curve be greater than that of the

LL curve.

Theorem 2: *A robust equilibrium is locally asymptotically stable under adjustment process* $\mathcal{Q}$ *if and only if*

$$\frac{\partial \lambda}{\partial w_r} \mid LL > \frac{\partial \lambda}{\partial w_r} \mid CC.$$

In this case, the approach to equilibrium is monotonic.

Note that $\in_1$ is locally asymptotically stable while equilibrium $\in_2$ is a saddle-point. For an intuition behind the result, consider, for example, a situation in which the system finds itself in the lens in Figure 5. Since it is above the *CC* curve, the value of λ is more than that required for equilibrium. Hence the argument of ψ is negative and λ decreases. Analogously, since the system is below the *LL* curve, w_r is more than that required for equilibrium. Hence the argument of π is positive and L_r increases and leads to a decrease in w_r. The two effects in conjunction drive the system away from $\in_2$ and towards $\in_1$. I present the formal proof in the Appendix.

I find Theorem 1 interesting when I view it in the context of previous work on the stability of equilibrium of either the HOS model with exogenously given wage differentials or of the HOS version of the Harris-Todaro model.[35] In this work, instability and other pathologies are intimately tied to conflicting factor intensities.[36] Here, it is precisely conflicting intensities that rule out multiple equilibria.

3.3. Social Opportunity Cost of Labour

The welfare function *W* in the context of my model is now given by

$$W(\mathcal{T}, \mathcal{K}, \mathcal{L}; p_r, p_{u1}, p_{u2}; a) = p_r X_r + p_{u1} X_{u1} + p_{u2} X_{u2}\,, \qquad \ldots \qquad \ldots \tag{21}$$

and can be rewritten in terms of national income as[37]

$$W = R\mathcal{K} + \tau\mathcal{T} + w_r L_r + w_i L_i + \overline{w}_u (L_{u1} + L_{u2}) = R\mathcal{K} + \tau\mathcal{T} + w_r \mathcal{L}. \tag{22}$$

Unlike Formula (10) pertaining to Chandra's model, domestic factor prices are no

[35]See Khan (1987) and the references therein.

[36]The *physical* and *value* intensities for the first model, and *unemployment-adjusted* and *elasticities-adjusted* intensities for the second. The latter collapse to a positive number in the case of an exogenously given sector-specific urban wage.

[37]The formula in Footnote 16 is also relevant here.

longer determined solely by international commodity prices. Thus, differentiation of (22) with respect of labour yields[38]

$$\frac{\partial W}{\partial \mathcal{L}} = w_r + (\mathcal{L} - L_r)\ \frac{\partial w_r}{\partial \mathcal{L}}\ , \qquad \ldots \qquad \ldots \qquad \ldots \qquad (23)$$

and allows me to present the first result of this subsection.

Proposition 3: *The social opportunity cost of labour is the rural wage adjusted by a factor reflecting the marginal change in the labour income of the urban sector, which is to say the urban employment times the marginal change in the average urban wage.*

I can rephrase the above proposition in terms of the informal sector wage, with (23) rewritten as

$$\frac{\partial W}{\partial \mathcal{L}} = w_i + \lambda(\overline{w}_u - w_i)\left(1 + (1 - \frac{L_r}{\mathcal{L}})\in\lambda\mathcal{L}\right)\ , \qquad \ldots \qquad \ldots \qquad (24)$$

However, whether the market price over- or under-estimates the social opportunity cost of labour depends on $\in_{\lambda\mathcal{L}}$, the elasticity of formal employment with respect to changes in the endowment of labour. For a complete treatment, this should be decomposed into more fundamental measures – a point emphasised by Stiglitz some years ago.[39] I turn to this. Note that with an increase in labour, the *LL* curve does not shift and I have to focus solely on the *CC* curve. Towards this end, note that for a given value of w_r, rural employment and hence labour supply to the urban region does not change. The question then arises as to what happens to λ. But this has already been determined by formula (19) which can now be reproduced as

$$\frac{d\log\lambda}{d\log\mathcal{L}} = \frac{a\mathcal{K}}{(L_{u1} + L_{u2})}\left(\frac{\Delta}{D}\right). \qquad \ldots \qquad \ldots \qquad \ldots \qquad (25)$$

But now the analysis is complete. If factor intensities conflict, λ decreases and the *CC* curve shifts downward. On the other hand, if factor intensities coincide, λ

[38]See The Proof of Proposition 3 in the Appendix.

[39]See Stiglitz (1982).

increases and the CC curve shifts upward.[40] Even though there is the possibility of multiple equilibria when factor intensities coincide, local asymptotic stability of equilibrium under the dynamic process $\mathcal{Q}$ leads me to focus only on the equilibrium labelled $\in_2$ in Figure 5. Consequently, I have established the following proposition.

Proposition 4: *If factor intensities conflict, the social opportunity cost of labour is underestimated by the rural wage. If factor intensities coincide and the equilibrium is locally asymptotically stable, the social opportunity cost of labour is underestimated by the rural wage which, in equilibrium, also represents the average urban wage.*

3.4. Social Opportunity Cost of Labour with Tariffs

I now return to the setting of Section 2.2 where there are differential tariff rates on the two different outputs produced in the formal sector. Formula (12) remains unchanged but (13) is now modified to

$$g_0\left(1-\frac{m(t_{u1}+t_{u2})}{1+(t_{u1}+t_{u2})}\right)\frac{\partial u}{\partial \mathcal{L}}=w_r+(\mathcal{L}-L_r)\frac{\partial w_r}{\partial \mathcal{L}}-t_{u1}\frac{\partial X_{u1}}{\partial \mathcal{L}}-t_{u2}\frac{\partial X_{u2}}{\partial \mathcal{L}}. \qquad (26)$$

Again, by determining what happens to each of the two terms on the right hand side of (25), I can evaluate the extent to which the rural market wage under or overestimates the social opportunity cost of labour.

Unfortunately, the situation is more complicated than was the case for Chandra's model. This follows simply from the fact that a change in the endowment of labour has two effects: a direct effect plus an indirect one on account of changes in the rural wage and consequent changes in the supply rural employment. The following Rybczynski-type formula brings this out.[41]

$$\begin{bmatrix} K_{u1} & K_{u2} \\ L_{u1}+aX_{i1} & L_{u2}+aX_{i2} \end{bmatrix}\begin{bmatrix}\hat{X}_{u1}\\ \hat{X}_{u2}\end{bmatrix}=\begin{bmatrix} \mathcal{K}\hat{\mathcal{K}} \\ 1-\dfrac{\partial L_r}{\partial w_r}\dfrac{\partial w_r}{\partial \mathcal{L}}\,d\mathcal{L}\end{bmatrix}. \qquad (27)$$

The difficulty lies in the fact that the direct and indirect effects are opposed to each other under the hypotheses that allowed to derive Proposition 4. I can therefore lamely conclude, at least for the present, the following

[40]Figures 4 and 5 are relevant and useful here provided $C'C'$ is interchanged with CC.

[41]This is essentially a rewriting of Formula (18).

Proposition 5: *In the presence of tariffs, the rural wage may or may not underestimate the social opportunity cost of labour. The direction and magnitude of the divergence depends on more detailed hypotheses on various elasticities.*

4. CONCLUDING REMARKS

I now conclude my lecture. First, a summary of the substantive results. In simple models which distinguish between the protected and unprotected urban sectors, I have computed formulae for the social opportunity costs of labour. In the absence of any tariffs, I have shown that the rural wage measures the social opportunity cost of labour if capital is shiftable between the rural and urban regions (Proposition 1); and underestimates it if it is not so shiftable and if the equilibrium is asymptotically stable in terms of an intuitively plausible, but in the final analysis, *ad hoc* dynamic process (Proposition 4). However, once I moved away from universal intersectoral mobility of capital, I could not present any clear results once the crutch of asymptotic stability was dispensed with (Proposition 3). With a tariff-ridden formal sector, on the other hand, such a lack of clean and unambiguous results was the rule rather than the exception (Proposition 5). However, I have presented a set of sufficient conditions involving factor intensities under which the underestimation result continues to hold (Proposition 2).

Next, I contrast these findings with Harberger's recommendation to use the informal sector wage for projects in the urban sector.

> I have attempted to present the case for using prevailing wage levels in the.. unprotected sector as a point of departure for estimating the social opportunity cost of labour in a given market area. With modest qualifications and occasional adjustments (usually upward) the unprotected-sector wage stands as the basic measure of social opportunity cost. As against alternative measures, most of which are based on macroeconomic analyses of one form or another, it has the great advantage of being readily capable of reflecting the complexity and subtlety of labour-market phenomenon. The approach here advocated takes the infinitely complex machinery of the economy itself as its computer and finds in the data generated by that machinery – in the form of unprotected-sector wages – the best approach to measuring the social opportunity cost of labour – by type, skill, and location.[42]

Since the informal wage is less than the rural wage, my results on the underestimation of the rural wage as a measure of the social opportunity cost agree, strictly

[42][Harberger (1972), p. 180-182.]

speaking, with Harberger's intuition of a "usually upward adjustment." It bears emphasis, however, that under my conception of the interconnectedness in the economy and of the size of the project, the social opportunity cost is independent of location. This implies that for a project located in the urban formal sector, the wage ought to be reckoned in terms of the relevant measure of social opportunity costs, but workers would be actually paid the formal sector wage. Harberger also draws attention to this.

> Let us now ask what is the true purpose behind the use of social opportunity costs (shadow wages) in the evaluation of investment projects. I believe that the answer is that where there is an excess of wages actually paid over social opportunity costs, this excess should be counted as part of the benefits of the project.[43] My discussion will be based on the general economic principle that employers do not wittingly pay workers more than they (the employers) believe the incremental contribution of each worker to the value of output to be.[44]

Of course, the converse ought also to hold in cases where the rural wage overestimates the social opportunity costs, namely that the deficit should be counted towards the costs of the project.

Harberger uses the informal wage as "the point of departure" for his computations. As I discussed through Formula (24), the particular benchmark used is not the important point – it can be the rural wage or the informal wage – but rather the divergence from it. Harberger, himself writes elsewhere,

> I shall present analyses indicating that the true measure of social opportunity cost lies somewhere between the measurable supply price of labour and the market price actually paid in a given activity.[45]

What is of interest to me is that he explicitly rejects my Proposition 1 even when he is not allowing for tariffs and other complications.

> The conclusion that is normally drawn is that, at least for unskilled urban jobs, the relevant measure of social opportunity cost is the marginal product of agricultural labour in rural areas. Plausible though it sounds, the above argument contains a basic flaw.[46]

[43][See Harberger (1972), pp. 165-166.]

[44][See Harberger (1972), p. 159.]

[45][See Harberger (1972), pp. 158-159.]

[46][See Harberger (1972), p. 162.]

Harberger emphasises and reasons in terms of the *destination wage.*

> The demand price is the fixed wage at the destination, the supply price is that wage which would just barely induce (or compensate) migration. As unemployment mounts, this supply price rises, and the adjustment becomes complete when this supply price equals the fixed destination wage. This demonstrates very simply the usual result that under conditions of migration-fed unemployment the social opportunity cost of labour will end up being equal to the fixed destination wage. Not only do we reach this result simply, but once again we see the power of the three postulates. The answer is a profound expression of postulate (ii).[47]

In summary, my difficulty with Harberger's prescriptions is that despite the wide-ranging and insightful discussion that is adduced in justification, it is difficult to pin down precisely the model that lies behind and articulates the several conceptions of the labour markets that he presents. It is the model which allows a clear interpretation of his postulate (i) and (ii), and what we are to do depends crucially on the conception of the economy which one has in mind. Economic theorising represents a double movement – from reality to model to reality. Each such movement represents a compromise and it makes little sense to me to search for *the* compromise.[48] Harberger comes close to this when he emphasises the word *equilibrium.*

> The emphasis here, of course, must be on the word *equilibrium.* The social opportunity cost of labour in a sense includes the cost of this unemployment, and hence must go up if more attractive wages or an increased fraction of jobs in the protected sector induce a rise in the equilibrium level of unemployment.[49]

Two final points – these relate to the issues of *simplicity* and *robustness.* I have worked with simple models. In particular, unlike some of Harberger's 1971 settings, I do not have a separate category of urban unemployed in my model,[50] and my introduction specifies in broad outline all that I have ignored. Furthermore, even though I have worked in a partial equilibrium setting – essentially mildly disaggregated Marshallian production theory – my analysis, especially of my second model, shows that one cannot really ignore the whole gamut of general equilibrium techniques such as existence,

[47][See Harberger (1988), p. 49.]

[48]This issue has obvious epistemological implications – see Khan (Section 3, 1991; 1992a). See also the introduction to Stiglitz (1977) and Stiglitz (1982).

[49][See Harberger (1972), p. 175.]

[50]It was precisely to provide an underpinning in terms of livelihood for the unemployed that constituted one of my motivations for the introduction of an informal sector, but I may have swung to the other extreme. See Gupta (1991) for a model with an informal sector and open unemployment.

cardinality, structural stability and hypotheses on the underlying dynamics.[51] Yet inspite of this, my formulae for the social opportunity costs can get complicated very easily. The question of robustness is equally murky. I shall end by reminding you that the only difference between the two models is the issue of non-shiftability of capital between the two regions, but the analysis and the results are very different.

5. APPENDIX

An alternative derivation of Formula 11:

$$\begin{aligned}
\frac{\partial W}{\partial \mathcal{L}} &= R\left(\frac{\partial K_r}{\partial \mathcal{L}} + \frac{\partial K_{u1}}{\partial \mathcal{L}} + \frac{\partial K_{u2}}{\partial \mathcal{L}}\right) + w_r \frac{\partial L_r}{\partial \mathcal{L}} + \bar{w}_u \left(\frac{\partial L_{u1}}{\partial \mathcal{L}} + \frac{\partial L_{u2}}{\partial \mathcal{L}}\right) + p_i \frac{\partial X_i}{\partial \mathcal{L}} \\
&= w_r \frac{\partial L_r}{\partial \mathcal{L}} + \bar{w}_u \left(\frac{\lambda}{1-\lambda}\right)\frac{\partial L_i}{\partial \mathcal{L}} + w_i \frac{\partial L_i}{\partial \mathcal{L}} \\
&= w_r \frac{\partial L_r}{\partial \mathcal{L}} + \frac{\partial L_i}{\partial \mathcal{L}}\left(\frac{\bar{w}_u \lambda + (1-\lambda) w_i}{1-\lambda}\right) \\
&= w_r \frac{\partial L_r}{\partial \mathcal{L}} + \frac{\partial L_i}{\partial \mathcal{L}}\left(\frac{w_r}{1-\lambda}\right) \\
&= \frac{w_r}{1-\lambda}\left((1-\lambda)\frac{\partial L_r}{\partial \mathcal{L}} + \frac{\partial L_i}{\partial \mathcal{L}}\right) \\
&= w_r \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (28)
\end{aligned}$$

Proof of Theorem 1: On applying Cramer's rule to (14), I obtain

$$\begin{aligned}
\frac{\hat{X}_{u1}}{\hat{\mathcal{L}}} &= (1/\mathcal{D}) \begin{bmatrix} \mathcal{L} & L_{u2} & L_r & L_i \\ 0 & K_{u2} & K_r & 0 \\ 0 & x_{u2} & 0 & -1 \\ (1-\lambda) & 0 & (1-\lambda)L_r & L_i \end{bmatrix} \\
&= (1/\mathcal{D})\, K_r \mathcal{L}[(1-\lambda)\, L_{u2} - \lambda x_{u2} L_i] \\
&= (1/\mathcal{D})\, K_r \mathcal{L}[(1-\lambda)\, L_{u2} - (L_{u1} + L_{u2}) x_{u2}]. \qquad \ldots \quad \ldots \qquad (29)
\end{aligned}$$

[51]Indeed, it is far from clear to me that in the settings that I work, the terms *partial* versus *general equilibrium* really carry that much bite. The extent of disaggregation may be a more relevant criteria to classify and distinguish the relevant literature.

$$\frac{\hat{X}_{u2}}{\hat{\mathcal{L}}} = (1/\mathcal{D}) \begin{bmatrix} L_{u1} & \mathcal{L} & L_r & L_i \\ K_{u1} & 0 & K_r & 0 \\ x_{u1} & 0 & 0 & -1 \\ 0 & (1-\lambda)\mathcal{L} & (1-\lambda)L_r & L_i \end{bmatrix}$$

$$= (1/\mathcal{D})\, K_r\, \mathcal{L}[\lambda x_{u1} L_i - (1-\lambda)\, L_{u1}]$$

$$= (1/\mathcal{D})\, K_r\, \mathcal{L}(1-\lambda)\, [(L_{u1} + L_{u2})x_{u1} - L_{u1}]. \qquad \ldots \qquad \ldots \qquad (30)$$

$$t_{u1}\frac{\partial X_{u1}}{\partial \mathcal{L}} + t_{u2}\frac{\partial X_{u2}}{\partial \mathcal{L}} = (1/\mathcal{D})\, K_r\, (1-\lambda)\, (l_{u2} + x_{u2})\, (t_{u1}X_{u1} + t_{u2}X_{u2})$$
$$= -\,(1/\mathcal{D})\, K_r\, (1-\lambda)\, (l_{u1} + x_{u1})\, (t_{u1}X_{u1} + t_{u2}X_{u2}). \qquad (31)$$

The proof is finished.

Proof of Lemma 2: The determinant $\mathcal{D}$, of the (4×4)– matrix in (17) is given by

$$L_i\{x_{u1}(L_{u2}K_r - L_rK_{u2}) - x_{u2}(L_{u1}K_r - L_rK_{u1})\} + (1-\lambda)\, L_r\{(L_{u1}K_{u2} - K_{u1}L_{u2}) \quad \ldots \quad (32)$$
$$- L_i(K_{u1}x_{u2} - K_{u2}x_{u1})\}. \quad \ldots \quad (33)$$

On collecting terms, the claim can be established.

A Derivation of Formula 19:

$$\frac{dlog\lambda}{dlog(\mathcal{L} - L_r)} = \frac{\mathcal{L} - L_r}{L_{u1} - L_{u2}}\left(\frac{dL_{u1}}{d(\mathcal{L} - L_r)} + \frac{dL_{u2}}{d(\mathcal{L} - L_r)}\right) - 1$$

$$= \frac{\mathcal{L} - L_r}{D(L_{u1} - L_{u2})}\left(\frac{K_{u1}}{L_{u1}} - \frac{K_{u2}}{L_{u2}}\right) - 1$$

$$= \frac{\mathcal{L} - L_r}{D(L_{u1} - L_{u2})}\left(\frac{K_{u1}}{L_{u1}}\left(1 - \lambda(1 + a\frac{X_{i2}}{L_{u2}})\right) - \frac{K_{u2}}{L_{u2}}\left(1 - \lambda(1 + a\frac{X_{i2}}{L_{u2}})\right)\right)$$

$$= \frac{K_{u1}L_i(x_1L_{u2} - x_2L_{u1}) - K_{u2}L_i(x_2L_{u1} - x_1L_{u2})}{L_{u1}L_{u2}D(L_{u1} + L_{u2})}$$

$$= \frac{a\mathcal{K}}{D(L_{u1} - L_{u2})}\left(\frac{X_{i1}}{L_{u1}} - \frac{X_{i2}}{L_{u2}}\right). \qquad \ldots \qquad \ldots \qquad \ldots \qquad (34)$$

Proof of Theorem 2: In what follows, I shall assume that $\pi'(0) = \Psi'(0) = 1$; it can be checked that this can be done without any loss of generality. Now, linearisation of the differential equations around their equilibrium values (denoted by starred superscripts) gives

$$\begin{bmatrix} \mathcal{D}L_r \\ \mathcal{D}\lambda \end{bmatrix} = \begin{bmatrix} p_r F_r^{LL} & -(\bar{w}_u - w_i) \\ -(a\mathcal{K}/(L - L_r)^2)\frac{\Delta}{D} & -1 \end{bmatrix} \begin{bmatrix} L_r - L_r^* \\ \lambda - \lambda^* \end{bmatrix}$$

$$= -(p_r F_r^{LL}) \begin{bmatrix} -1 & -1/(\frac{\partial\lambda}{\partial w_r}|LL) \\ -(\frac{\partial\lambda}{\partial w_r}|CC) & -1 \end{bmatrix} \begin{bmatrix} L_r - L_r^* \\ \lambda - \lambda^* \end{bmatrix} \quad \ldots \quad (35)$$

I first show sufficiency of the condition. For this, I appeal to a result in [Hirsch-Smale (1974), p. 181], which guarantees that an equilibrium is locally asymptotically stable if in (17) the trace of the matrix is negative and the determinant is positive. It is clear that this is so under the assumptions of my model and the condition stipulated in the theorem.

In order to show that locally asymptotically stability of the equilibrium implies the stipulated condition, I appeal to another result in [Hirsch-Smale (1974), p. 187]. This guarantees that none of the roots of the characteristic quadratic of the matrix in (17) have positive real parts. Consider the case when the roots are real. If one or both of them are zero, their product is zero and hence the determinant of the above matrix is zero. This implies that

$$\frac{\partial\lambda}{\partial w_r}|LL = \frac{\partial\lambda}{\partial w_r}|CC,$$

a contradiction to the fact that the equilibrium is robust. Thus neither of the roots is zero and thus the determinant of the above matrix is positive. But this implies the condition of the theorem.

Thus, suppose that the roots are imaginary, pure or otherwise. In either case, the determinant of the above matrix is positive and we again obtain the condition of the theorem.

All that remains for me to show is that the approach to equilibrium is monotonic. For this, I have to show the impossibility of imaginary roots to the characteristic equation. It is a simple result that a sufficient condition for this is that [trace $(A)]^2 > 4$ [determinant (A)]. It is easy to check that this is implied by the condition of the theorem.

Proof of Proposition 3: Consider the following identity phrased in terms of any given parameter α.

$$T\frac{\partial\tau}{\partial\alpha} + L_r\frac{\partial w_r}{\partial\alpha} = 0, \ (\alpha = \mathcal{T}, \mathcal{K}, \mathcal{L}). \quad \ldots \quad \ldots \quad \ldots \quad (36)$$

This follows from constant returns to scale of the function F_r (.,.) which implies $TF_r^{LT} + L_rF_r^{LL} = 0$ and $TF_r^{TT} + L_rF_r^{LT} = 0$. But now on differentiation of the identity and on the relevant substitutions, I obtain

$$\frac{\partial w}{\partial \alpha} = x + (\mathcal{L} - L_r)\frac{\partial w_r}{\partial \alpha}, \ (x = \tau, R, w_r), \ (\alpha = \mathcal{T}, \mathcal{K}, \mathcal{L}). \quad \ldots \qquad (37)$$

This completes the proof.

REFERENCES

Bhagwati, J. N. (1971) The General Theory of Distortions and Welfare. In J. N. Bhagwati *et al.* (eds) *Trade, Balance of Payments and Growth.* Amsterdam: North Holland Publishing Co.

Chandra, V. (1991) The Informal Sector in Developing Countries: A Theoretical Analysis. Unpublished Ph. D. Dissertation, The Johns Hopkins University, Baltimore.

Chandra, V., and M. Ali Khan (1991) Foreign Investment in the Presence of an Informal Sector. *Economica.* Forthcoming. (Johns Hopkins Working Paper No. 276.)

Chipman, J. (1972) The Theory of Exploitative Trade and Investment Policies: A Reformulation and a Synthesis. In L. E. Di Marco (ed) *International Economics and Development.* New York: Academic Press.

Debreu, G. (1976) Regular Differentiable Economies. *American Economic Review* 66: 280–287.

Eatwell, J., P. Newman and M. Milgate (eds) (1987) *The New Palgrave.* New York: Macmillan.

Gupta, M. R. (1992) Rural Urban Migration, Informal Sector and Development Policies: A Theoretical Analysis. *Journal of Development Economics.* (Forthcoming.)

Harberger, A. C. (1971) On Measuring the Social Opportunity Cost of Labour. *International Labour Review* 103: 559–579. Reprinted as Chapter 7 in Harberger (1972) and in K. Wohlmuth (ed) (1975) *Employment Creation in Emerging Societies.* New York: Praeger Publishers.

Harberger, A. C. (1971a) Three Basic Postulates for Applied Welfare Economics: An Interpretive Essay. *Journal of Economic Literature* 9: 785–797. Also Tres postulados basicos para la economia del binestar aplicada: un ensayo interpretativo. In E. Foster (ed) *Analysis Costo-Beneficio.* Madrid: Instituto de Estudios Fiscales, Ministerio de Hacienda.

Harberger, A. C. (1972) *Project Evaluation: Collected Papers.* Chicago: Markham Publishing Co.

Harberger, A. C. (1988) Reflections on Social Project Evaluation. Taipei: Academia Sinica. (Chung-Hua Series of Lectures No. 15.)

Hirsch, M. W., and S. Smale (1974) *Differential Equations, Dynamical Systems and Linear Algebra*. New York: Academic Press.

Khan, M. Ali (1982) Social Opportunity Costs and Immiserizing Growth: Some Observations on the Long Run Versus the Short. *Quarterly Journal of Economics* 97: 353-362.

Khan, M. Ali (1987) Harris-Todaro Model. In J. Eatwell, P. Newman and Milgate (eds) *The New Palgrave*. New York: Macmlillan.

Khan, M. Ali (1991) On the Languages of Markets. *The Pakistan Development Review* 30: 4 503–549.

Khan, M. Ali (1992) Trade and Development in the Presence of an Informal Sector: A Four Factor Model. In K. Basu, M. Majumdar and T. Mitra (eds) *Essays in Honour of S. Chakravarty*. Oxford: Basil Blackwell.

Khan, M. Ali (1992a) On the Irony in/of Economic Theory. Paper presented at a Colloquium at Johns Hopkins University.

Khan, M. Ali, and Po-Sheng Lin (1982) Sub-optimal Tariff Policy and Gains from Trade for LDCs with Urban Unemployment. *The Pakistan Development Review* 21: 105–126.

Khan, M. Ali, and S. N. H. Naqvi (1983) Capital Markets and Urban Unemployment. *Journal of International Economics* 15: 367–385.

Portes, A., M. Castells and L. A. Benton (eds) (1989) *The Informal Economy: Studies in Advanced and Less Developed Countries*. Baltimore: The Johns Hopkins University Press.

Stiglitz, J. E. (1977) Some Further Remarks on Cost-benefit Analysis. In H. Schwartz and R. Berney (eds) *Project Evaluation*. Washington: Inter-American Development Bank.

Stiglitz, J. E. (1982) The Structure of Labor Markets and Shadow Prices in LDCs. In R. H. Sabot (ed) *Migration and Labor Markets in Developing Countries*. Boulder: Westview Press.

Comments on* "On Measuring the Social Opportunity Cost of Labour in the Presence of Tariffs and an Informal Sector"

Mr Chairman I find myself in an interesting situation since I was given this paper yesterday which in effect does bear some slight resemblance to Prof. Ali Khan's talk, although it requires quite a lot of work to find this resemblance.

It is an interesting and stimulating paper. I exaggerate because in fact the issues which come up in the paper, entitled Trade and Development in the Informal Sector – A Four Factor Model, are in fact those issues which Prof. Ali Khan talked about in much of his lecture and I think that the general level of comments do have a strong bearing on his lecture. In the paper, and this is also clear from the basis of the talk, Prof. Ali Khan develops a small static model of an economy which he briefly describes as having four outputs: three types of labour, capital and land, and the fourth is the presence of the informal sector, which produces intermediate goods. He did not say that. However, it is here in the results that the informal sector produces only intermediate goods and in this sector the average product equals the marginal product equals the wage. The formal sector wage is fixed and so are formal sector and agricultural sector prices. This model is then applied to project evaluation and various policies including the ones which he mentions. Now it is important to think of that because the abstract issues which are presented serve as a guide in tackling the problems that Prof. Ali is presenting. You have to actually look into the nature of the models which are developed and have them function. One problem is that as soon as you have created a model, they have a certain abstract beauty and everything follows logically within. The really interesting questions are in the assumptions. And let me concentrate on two standard assumptions. The first is the treatment of unemployment and the second is with respect to the informal sector. But first unemployment – its link to the treatment of unemployment and the assumption that markets are clearing. Now markets have to clear in some way in these sort of models if you want some logical results out of them. The presence of involuntary unemployment on a large scale in the world suggests that at least the labour market does not clear very well. There is unemployment. It appears that formulation can be built in because unemployment is considered involuntary. As soon as unemployment becomes involuntary the problem re-emerges. Essentially you have abandoned unemployment as an adjustment mechanism. I think it sharply reduces the value of models of this class. I think, at minimum, you need to incorporate three adjustment mechanisms into this type of model with respect to the manner in which the labour markets are operating. The first is wages,

*These comments are on an earlier draft of the paper presented by Professor M. Ali Khan at the 8th Annual General Meeting of the Pakistan Society of Development Economists.

the second is unemployment. And once you get these adjustments in, you can try to depict something of the real world. If you have not got them then you are in trouble. But then you come to the question of the conceptualisation of the informal sector. This is quite interesting, because if you go back to the model which I have seen in this paper but none of you have, the informal sector is producing only intermediate goods. It only uses labour, and it receives an average product. It means that in this particular model, the informal sector is precisely equivalent to the second type of labour in the production functions of the formal sector: i.e., there is no informal sector. There is just a segmented labour market: informal sector production uses some labour on fixed wages and some labour at a flexible wages. Now, that is an important difference of concept because it actually is, I think, the way the model can be interpreted. It leads me to a broader concern in the way the informal sector is considered. There is a massive literature available on the informal sector. Some of it is theoretical, some of it is empirical. It is tended to move towards the conclusion that there is no such thing as an informal sector but what you have is a whole range of different labour processes operating in a highly segmented labour market, with labour of different types, with degrees of different control over their jobs. Every actor in the system has a considerable interest in making it function as imperfectly as possible in protecting their patch. As a result, you have sub-sectors, with more or less free entry in the traditional informal sector sense. It is where everybody can get a job. But these are pretty small, like casual construction work, domestic services etc. The bulk of the informal sector does not go that way at all. They are entirely differentiated. That makes the adjustment mechanism extremely complex. And of course the informal sector produces both final and intermediate goods. That needs to be taken into account: part of it is linked to the formal sector and part is to satisfy the independent developed sector. This makes a lot of difference to the way you treat the outputs in a model like this. I think it always makes a difference between whether you regard them as interesting exercises, quite removed from the real world or you think they have something to say of the real world. Probably, the fundamental problem is that in order to approach the real world you need to introduce complexity, you need to arrange different adjustment mechanisms which will tend to make your model rather indeterminant. You cannot get a beautiful solution without it. That is probably why people move to the performance of numerical simulation. Elegance is certainly aesthetically pleasing but it may sometimes have to be sacrificed.

Garry Rodgers

International Institute of
Labour Studies,
Geneva, Switzerland.