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United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.150/5
20 February 1973

ORIGINAL: ENGLISH

Expert Group Meeting on Uses of
National Investment Criteria for
Industrial Project Analysis
Washington, D.C., 28-30 March 1973

# The Social Value of Investment and the Shadow Wage Rate

## An Exercise on the UNIDO Guidelines for Project Evaluation 1/

by

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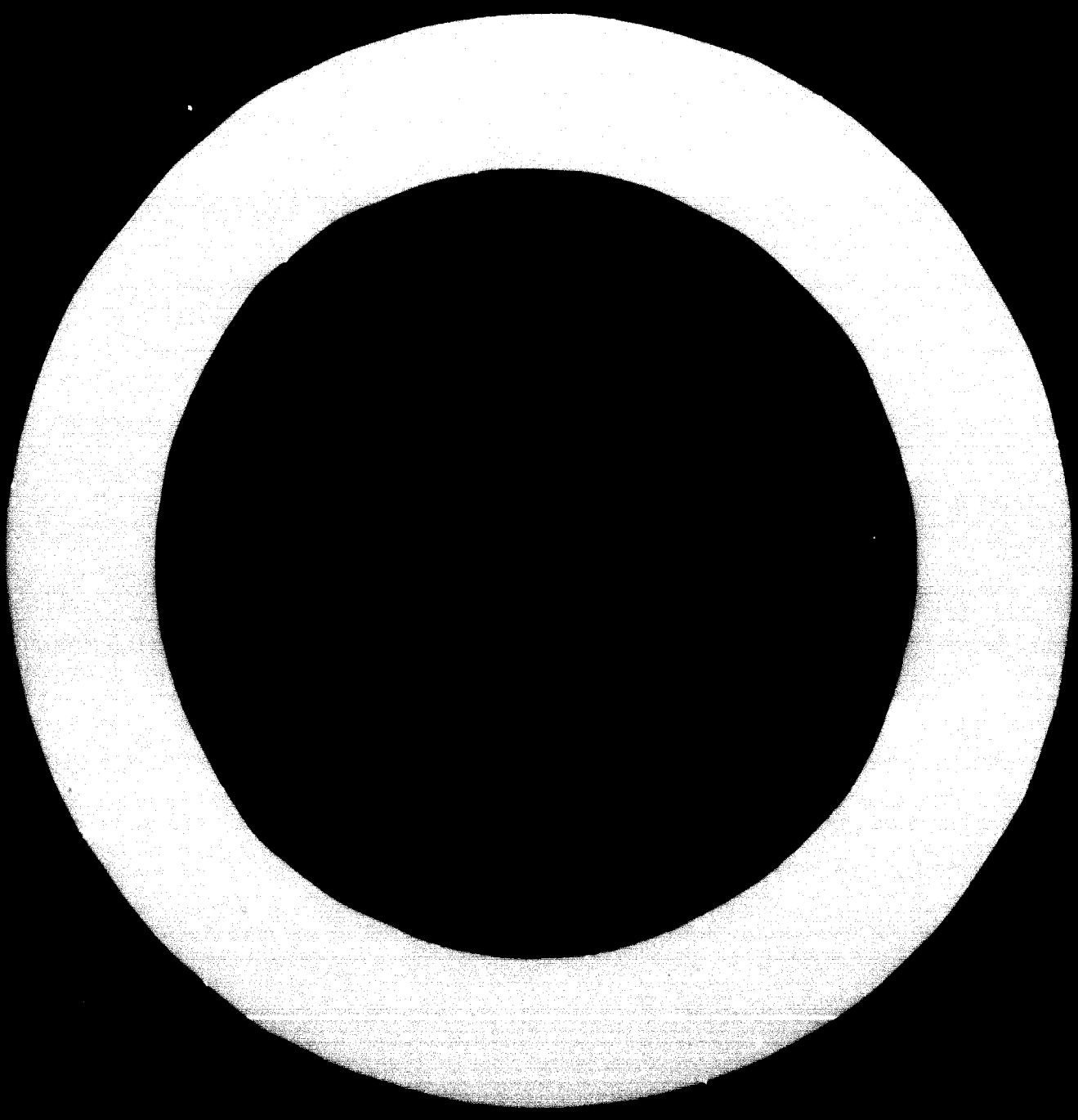

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## 1. Introduction

This paper is concerned with two of the several national parameters that the Guidelines for Project Evaluation (henceforth, Guidelines) have discussed at length. In particular, we shall be concerned here with the social value of investment and the shadow wage rate (see in particular Chapters 14, 15 and 17 of the Guidelines). In Section 2 I shall present a synopsis of the arguments presented in the Guidelines. In Section 3 I shall attempt at estimating the values of these parameters in the context of the Indian economy. These estimates will, of necessity, be very crude. They are meant to show merely the orders of magnitude involved. Partly also, the point in an exercise such as this is to bring out sharply the kinds of datum that one will need to collect in order to make such estimates.

The form and the quality of data depend very much on their demand. I have found that official documents in India often do not cast the data in a way which enables them to be of use for the purposes of an agency concerned with project evaluation. This is, of course, not surprising. The methods advocated by the Guidelines are not entirely well-known. The questions that one needs to ask in following the methodology of the Guidelines are ones which have not all been anticipated. Some of this will become clear in the course of this paper.

But finally, something more than mere data collection and their use are involved in the methodology. I do not believe that government agencies will be in a position to articulate in official documents answers to all the questions that the project evaluator's office will wish to ask in the course of its work. After all, government decisions with regard to taxation, licensing, import controls, savings, etc., change over time. Moreover, different projects will require of the project evaluators to ask in general different sets of questions. Often the evaluator will need to make simplifying hypotheses about government policies. It is precisely in the formulation of such hypotheses that a matter of judgement will be involved. Such judgements can, it seems to me, be made only in the course of repeated exercises in actual project planning. Projects cannot really be evaluated - at least not by the yardstick of national economic profitability - in the absence of a fairly detailed knowledge of government policies.

The purpose of this paper is not to establish the value of the shadow of investment or the shadow wage rate in India (in any case, the definite article preceding the foregoing parameters is misplaced!). The purpose is purely illustrative - to see what kinds of arguments are involved. In this sense the present paper, and the accompanying paper on the shadow price of foreign exchange, may be taken in conjunction with the case studies in Part IV of the Guidelines to demonstrate simply that the methodology of the Guidelines is operational.

## 2. Some Theory

Both the social value of investment and the shadow wage rate have been given extensive treatments in the Guidelines. Here I shall, merely for completeness, reproduce the basic arguments that lead to the approximate formulae that are derived there.

The problems that we are concerned with here pertain to the methods by which to value investment and unskilled labour that are involved in a marginal project. Patently then, to be very accurate, one will need to know precisely where the investment involved comes from (i.e. the source of the fund and, indeed, what is likely to happen to the resource if it is not involved in the project under review). One will need also to know details about unskilled labour employed in the project -- where it comes from and what it would do in the absence of the project. It is plain that the answers to these questions will vary, generally speaking, from project to project. The extent to which global assumptions about these matters will suffice will depend naturally on the case at hand. Again judgements on the part of the planning office about these will have to be made. I shall make alternative hypotheses about some of the factual parameters to obtain different ratios of these national parameters in India.

Having said this, I go to the problem at hand. Let z denote the direct opportunity cost of unskilled labour. If unskilled labour is drawn directly from the rural sector, z will represent the marginal product of unskilled labour in agriculture. Represent by w the industrial wage rate. Typically one will suppose that $w > z$. Even if the unit of time is a calendar year, both w and z may vary with time. I assume, without much distortion to the order of magnitude, that they are both constant over time. Assume that a unit investment in the modern sector creates l new employments. By the "modern sector" I shall mean the set which excludes agriculture and its allied activities, such as fisheries and plantations, as well as services. If we now write by y the annual increment of output (assumed constant) in the modern sector due to a unit of investment, the rate of net profit due to this investment is

$$y - wl.$$

Write by s the marginal propensity to save out of profits in the modern sector. It follows that $s(y - wl)$ will be saved out of

profits and $(1 - s)(y - wl)$ will be consumed. Denote by $P^{inv}$ (assumed constant over time) the overall social value of investment in terms of consumption. It follows that the contribution to aggregate consumption by the net profits due to the unit investment is

$$P^{inv}\, s(y - wl) + (1 - s)(y - wl).$$

Assume, as is quite plausible, that unskilled labour saves nothing. Then the consumption that they derive due to this unit investment is

$$(w - z)l.$$

It follows that the contribution to aggregate consumption due to this unit investment in a typical year is

$$P^{inv}\, s(y - wl) + (1 - s)(y - wl) + (w - z)l.$$

Thus, if i is the social rate of discount (assumed constant over time), the present value of the aggregate consumption stream is

$$P^{inv} = \frac{P^{inv}\, s(y - wl) + (1 - s)(y - wl) + (w - z)l}{i}$$

Solving for $P^{inv}$ one obtains

$$P^{inv} = \frac{(1 - s)(y - wl) + (w - z)l}{i - s(y - wl)} \qquad (1)$$

Expression (1) is an approximate formula for the social value of investment in the modern sector.[1/] Hence, if a marginal project draws investment away from the modern sector, the cost of investment embodied in the project will be valued by its price $P^{inv}$.

Turning to the shadow wage rate, note that in employing a marginal unskilled worker, agricultural workers as a group gain $(w - z)$, and in making the payment of the market wage w, the net loss of aggregate consumption is $(1 - s)w + s\, P^{inv} w$. Hence the shadow wage rate

$$\bar{w} = z(w - z) + (1 - s)w + s\, P^{inv} w \quad \text{or}$$

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1/ See Guidelines, Chapter 15, Section 15.4 for a more complete discussion.

$$\bar{w} = s + z(p^{inv} - 1)w^{2/} \qquad (2)$$

It ought to be noted that we are defining the shadow wage rate on the assumption of giving equal weight to workers' consumption and the consumption of profit earners (whether in the hands of the private sector or those of the government). I am not discussing for the more general formulation that would ensue if we wished to put different weights to these incomes.[3/]

## 3. The Application

In valuing the investment made in a project, it is of importance to know where the resource comes from. Does investment carried out in a given project deprive the rest of the public sector of an equal amount of investment, as it may be in the case of evaluating a project variant? Or is the project financed by additional taxation? Or what? That is to say, the source of the funds for the project needs to be known. In the case of India, given the fact that the total volume of public sector industrial investment is broadly decided in advance, it would be fairly appropriate to value investment in a public sector industrial project on the assumption that the resources involved would, in the absence of the project, be in the hands of the Government. This being the case, one would want s to reflect the Government's marginal propensity to save, and y and l to represent the marginal output-capital ratio and the marginal labour-capital ratio, respectively, in the advanced part of the public sector. But in point of fact, it is somewhat difficult to do this. The Five-Year Plan document does not give projections of total Government expenditure directly, though, of course, overall investment carried out in the public sector over the Plan period is documented in detail. I shall, therefore, attempt to estimate y and l for the modern industrial sector of the economy as a whole (i.e.

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2/ See Guidelines, Section 15.4.

3/ See Guidelines, Chapter 14, Section 15.5 for a detailed discussion of this.

combined public and private sector) and assume that these aggregate values represent roughly the corresponding values in the public sector. This is plainly quite legitimate since the technologies in the modern part of the public and the private sector do not differ much in India.

For the purposes of this case study, the choice of industries was dictated by the assumption that investment in an industrial project in the public sector would divert funds only from the industrial sector of the Government. Needless to say, alternative assumptions about this can be made, depending on the project at hand. Towards this it was decided to ignore the agricultural sector (and the allied industries of forestry, plantations and fishing) as well as the service and commercial sectors. In accordance with industry-wise classification made by the Government of India, this left one with (i) mining and quarrying, (ii) large and small manufacturing, (iii) construction, (iv) electricity, etc., and (v) transport and communications. The sector labelled "defense" was ignored since it is hard to believe that an average industrial project competes for funds with "defense" projects.

The parameters l, y and x were estimated from data supplied in the Fourth Five-Year Plan (1969-1974). Turning first to the parameter, l, one needs to know the growth of employment in these stipulated industries over the Plan period. Unfortunately this projection is supplied neither by the Plan document nor by the Ministry of Labour publication Indian Labour Statistics (1971). As a result, the following roundabout procedure was followed: In Table 1, I present total employment in the chosen industries for the years 1962 and 1969 (as published in Indian Labour Statistics, 1971) and compute the annual rate of growth of employment in these industries. It is found to be roughly three per cent per annum. Assuming then that the rate of growth of employment will remain roughly equal to three per cent per annum over the Fourth Plan period, one estimates total employment in these industries

in 1974. The increase in employment over the Plan period ($\Delta L$) is estimated to be about $1.3 \times 10^6$ (see Table 1). The method is, of course, immensely crude; but, as it will turn out, not much will depend on the crudeness, since the marginal labour-capital ratio (l) in these chosen industries is very small.

Table 2 presents data obtained from the Fourth Plan with regard to estimates of output in these industries at the beginning and at the end of the Plan. The increase in output ($\Delta Y$) from these industries over the Plan period is estimated at about Rs. 3,245 crores.

Finally, Table 3 presents estimates of investment to be carried out during the Plan period in the stipulated industries. The data are taken from the Fourth Plan document and the total figure appears to be roughly Rs. 12,700 crores. From these data it is simple to estimate the marginal output-capital ratio ($y = \frac{\Delta Y}{I}$) and the marginal output-labour ratio ($i = \frac{\Delta L}{I}$). They turn out to be about 0.25 and $10^{-5}$ respectively. A marginal capital-output ratio of 4 in the advanced sector appears to be reasonable but I must confess to being surprised by the very large figure for the marginal capital-labour ratio. Granted that the technology chosen in the modern industrial sector in India is known to be very capital intensive. Nonetheless, a figure of Rs. 100,000 of capital for each additional worker seemed (at least to one at first) very high.

The industrial wage rate (w) is well documented. The average annual wage of an industrial worker in 1969 appears to have been found Rs. 2,564. (See Indian Labour Statistics (1971), Table 4.1, p. 56). It is more or less uniform throughout the country and I shall take it that it will remain more or less constant over the near future.

The direct opportunity cost (z) of unskilled labour is immensely difficult to estimate. It patently varies from region to region. It seems best then for the purposes of this case study to take a set of values of z. I shall estimate both $P^{inv}$ and $\bar{w}$ on the assumption that $z = \frac{w}{2}$.

Turning now to the final parameter of interest, the Government's marginal propensity to save (s), I follow a somewhat roundabout procedure. The problem arises over the fact that the Plan document does not appear to present estimates of total Government expenditure on an annual basis over the Plan period. Nevertheless, the Plan document does suggest that total Government consumption in the two fiscal years (1968-1969) and (1973-1974) are estimated at Rs. 3,100 crores and Rs. 4,100 crores, respectively. (See Fourth Five-Year Plan, Chapter 2, Table 1, p. 32.) Next, total investment carried out in the public sector over the Plan period is estimated at Rs. 13,655 crores (see Fourth Five-Year Plan, Chapter 3, Table 1, p. 52). The question is: how will this investment be spread out over the Plan period, that is, what will the growth in public sector investment be over the Plan period? Towards this, I have had more or less to make some calculated guesswork. The Plan document suggests that public consumption expenditure is estimated to grow somewhat faster than private consumption, the latter being estimated to grow at about 5.3 per cent per annum (see Section 2.3, p. 33 of the Fourth Five-Year Plan). I assume that Government investment will grow at about 5 per cent per annum. It does not matter too much to within a couple of percentage points, since the result is not sensitive to the rate of growth of investment of values greater than about 3 per cent. Assuming there is a rate of growth of 5 per cent per annum for public investment, one estimates public investment in the first year of the Fourth Plan as

$$I_G^1 = \text{Rs.} \frac{\cdot\ 136.55 \text{ crores}}{\left[1 + 1.05 + (1.05)^2 + (1.05)^3 + (1.05)^4\right]}$$

or $I_G^1$ - Rs. 2,460 crores.

Likewise one estimates overall public investment in the final year of the Plan at

$$I_G^5 = (1.05)^4 I_G^1 - \text{Rs. } 3,000 \text{ crores.}$$

Total Government expenditure ($Y_G^1$) in the first year of the Plan is thus roughly Rs. (3,100 + 2,460) crores = Rs. $55.6 \times 10^9$ and Government expenditure in the final year ($Y_G^5$) is about Rs. (4,100 + 3,000) crores = Rs. $71 \times 10^9$. Thus the increment in public expenditure ($Y_G^5 - Y_G^1$) over the Plan period is about Rs. $(71 - 55.6) \times 10^9$ = Rs. $14.4 \times 10^9$, and the increment in Government investment ($I_G^5 - I_G^1$) is about Rs. $(30 - 24.6) \times 10^9$ = Rs. $5.4 \times 10^9$.

It follows that the Government's marginal propensity to save s ($= \frac{5.4}{14.4}$) is of the order of 40 per cent. This is not a very high figure, but it does appear to be roughly consistent with the estimate of round 10 per cent for the economy-wide marginal propensity to save.[4/] Moreover, given the Government's express desire to increase rapidly the expenditure on education, health and social services,[5/] the figure of about 40 per cent seems reasonable.

We are now in a position to estimate both the social value of investment ($P^{inv}$) and the shadow wage rate ($\bar{w}$) using formulae 1 and 2. The social rate of discount (i) is, of course, an unknown. We shall estimate $P^{inv}$ for three values of i, namely 10 per cent, 12 per cent and 15 per cent. Tables 4A and 4B present estimates of $P^{inv}$ for different values of i on the assumption (i) that $z = 0$ (Table 4A) and (ii) that $z = \frac{w}{2}$ (Table 4B). The point to notice is that while the social value of investment is very sensitive to the choice of the social rate of discount, it is quite insensitive to the direct opportunity cost of labour (z). That it

4/ For such an estimate, see Raj.

5/ See Fourth Five-Year Plan, Section 2.9, p. 33.

is insensitive to z should not be surprising. As we noted earlier, the marginal labour-capital ratio in the industrial sector in India is extremely small. Consequently, the impact on labour due to investment in the industrial sector is negligible. It appears, therefore, that it is legitimate to use an economy-wide social value of investment in evaluating a project, if there is a reason to believe that the project diverts capital formation in the Government's industrial sector. 6/

But not so, of course, for the shadow wage rate. The shadow wage rate is directly additive in the direct opportunity cost of labour (z). It is plain, then, that generally one cannot make use of an economy-wide shadow wage rate. It will vary from region to region, depending on z. Table 5 presents various values of the shadow wage rate under alternative assumptions. The uninitiated reader may be startled by the fact that the shadow wage rate may exceed the market wage rate, giving the impression that employment is socially less desirable than what the market indicates. The impression would be entirely unjustified, since the point in the Guidelines' methodology is to compare the social cost of employing an extra worker with the social cost of capital and, of course, capital will be valued in terms of $P^{inv}$ bringing the costs of these factors on a comparable basis. 7/

## 4. Some Remarks

The exercises performed in this paper are meant to be illustrative. The aim was to compute as a first approximation the social value of investment and the shadow wage rate required in evaluating a public sector project on the assumption that the investment would

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6/ This is essentially the justification for using the somewhat cruder expression for $P^{inv}$ in Part IV of the Guidelines.

7/ For a detailed discussion, see Guidelines, Section 15.4, p. 207. Also see Dasgupta, P., "A Comparative Analysis of the UNIDO Guidelines and the OECD Manual", Oxford Bulletin (February 1972).

otherwise be made in the Government's industrial sector. Quite apart from the approximate nature of the formulae used in this paper,[1] we have made only crude estimates of the key parameters required in computing these shadow prices. To take, for example, the marginal output-capital ratio in the industrial sector, we made use of estimates in the Fourth Plan. But it must be admitted that the figure of 0.25 that we obtained seems reasonable on balance. The major problem appeared with regard to the Government's marginal propensity to save. Despite the excellent coverage of data in the Indian Plan, this crucial parameter does not appear to be available. I have made only tentative calculations towards this for the moment.[2] But, of course, the method by which a project in the public sector is financed will dictate the social value of investment in the project. If additional taxation is used to finance a project, the marginal propensity to save of different groups will be required. There is ample documentation of savings propensities in India by now.

But despite all this, the orders of magnitude of the various parameters seem on the whole in line with what intuition suggests. I should doubt if very refined methods of estimating the social value of investment will be possible. For after all, in evaluating projects one is necessarily peering into the future and one will, of necessity, have to make some heroic assumptions about economic decisions that are yet to be made. All in all, it may not be overly outrageous to rely on crude capital-output ratios and so on. Even then, the impact of such rough considerations is immense. At a social rate of discount of 10 per cent per annum (by no means an implausible working figure), the social value of investment is very large. This is not surprising. Even intuition suggests

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1/ For less approximate formulae, see Guidelines, Chapter 14, Appendix A.

2/ That is, in the face of the documents available to me at present, no doubt it is possible in principle to estimate the Government's marginal propensity to save.

that if the social rate of discount (i) is judged to fall short of the social rate of return to investment (r - s1), it is absurd to say that a rupee of investment is worth merely a rupee of consumption.

TABLE 1

Estimated Employment in Public and Private Sectors
(1960 - 1969) (in $10^3$)[10]

| | 1962 | | | 1969 | | |
|---|---|---|---|---|---|---|
| | Public | + Private | = Total | Public | + Private | = Total |
| 1. Mining and quarrying | 145 | + 480 | = 625 | 174 | + 422 | = 596 |
| 2. Manufacturing | 421 | + 3,050 | = 3,471 | 757 | + 3,772 | = 4,529 |
| 3. Construction | 641 | + 180 | = 821 | 788 | + 154 | = 942 |
| 4. Electricity, etc. | 234 | + 40 | = 274 | 369 | + 44 | = 413 |
| 5. Transport and communication | 1,737 | + 120 | = 1,917 | 2,159 | + 108 | = 2,267 |
| TOTAL | | | 7,108 | | | 8,747 |

Growth of employment in stipulated industries over seven-year period = 8,747 - 7,108

= $1,639 \times 10^3$

Per cent rate of growth of employment per annum = 0.03

Estimated total employment in stipulated industries in 1974 = $10,069 \times 10^3$

Therefore, increase in employment during 1969 - 1974 = $\Delta L = 1,322 \times 10^3$

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10/ Adapted from Table 2.1 in Indian Labour Statistics (1971), Department of Labour and Employment, Ministry of Labour, Employment and Rehabilitation, Government of India, p. 45.

TABLE 2

Estimate of Net Output in Stipulated Industries (1968-69 to 1973-74)
(Rs. $10^7$ in 1968-1969 prices)[11/]

| | | 1968-1969 | 1973-1974 |
|---|---|---|---|
| 1. | Mining and quarrying | 317 | 465 |
| 2. | Large-scale manufacturing | 2,242 | 3,490 |
| 3. | Small-scale manufacturing | 1,559 | 2,011 |
| 4. | Construction | 1,142 | 1,722 |
| 5. | Electricity and power | 237 | 370 |
| 6. | Transport and communication | 1,959 | 2,645 |
| | TOTAL | 7,458 | 10,703 |

Increase in output of stipulated industries = $\Delta Y$
= Rs. $3,245 \times 10^7$

11/ Adapted from Table 8 in Fourth Five-Year Plan (1969-1974), Planning Commission, Government of India, p. 63.

TABLE 3

Estimated Investment during 1969 - 1974
(Rs. $10^7$)[12/]

| | | Investment |
|---|---|---|
| 1. | Industry and minerals | 5,298 |
| 2. | Small-scale industries | 746 |
| 3. | Electricity and power | 2,523 |
| 4. | Transport and communication | 4,117 |
| | TOTAL I = | 12,684 |

$$l = \frac{\Delta L}{I} = \frac{1.3 \times 10^6}{12.7 \times 10^{10}} = 0.00001$$

$$y = \frac{\Delta Y}{I} = \frac{3.245 \times 10^{10}}{12.684 \times 10^{10}} = 0.25$$

12/ Adapted from Table 1 in Fourth Five-Year Plan (1969-1974), Planning Commission, Government of India, p. 52.

TABLE 4

Estimation of the Social Value of Investment for India

$s = 0.40 \quad y = 0.25 \quad l = 10^{-5} \quad w = Rs.\ 2,564$

$$p^{inv} = \frac{(1 - s)(y - wl) + (w - z)l}{i - s(y - wl)}$$

TABLE 4A

$z = 0$

| i | $p^{inv}$ |
|---|---|
| 0.10 | 16 |
| 0.12 | 5.3 |
| 0.15 | 2.7 |

TABLE 4B

$z = \frac{w}{2}$

| i | $p^{inv}$ |
|---|---|
| 0.10 | 15 |
| 0.12 | 5 |
| 0.15 | 2.3 |

TABLE 5

Estimation of Shadow Wage Rate

$$\bar{w} = z + s(p^{inv} - 1)w$$

TABLE 5A

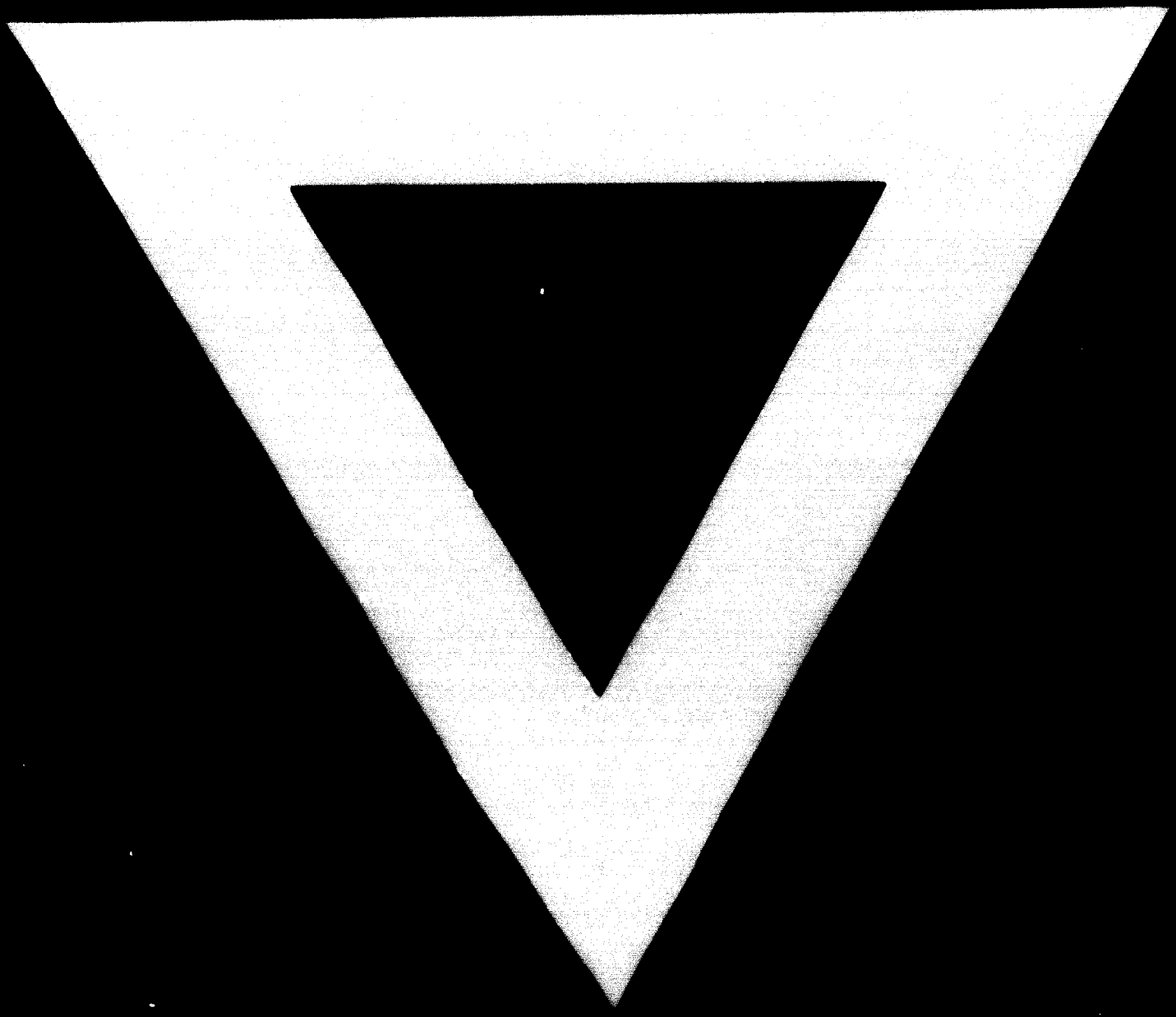
$z = 0$

| $p^{inv}$ | $\bar{w}$ (Rs. per annum) |
|---|---|
| 16 | 15,304 |
| 5.3 | 7,410 |
| 2.7 | 1,744 |

TABLE 5B

$z = \frac{w}{2}$

| $p^{inv}$ | $\bar{w}$ (Rs. per annum) |
|---|---|
| 16 | 15,640 |
| 5 | 5,304 |
| 2.3 | 2,615 |



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