D R A F T

A Comparison of Calculations of Investment and Savings Requirements

For India's Fourth Five Year Plan[*]

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The Target Model developed at the M.I.T. Center for International Studies is a linear model for optimizing the intertemporal and intersectoral allocation of resources. It provides a method of determining some of the major implications of the goals of an economic plan.[1] One of the recent exercises with the model has been its application to a set of targets for the Fourth Five Year Plan period which were prepared by the Perspective Planning Division of the Planning Commission.[2] In this brief note we shall present the results of the calculations with respect to the investment and savings requirements of the PPD targets and compare these results with the estimates of the Perspective Planning Division itself and alternative estimates prepared by Joel Bergsman and Alan Manne. The latter are contained in an interesting and ingenious paper which undoubtedly deserves and will receive considerable attention.[3]

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1 The analytical framework was originally developed by Professor S. Chakravarty of the Delhi School of Economics, Professor Louis Lefeber of Stanford University and the authors. The authors alone are responsible for the computations and views presented in this paper.

2 Notes on Perspective Development, India: 1960-61 to 1975-76. This will be referred to hereafter as the PPD, Notes and the terminal year levels of output in various sectors as the PPD targets.

3 J. Bergsman and A. Manne, "An Almost Consistent Intertemporal Model for India's Fourth and Fifth Plans." The Bergsman-Manne paper extends the work of A. Rudra and A. Manne, "Studies in the Structure of the Indian Economy," Sankhya, February-March, 1965.

Since there is at present considerable interest in the issues and the techniques we have attempted to reconcile the Bergsman-Manne approach with the Target Model.

Although the investment and savings requirements are only two, closely related aspects of a plan they are crucial aspects with wide ramifications. A good deal of the debate over the Indian plans has rightly focused on their size measured in these terms. The over-all investment requirements along with the net foreign capital inflow determine domestic savings requirements. Policy makers and the public have few criteria by which they can judge an intricate and detailed economic plan. They do have opinions about what savings rates can and ought to be,for the significance of the domestic savings or consumption rate is readily understood as a major determinant of the intertemporal distribution of the benefits of economic growth.

The Target Model

The Target Model is a linear programming model which optimizes with respect to an objective function subject to certain constraints. The constraints specify the intersectoral and intertemporal dependences via the use of an input-output matrix, a capital-coefficients matrix and gestation lags for each type of capital in each sector. The scarce resources are capital stocks and foreign exchange. Production requires fixed capital and current inputs and may be augmented in some sectors by imports. The supply of each sector's output from all sources is allocated to current production inputs, private consumption, inventory accumulation, new fixed capital formation, fixed capital replacement,

government consumption and exports. The allocations must, of course, be consistent with the technical parameters and the composition of consumption which is specified.

In addition to technical production conditions the following constraints must be met by the solution:

(1) The terminal year targets in the form of available capital stocks must be achieved and enough capital must be in process at the end of the plan period to maintain post-terminal growth in each sector. The post-terminal sectoral growth rates stipulated for the calculations are the implicit intra-plan growth rates.

(2) Consumption is required to grow monotonically at specified minimum rates except in the first period as compared to the pre-plan period. Alternative rates of 2.5% and 5% are stipulated to guarantee at least a roughly constant per capita consumption or a 2.5% rate of growth in per capita consumption.

(3) Imports are strictly limited to foreign exchange earnings and the net capital inflow which is specified in each year. Thus the model does not allow output deficits unless they can be financed by the pre-determined amounts of available foreign exchange. Export estimates are based on the PPD, Notes. Foreign capital inflow is varied in alternative solutions from 500 crores per year, roughly the current rate, to double that rate in alternative solutions.

(4) The initially endowed "investment-in-process" at the beginning of the plan is specified and is not assumed to

adjust to whatever level is necessary. This specification,
however, is based on a backward extrapolation of the growth
rates implicit in the PPD, Notes. The model is free to
choose not to complete this investment.

In addition the Target Model calculations have the following character-
istics:

(1) Replacement requirements are specified exogenously but
the model decides whether replacement shall actually occur.

(2) Government consumption is specified exogenously.

(3) The initial level of consumption is set in the process
of solution.

(4) Most of the technical coefficients are based on the PPD,
Notes or the cited work by Rudra and Manne.

(5) The PPD, Notes stipulate output targets for 1970-71. The
base year from which increments in output were computed is
1965-66. However, to obtain the investment and savings re-
quirements for the Fourth Plan period one should compare
the capacities on hand at the end of 1970-71 and at the be-
ginning of 1966-67. The capacity which produces the output
of 1965-66 must, therefore, be increased to find the capacity
of 1966-67. Likewise, the capacity which produces the output
of 1970-71 must be increased to determine the capacity on hand
at the end of the plan period. The simple adjustment to take
this into account used the implicit intra-plan growth rate in

each sector to project capacities.[1]

The investment required in the Fourth Plan period in order to maintain growth in the post plan period is computed separately as part of the solution.

(6) Finally, the PPD sectoral output targets were adjusted to make them more comprehensive. Detailed sectoral projections are made in the PPD, Notes mainly for the "organized" part of manufacturing. Output targets for the "unorganized" sectors are not provided in similar detail. Comparison of the detailed PPD estimates of 1960-61 output levels with the 1960-61 sectoral outputs of the Rudra-Manne input-output table indicated that varying but often substantial parts of total output in each sector were not covered by the PPD. The differences, however, also have their sources in variations in classification and pricing so that no foolproof adjustment procedure has been possible with the information available to us. In order to carry out the analysis on a comprehensive basis the PPD targets were simply adjusted by the proportions in which the sectoral PPD output levels for

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1 With the implicit intra-plan growth rate in each sector, α_i, the adjustment in capacity in each sector was $\alpha_i k_i \overline{X_i(0)}$ and $\alpha_i k_i \overline{X_i(5)}$, where k_i are the sectoral capital coefficients and $\overline{X_i(0)}$ and $\overline{X_i(5)}$ are specified pre-plan and terminal year sectoral output levels. The net adjustment during the plan period in required additions to capacity in each sector is $\sum_i \alpha_i k_i [\overline{X_i(5)} - \overline{X_i(0)}]$, which turns out to be a substantial number. This adjustment also affects investment requirements for post-terminal growth.

1960-61 varied from the 1960-61 output levels of the Rudra-
Manne table. This implies the assumption that the rate of
growth of the portions omitted by the PPD estimates would
be equal to the growth rate of the parts covered. The net
effect of these adjustments was a substantial increase in
the total value of target output.[1]

The Target Model is an optimizing model but the solution process
can be viewed as one in which the highest priorities are given to
meeting the constraints. The maximand is discounted consumption over
the plan period. This is made as large as possible subject to the con-
dition that all the constraints are satisfied. In the Target Model the
targets are themselves one of the major constraints. In effect the
solution can be regarded as being carried out in three steps. First
the total investment requirements of the plan targets are calculated.
Secondly, the model decides if that amount of investment can be carried
out consistently with all the other model specifications. If so it then
distributes the investment over the plan period in such a way as to
maximize consumption.[2]

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1 The PPD, <u>Notes</u> in one table presents projections of <u>value
added</u> in the unorganized part of all manufacturing industry which in
1970-71 was to be 62.7% of output in the organized sector. Total pro-
jected value added would, therefore, be 163% of that for the organized
sector alone. For purposes of comparison our adjustment in the PPD
<u>output</u> targets to obtain more comprehensive coverage of the manufacturing
sector resulted in an increase of 64.7% in the total output targets of
the same sectors.

2 The Target Model solutions might in some circumstances provide
more investment than required only to meet the targets. However, it does
not happen in this case as the targets themselves impose so much of a
strain on the system.

The Bergsman-Manne Model

Turning now to the Bergsman-Manne approach we shall first review their technique so that what errors there may be in our reconciliation due to misunderstanding of their work may become apparent. Their method, as we understand it, is in outline as follows:

(1) Net investment in the terminal year of the plan is calculated by specifying exogenously the demands in that year of households, government, exports, "others" and some types of capital formation and a future growth rate of output in each sector. With assumed fixed capital-output ratios, investment gestation patterns, inventory-output ratios and import-output coefficients, the output level in the terminal year in each sector is determined.

The output levels in the intermediate years are then interpolated log-linearly between the terminal output levels and the initial year levels.

(2) The possibility of infeasibilities which would manifest themselves in negative outputs, implicit or explicit, is avoided by a number of "shock absorbers" which adjust themselves in various ways to maintain consistency. These shock absorbers are:

    (a) imports of some investment and producers goods;

    (b) consumption shortfalls in some sectors (which apparently were minor);

    (c) exogenous changes in some service sectors to adjust output levels to equal demand (these were apparently minor except in urban and industrial construction);

> (d) it is assumed that the pre-plan investment re-
> quired is whatever is necessary to sustain the
> log-linear path derived for the plan period.

There are a number of differences between the Bergsman-Manne procedure described somewhat cryptically above and the procedure used in the linear programming Target Model which is designed to test the implications of a set of plan targets. Some of these represent the different purposes of the two analyses. Mainly, however, the Target Model is more firmly constrained with respect to targets. The solution requires that at least those targets projected by the PPD be met. In addition for any one run of the Target Model the net foreign capital available is specified prior to the solution though the availability is changed from solution to solution. In the Bergsman-Manne approach, the capital inflow required is part of the solution. The import-output coefficients in the Target Model are kept constant at approximately their pre-Fourth Plan levels.[1]

In addition the Bergsman-Manne model does not appear to contain the adjustment necessary to convert the output targets of the last year of the plan into capacity targets for the last year of the plan and, thereby, include all the investment in the last plan year. Nor is the corresponding adjustment made for the first plan year. Finally, the PPD output targets which are taken over intact into their calculation do not appear to have been adjusted to extend their limited coverage.

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[1] Moderate changes in these would not affect the Target Model estimates of investment requirements in any case though they would certainly affect other aspects of the solutions.

Turning from contrasts between the models to similarities, both models explicitly reflect post-terminal conditions back into the planning period. In the Target Model the post-terminal conditions are capital stocks based on extrapolations of Plan targets using sectoral intra-Plan growth rates. In both models, once the terminal year capacities or output levels are determined, the calculation of total investment requirements during the plan period to provide the capacities can be seen as a straightforward exercise with capital output ratios.

The differences in the estimation of investment requirements by the two approaches are not mainly the result of the way investment is allocated over the plan period. For the most part the differences stem from: (1) the level and composition of targets in the two exercises, (2) the parameters of the models, particularly the fixed capital-output ratios and inventory coefficients, (3) the original endowments of capital and investment-in-process.

Comparison of calculations of investment requirements[1]

The estimates of investment requirements of the PPD Fourth Plan targets as prepared in the Perspective Planning Division are shown in Table 1. Additional sectoral detail is provided, of course. The brief references to methodology suggest that the investment estimates are based on a more or less conventional application of capital-output ratios to projected increments in outputs.

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1 All calculations have been made and reported in 1959-60 prices.

Table 1

Investment Requirements of Fourth Plan PPD Targets

As Estimated in PPD, Notes

(in Rs. crores at 1959-60 prices)

Net fixed investment	20,760
Inventory investment	1,400[1]
Total net investment	22,160

The Target Model estimates of investment requirements to achieve the more comprehensive Fourth Plan targets estimated from the Notes are shown in Table 2. The estimates are taken from solutions to the Target Model but they can also be derived in a simple and straightforward manner which has nothing to do with the optimization portion of the solution. Table 2 presents the results in this way. In the Table $\overline{X_i(5)}$ and $\overline{X_i(0)}$ are the final year and pre-plan sectoral output levels. The α_i represent the sectoral growth rates implicit in the adjusted PPD targets. The k_i are capital-output ratios. This calculation demonstrates the results of a simple and comprehensive method of calculating investment requirements of a set of plan targets.

The Bergsman-Manne estimates of total gross investment requirements for their several cases are shown in Table 3. The "A" cases are based on a "consensus" at the Planning Commission in July, 1965. The "B" cases are a "more pessimistic view than is being considered by the

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1 This is acknowledged to make no provision for the inventory requirements of the unorganized sector (PPD, Notes, p. 252).

Table 2[1]

Target Model Estimates of Fourth Plan PPD Targets

(in Rs. Crores at 1959-60 prices)

(1) $\sum_i k_i [\overline{X_i(5)} - \overline{X_i(0)}]$ 23,068

> This is the conventional capital-output ratio calculation. Most of the variations from the PPD estimates due to the use of different capital-output ratios are probably reflected in this number as compared to the PPD estimate of Rs. 20,760 crores of net fixed investment. The higher initial and target output levels than those of the PPD due to expanded coverage also have an effect.

(2) $\sum_i \alpha_i k_i [\overline{X_i(5)} - \overline{X_i(0)}]$ 2,864

> This reflects the correction described above to put the calculations on a 1966-71 basis.

(3) Net fixed investment in plan period for post-terminal growth.

> This requires specification also of the pattern of gestation lags.   5,823

(4) Total net fixed investment implied by adjusted Fourth Plan PPD targets.   31,755

(5) Minus assumed net fixed investment prior to Fourth Plan for Fourth Plan period.

> This requires specification of gestation lags.   3,218

(6) Net fixed investment required during Fourth Plan period.   28,537

(7) Inventory investment during Fourth Plan.

> This is computed using inventory-output coefficients.   5,719

(8) Total net investment during Fourth Plan.   34,256

(9) Replacement.

> This estimate is based partly on the PPD, Notes.   5,192

(10) Total gross investment during Fourth Plan.   39,448

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1 For data inputs see Appendix.

Table 3

Bergsman=Manne Estimates of Total Investment Requirements

for Fourth Plan Period

(in Rs. crores at 1959-60 prices)

Case	Total Gross Investment	Total Net Investment
A1	29,743	26,700
A2	29,583	
A3	28,601	
B1	25,820	22,800
B2	25,865	
B3	24,799	
A1 (with shorter lags)	28,091	
A2 (with larger exports)	30,293	

Planning Commission." The 1, 2, 3 versions represent successively less ambitious import substitution policies.

The PPD estimates of net investment requirements for the Fourth Plan period at Rs. 22,160 crores are by far and away the lowest of the three sets of estimates except for the non=Planning Commission "pessimistic view" (Case B1) which is only slightly higher.

The Bergsman=Manne A1 case requires 20% more net investment than the PPD estimates. If their estimate of replacement remains constant in all cases, as it appears to be, the net investment requirements of even their least ambitious import substitution case, A3, are 15.5%

above the PPD estimates.[1]

The Target Model estimates of net investment requirements for the adjusted PPD targets at Rs. 34,256 crores are by far and away the highest of the estimates being virtually 55% larger than the PPD estimates. This is in spite of a general similarity in parameters, although the differences which persist may still lead to substantial discrepancies. Part of the dif- ference is in the Target output levels with which Bergsman and Manne work as compared to the adjusted PPD targets. Table 4 indicates the terminal year output levels of the various calculations. The first column pre- sents the sectoral targets which could easily be read out of the PPD, Notes. As pointed out above, these are not comprehensive either with respect to sectors or coverage within sectors. The second column presents the targets used in the Target Model calculations which adjusts the PPD targets to make them comprehensive.[2] Columns three and four present

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1 It may be noted that the Bergsman-Manne estimates of replacement requirements at Rs. 3000 crores are less than the roughly Rs. 6000 crores implicit in the PPD, Notes or the Rs. 4,935 crores estimate of the Target Model.

2 Since these target levels are crucial at least a brief explana- tion of their derivation is warranted. The PPD, Notes presents a set of estimates and projections for most but not all sectors and within sectors the estimates and projections are not comprehensive. For example, the PPD estimate of value of output in the electrical equipment sector in 1960-61 is Rs. 94.2 crores. By comparison the estimate in the input-output table for 1960-61, presented in Appendix II in the PPD, Notes, and prepared by Rudra and Manne, is Rs. 126 crores. Similarly, the PPD estimate of output in the non-electrical equipment sector in 1960-61 is Rs. 98.4 crores, while the input-output table estimate is Rs. 343.5 crores.

The following technique was used to inflate the PPD targets which were provided for 1970-71 to obtain fuller coverage. The PPD estimates for 1960-61, 1965-66 and 1970-71 were used to construct an index of growth in each sector. Where relevant these indices were then applied to the output levels of the 1960-61 input-output table in order to obtain a comprehensive set of output levels for 1965-66 and 1970-71. If the portions of the sectors not covered in the PPD estimates were to have sharply lower

(Continued)

Table 4

Fourth Plan Terminal Year (1970-71) Sectoral Output Levels

(in Rs. crores)

	Sector	PPD, Notes	Projected Output Levels Used in Target Model[1]	Bergsman-Manne[2]	
				Case A1	Case B3
1.	Construction, Urban ⎫		5546[3]	4298	3685
2.	Construction, Rural ⎭				
3.	Electrical equipment	717	959	501	371
4.	Transport equipment	1023	778	716	594
5.	Non-electrical equipment	1151	4019	1423	1040
6.	Iron and steel	1742	1861	1359	1070
7.	Iron ore	51	44	38	33
8.	Cement	133	161	170	146
9.	Other metals	121	224	227	174
10.	Other minerals	181	135	198	175
11.	Plantations	150	282	276	272
12.	Leather and leather products		379[4]	338	317
13.	Animal husbandry	2164	1865	1881	1903
14.	Food industries	943	2104	1980	1903
15a.	Food grains ⎫	5672	6001	5770	5551
15b.	Grain milled ⎭				
16.	Cotton and other textiles	2049	2168	1320	1250
17.	Jute textiles	226	200	214	206
18.	Other agriculture	4202	3104	3353	3194
19.	Fertilizers	296	338	455	435
20.	Glass, wooden and non-metalic mineral products	193	1449	1107	960
21.	Forestry products	185	281	506	440
22.	Motor transport	1165	1164	965	885
23.	Petroleum products	372	1266	894	818
24.	Crude oil	72	85	71	71
25.	Rubber products	179	292	162	147
26.	Rubber-synthetic	30	30	11	7
27.	Chemicals	1507	1556	842	749
28.	Railways	1083	1076	884	792
29.	Electricity thermal (hydro)		500	427	379
30.	Coal	30	290	246	214
	Sub-total		38147	30632	27656
31.	Housing		988[5]	--	--
32.	Others and margin		14640[6]	--	--
	TOTAL		53775		

1 These reflect the adjustments for comprehensiveness explained above except where noted.

(Continued)

Footnotes to Table 4 continued

    2 These figures are those given for 1970-71 by Bergsman-Manne.
If 1971-72 were meant to be the final year of the Fourth Plan the total
amount of output in the target year in case A-1 would be Rs. 33,216
crores. The issues related to the pattern of the Bergsman-Manne targets
will not be raised here.

    3 This was taken from the PPD, Notes projection of national
income.

    4 This was based on an Indian Statistical Institute study,
Studies in the Structure of the Indian Economy.

    5 This target was estimated by applying the ratio of national
income generated in the housing sector to total national income in years
prior to the Fourth Plan to the national income projected by the PPD for
1970-71 and historical ratios of net to gross output in this sector. By
comparison with the PPD estimate of Rs. 2700 crores of net investment in
housing, our adjusted target resulted in a projection of Rs. 3087 crores
of investment on the same basis.

    6 This was estimated using a historical ratio of the relation of
this sector's output to total output.

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Bergsman-Manne terminal year output levels. These latter differ sub-

stantially in their composition from the original PPD targets but overall

are at roughly the same levels as the unadjusted PPD targets, i.e., those

for only the unorganized sectors. This implies lower Bergsman-Manne

targets than those of the PPD, Notes for both the organized and unorganized

sectors. Even so the Bergsman-Manne procedure leads to estimates of invest-

ment requirements which are much higher than those in the PPD, Notes.[1] With

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Footnote continued

growth rates than the covered portions, our procedure would lead to over-all
projections which are higher than warranted. In any case, however, the PPD
targets should be revised upward by some amount to include the portions of
the economy not covered. The differences between columns one and two in
Table 4 which reflect differences in base level (1960-61) estimates and
differences in coverage are often quite substantial.

    1 This may be due to the use of different capital-coefficients
as Bergsman and Manne suggest.

an over-all capital-output ratio only slightly larger than unity, the differences in terminal year outputs would explain the differences between the Bergsman-Manne estimates of investment requirements and those of the Target Model.

Comparison of estimates of savings requirements

Corresponding to each of the estimates of investment requirements there is an estimate of domestic savings requirements obtained by subtracting the net foreign capital inflows. The average net savings rate in the PPD, Notes rises from 13.1% in 1965-66 to 19.4% in 1970-71. With linear interpolation, the marginal net savings rate over the Plan period is 33.7%. We have not been able to find in the PPD, Notes an explicit estimate of the total net foreign capital inflow during the entire Fourth Plan period. However, it projects a decline in this inflow from Rs. 550 crores in 1965-66 to Rs. 350 crores in 1970-71. Interpolating linearly for the Fourth Plan period and adding the amounts for the individual years leads to a total of Rs. 2,150 crores. Subtracting this from total investment requirements leads to the estimate of net domestic savings of Rs. 20,010 crores.

The Target Model estimates of net domestic savings requirements are obtained by subtracting the stipulated Rs. 2,500 crores of net foreign capital inflow from the estimated Rs. 34,256 of total net investment requirements. This indicates a total net domestic savings requirement of Rs. 31,756 crores. If foreign aid were doubled, the net domestic savings requirement would be reduced by another Rs. 2,500 crores to Rs. 29,256 crores. The savings rates implicit in the Target Model reflect the ability of the model to generate income and consumption

over the plan period. This in turn is governed by the character of the
maximand, the optimization process and constraints such as those which
limit the allocation of imports and fix the composition of consumption.
According to the Target Model if foreign aid were available in the
Fourth Plan as in the Third Plan and roughly the same allocations of
imports were made, and if the Targets were to be achieved, income would
have to be reduced drastically. With much lower income the average
savings rate would come to about 41%. This undoubtedly overstates the
rate of savings required because the solution understates the level of
income which could be achieved within the constraints. In another
solution, the foreign exchange available was doubled and greater flexi-
bility was allowed in the use of imports. The income produced in this
case almost doubled and the average savings rate required dropped to
21.7%. These results are summarized in Table 5.

Table 5

Target Model Projections of Savings Requirements (in Rs. crores)
and Savings Rates

	Trade Deficit	Gross Domestic Savings	Net Domestic Savings	Average Gross Savings Rate
Case 1	2500	36948	31756	41.0%
Case 2	5000	34448	29256	21.7%

The domestic savings and savings rates required for the Bergsman-Manne cases for the Fourth Plan period are shown in Table 6.

Table 6

Bergsman-Manne Projections of Savings Requirements (in Rs. crores)
and Savings Rates

		Total Trade Deficit	Gross Domestic Savings	Net Domestic Savings	Average Gross Savings Ratio	Marginal Gross Savings Ratio
Case	A1	4,440	25,303	22,303	22%	39%
	A2	4,840	24,743		21%	36%
	A3	4,800	23,801		20%	33%
	B1	3,000	22,820	19,820	20%	38%
	B2	3,380	22,485		20%	34%
	B3	3,360	21,439		19%	31%

The average gross domestic savings rate for 1965-66 is estimated generously by Bergsman and Manne at 15% since the Reserve Bank of India estimate for 1961-62 and 1962-63 is 9.5%.[1] The present level of net foreign capital inflow for five years is roughly Rs. 2,500 crores.

The Bergsman-Manne and Target Model savings rate for comparable foreign-exchange conditions are, in turn, rather comparable. Since the absolute level of savings required in the Target Model is much higher, the comparability of savings rates in this case is the result of the much higher level of income which is generated in the Target Model.

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1 Reserve Bank of India Bulletin, March, 1965, p. 327.

Appraisal

The investment and savings requirements of a plan are crucial not only for judging over-all _feasibility_ but also for public determination of its acceptability. There are many indications from the three sources reviewed in this paper and from other studies that an incremental addition to the burden of savings will yield substantially greater returns over the future than the current reduction in consumption required. But that, in itself does not justify undertaking that additional burden. The decision rests on an evaluation of the relative desires of the Indian society for the additional consumption in the distant future or in the near future. It is essential that policy-makers and the public have as precise estimates as possible about the savings and consumption implications of a set of plan targets in order to come to a judgment as to what should be attempted. Without such estimates they may implement a savings program inadequate to meet the plan targets or, in vigorously pursuing the plans, try to force a savings rate which will prove to be unacceptable. Either of these circumstances will lead to shortfalls in the plan and may, as well, create various kinds of unexpected economic and social tensions. The over-all feasibility of a plan must be judged with these considerations in mind.

Import substitution policy in the Bergsman-Manne paper does not raise the customary question of the allocation of a more or less fixed amount of investment resources among sectors. In their paper with the specified alternative import-output ratios the total amount of foreign and domestic resources varies widely. A higher rate of "import substitution," i.e., lower import-output ratios, requires a higher rate of

investment financed by more foreign aid and more domestic saving. Import
substitution in this sense pays off just as investment always pays off
in a lower balance of payments deficit in the future or in a higher
growth rate. The Bergsman-Manne results demonstrate just this point and
are an example of a general characteristic of linear models. Import
substitution in the Bergsman-Manne paper becomes a decision about the
savings and investment rates for which India should strive.

A full reconciliation and appraisal of the calculations presented
above would require more information about the methods and parameters
behind the PPD targets than was presented. However, in reviewing the
three sets of investment estimates associated with the Fourth Plan
targets it is clear that those of the PPD, Notes are by far the lowest,
being smaller than the Bergsman-Manne estimates with the most conservative
import-substitution programs. The Bergsman-Manne estimates in turn are
under-estimates because their targets are not comprehensive. The Target
Model estimates presented may be too high if we have projected the growth
in the areas not covered by the PPD targets beyond what is warranted.
It is our view that reasonable differences in technical parameters
would not account for a major part of the discrepancies.

It would make a difference for the operation of the Indian
economy whether the targets require 100%, 50% or 15% more investment
than was planned and could be achieved with the available foreign
exchange and domestic savings. On the issue of feasibility Bergsman
and Manne say only that, "there will be wide differences of opinion as
to the feasibility of providing the resource inputs needed for internal
consistency within one or another of our six alternative cases." The
question of feasibility requires separate judgments about foreign exchange

and domestic resource availabilities. Decisions about the former will
certainly depend on decisions about the latter. The Indian economy has
done spectacularly well in raising savings over the recent past. Still,
it seems to us unlikely that the savings rates implied by the Bergsman-
Manne calculations can be achieved and even more unlikely that the savings
rates implicit in the Target Model calculations on the adjusted targets
of the PPD, Notes, could be reached.

It is no service to India to avoid confronting the issues raised
by the calculations above. The preparations for the Fourth Plan require
understanding the reasons for the shortfalls of the Third Plan. The
most popular explanations do not question the Plan's feasibility given
the planned investment. Instead the inadequacies are explained in
other ways: by faulty implementation -- too much or too little or the
wrong kind of administration; as the result of bad weather -- drought
and floods; and as a consequence of the reorientation of effort following
the Chinese invasion in 1962. All of these have undoubtedly been important
factors. However, calculations similar to those above with the Third
Plan targets suggest that they actually required a substantially higher
level of investment and a higher level of savings than was programmed
and thought to be feasible.[1] It puts the previous explanations of the
Third Plan's shortfalls in a different perspective if there is doubt
that with any method of implementation along with normal weather and
without foreign invasion the Plan could have been successful.

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[1] In terms of savings raised as compared to the planned savings
the Third Plan should be considered successful.

The need for success in economic development should not be minimized. Undertaking a Plan of dubious economic feasibility at this juncture may not contribute to India's political and social development.

APPENDIX

Data Used in Target Model Calculations

(The date is presented at eleven sector aggregation based
on 1965-66 output levels. The calculations in Table 2
were, however, carried out for 32 sector.)

Table A1

Sector i	Output in Rs. Crores		Implicit Yearly Growth Rate α_i
	1965-66 $x_i(0)$	1970-71 $x_i(5)$	
1. Agriculture and Plantations	8628.0	11533.0	.060
2. Mining and Metals	1166.0	2554.2	.170
3. Equipment-Electrical, Non-electrical and Transport	2275.0	5756.0	.204
4. Chemicals, Fertilizers, Petroleum and Rubber Products	1614.3	3567.3	.172
5. Cement, Glass, Wooden and Non-metallic Products	802.9	1600.0	.148
6. Food Industries, Textiles and Leather Products	2898.0	4851.0	.109
7. Electricity Generation and Transmission	249.0	500.0	.150
8. Railway and Motor Transport	1255.0	2240.0	.123
9. Construction	2894.0	5546.0	.139
10. Housing	700.0	988.0	.071
11. Trade Margin and 'Others'	8338.0	14640.0	.119

Table A2

Sector i	Capital/Output Ratio b_i	Capital in Rs. Crores at the Beginning of	
		1966-67 $k_i(1) = b_i(1+\alpha_i)x_i(0)$	1971-72 $k_i(6) = b_i(1+\alpha_i)x_i(5)$
1	1.510	13807.0	18452.0
2	2.477	3381.0	7400.0
3	.955	2615.0	6616.0
4	1.056	1997.0	4413.0
5	.862	794.0	1583.0
6	.557	1791.0	2997.0
7	6.259	1792.0	3598.0
8	2.173	3062.0	5465.0
9	.153	504.0	966.0
10	10.000	7504.0	10585.0
11	.157	1460.0	2564.0
Total		38707.0	64639.0

Table A3

Sector i	Inventory/Output Ratio S_i	Inventories in Rs. Crores at the Beginning of	
		1966-67 $S_i x_i(0)(1+\alpha_i)$	1971-72 $S_i x_i(5)(1+\alpha_i)$
1	.393	3594.0	4804.0
2	.236	322.0	705.0
3	.384	1052.0	2661.0
4	.527	997.0	2203.0
5	.236	218.0	433.0
6	.359	1154.0	1931.0
7	.129	37.0	74.0
8	.018	25.0	45.0
9	.068	224.0	430.0
10	0	0.	0.
11	.008	75.0	131.0
Total		7698.0	13417.0

Table A4

Sector i	C/O Ratio b_i	Proportion of Investment to be Made			Capital in Process Rs. Crores at the Beginning of	
					1966-67	1971-72
		1 year ahead P_i^1	2 years ahead P_i^2	3 years ahead P_i^3	$(P_i^2 + P_i^3)k_i(1)\alpha_i + P_i^3 k_i(1)\alpha_i(1+\alpha_i)$	$(P_i^2 + P_i^3)k_i(6)\alpha_i + P_i^3 k_i(6)\alpha_i(1+\alpha_i)$
1	1.510	.359	.359	.282	778.8	1041.0
2	2.477	.428	.428	.144	425.4	931.8
3	.955	.430	.430	.140	394.1	997.2
4	1.056	.422	.422	.156	261.5	577.8
5	.862	.417	.417	.166	91.0	181.3
6	.557	.452	.452	.096	127.7	213.8
7	6.259	.409	.409	.181	214.6	430.9
8	2.173	.500	.500	0.	188.4	336.2
9	.153	.456	.456	.087	45.0	86.3
10	10.000	.333	.333	.333	544.3	768.3
11	.157	.393	.393	.213	147.2	258.4
Total					3218.0	5823.0