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# PRICING OF POSTAL SERVICES IN INDIA

The present study was commissioned by the Expert Committee on Excellence in Postal Services, Ministry of Communications, Government of India in February 1988. The focus of the terms of reference of the study was on evolving principles for determining the structure of tariff for various services provided by the Indian Postal Department. In several important respects postal services partake of the character of a public utility, and their pricing gives rise to intricate issues. Questions of efficiency and equity come up in a complex way. The study addresses these issues analytically, taking due note of the available literature on the subject.

The study provides certain analytical methods for fixing postal tariffs in India. First, it critically evaluates the current practices of fixing postal tariffs by the Indian Postal Department. It then presents alternative scenarios of pricing with illustrations using Indian data. In particular, illustrations of computing the first best/cross-subsidy-free prices and second best Ramsey prices for postal services in India are provided. Finally, a detailed review of methods of public utility pricing is attempted.

We believe this is perhaps one of the first attempts to suggest ways of designing the structure of the postal tariff in the country on rational principles. We hope the study will be of interest and use not only to policy-makers but also to the wider academic community working in this area.

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*PRICING OF POSTAL SERVICES IN INDIA*
By Raghbendra Jha, M.N. Murty, Satya Paul
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# Preface

The National Institute of Public Finance and Policy is an autonomous non-profit organisation whose primary functions are to undertake research, consultancy and training in the field of public economics and related policy.

The present study was commissioned by the Expert Committee on Excellence in Postal Services, Ministry of Communications, Government of India in February 1988. The focus of the terms of reference of the study was on evolving principles for determining the structure of tariff for various services provided by the Indian Postal Department. In several important respects postal services partake of the character of a public utility, and their pricing gives rise to intricate issues. Questions of efficiency and equity come up in a complex way. The study addresses these issues analytically, taking due note of the available literature on the subject. We believe this is perhaps one of the first attempts to suggest ways of designing the structure of the postal tariff in the country on rational principles. We hope the study will be of interest and use not only to policy-makers but also to the wider academic community working in this area.

The study was planned and conducted by Raghbendra Jha, M.N. Murty and Satya Paul. The report was also drafted by the three authors jointly.

The Governing Body of the Institute does not take any responsibility for the views expressed in the report. That responsibility lies with the Director and more particularly the authors.

AMARESH BAGCHI

DIRECTOR

# Acknowledgements

# Contents

# 1. An Introduction to the Setting of Postal Tariffs

## 1. Introduction

THE Post is one of the organic bases of social relations and consequently, of civilisation. As an indispensable aid to the development of industry and commerce and as the most important agency for disseminating information among the people, it plays a predominant part in the economic life of our nation. The Post Office touches the lives of people more intimately than, perhaps, any other government agency.

Given the vital importance of the Office, it follows that the pricing of its services is a matter of serious concern. It also follows that pricing is only one facet of the economics of post offices. Quality and type of service, the ability to anticipate demand for various categories of postal services, the ability to absorb new technologies in the field of communication and transport, and the capacity to adjust to these and other changes and grow harmoniously are equally important indicators of the economic health of the postal system.

These are all extremely important aspects of the economics of postal services. Unfortunately, however, apart from some studies, and colloquia reports sponsored by the Universal Postal Union and a few other studies there does not exist much analytical/empirical work on these problems. Far too often there has been a tendency to study the problems of postal services within the framework of the theory of public utility services. Even so, such work for the Indian post office is almost non-existent.

While the study of postal problems within the theory of

public utilities has undoubtedly yielded some insights, most practical observers of the postal system would feel that the postal services have sufficient special characteristics to merit independent treatment.

In this report we concentrate mainly on the problems of pricing and related issues of postal services. We study trends in costs and output, efficiency and pricing mechanisms of the Indian Postal Department (IPD).[1] Moreover, we offer suggestions for improvements in the pricing structure by examining the problems of cross-subsidy-free/first best prices and second best prices for a public utility with revenue and equity objectives. Issues relating to demand are taken up within the context of second best Ramsey pricing. An eclectic view of pricing of postal services as a part of general revenue policies of the government is taken in a new approach outlined in this paper. We also offer some ideas on how to improve the data base of the Indian post office so that meaningful research can be carried on on a sustained basis.

In the present chapter we attempt a review of some of the principles of postal tariff fixing that have been discussed in the literature. The emphasis here is on a survey of issues involved and no attempt is made, in particular, to assess the performance of these principles in different contexts.

Broadly speaking, the problem of postal tariff fixing has been considered at two levels. First, there is what we shall call the aggregate or sectoral concern. Second is the more micro concern about pricing of individual items of the postal services and the relationship between such prices. We will discuss each of these issues in turn.

## 2. Aggregate Issues

The principal concern here seems to be whether the post office can "legitimately" earn a return over its cost. It is realised

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1. Henceforth in this text, IPD.

that in most instances the post office has a virtual monopoly over its services. It is possible, therefore, to have a tariff structure that will yield positive profits. The counter argument to this is that postal services are an indispensable tool of mass communication so that benefits from them are typically underestimated. A tariff structure that seeks to earn monopoly profits may stifle demand and thus have adverse effects particularly in a developing country like India. At colloquia organised by the Universal Postal Union, representatives of many countries have argued against the post office earning substantial profits. However, increasingly it is being realised that uncritical acceptance of large subsidies to the post office is also unjustified.

Enlightened post office administrators all over the world favour a postal tariff structure that yields "adequate" revenue and ensures maximum possible traffic. To some extent these goals are conflicting and there does not seem to be a well defined consensus on how to resolve this conflict. In appraising it, however, the following factors should be kept in mind.

If the postal department is, by virtue of the spread of mass communication argument, running large losses, these losses must be adequately justified. The policy maker/budget planner should be convinced that the public funds committed to covering the losses are being made good use of.

Secondly, the spread of mass communication argument should not be allowed to become a cover for inefficiency of the postal system. Unfortunately this has probably tended to happen in the Indian case. However, the nature of the technology of the postal services is such that because of joint production there are substantial economies of scale so that the inefficiency observed in the postal department is of the nature of scale inefficiency. This problem is examined in detail in our discussion of inefficiency in the Indian postal system in Chapter 3.

A general subsidy to the postal services ought to be sharply distinguished from cross-subsidisation within the postal services.

Whereas the former can be justified to some extent in terms of some of the arguments advanced above, it is, as has been argued repeatedly in this report, hard to justify the latter. A wrong pricing structure within the postal services might lead to a misallocation of resources within the postal services and lead to larger losses in the aggregate.

There is a popular fallacy that low postal rates (and hence large postal losses) are beneficial in that they facilitate economic development, while raising them to a level which will cover the real cost of the service, including depreciation and replacement of equipment, is inflationary. It is possible, however, that low rates by distorting demand and upsetting the balance between productivity and the real value of the service to the user, might actually fuel inflation. Similarly, one has to evaluate the inflationary impact of the subsidy given to the post office. The subsidies to postal services may result in a rise in the prices of some other commodities if such subsidies are financed by either increasing commodity taxes or deficit financing. One must also remember that the resulting inflation would penalise non-users as well, hence there would be some kind of inequity built into this.

## 3. Micro Issues

Under this heading our principal concern is with the structure of prices and costs within the postal department.

Many commentators have observed that costing techniques need to be improved. For instance, there might be too much emphasis on estimated cost functions for calculating prices whereas, in reality it might be difficult to ascribe costs unambiguously. In other words, allocating costs among the various items of the postal service by estimating a cost function might be restrictive.

Several commentators have, therefore, suggested independent methods of allocating costs. For instance, the British administrators conducted periodic sampling to find out the allocation of overall staff hours among various items of the postal services. These percentages were then applied to the relevant salary bill. Similar

conventions were applied to working areas and vehicles, and in this way the costs were allocated. However, this example showed clearly that in a certain sense such information was not very useful because it could be demonstrated that eliminating one of those services had an insignificant effect on overall costs. All that was achieved was the elimination of a source of revenue without achieving a cut in expenditure proportional to that reduction in revenue. In an attempt to get out of this difficulty, a number of experiments were carried out; studies on the longer term evaluation of marginal costs were conducted throughout the UK with very detailed analysis of the work related to traffic levels and flows. A study was commissioned to produce a common classification for both variable and fixed costs. The results were not very encouraging and such detailed sampling techniques have been given up.

Given the agnosticism with respect to both econometric cost function estimation and detailed sampling, many observers have favoured the use of simple pricing techniques like marginal cost pricing or variable cost pricing. Nonetheless, over the years these econometric estimation techniques and sampling methods have led to the development of a suitable data base and better understanding of the cost structure of postal services. In India, however, considerable work needs to be done along these lines.

Our approach to pricing has been threefold. We have first reviewed pricing within the post office as a Pareto-optimizing exercise. Cross-subsidy-free prices have been estimated. The argument here is simply that unless each constituent service of the post office does at least as well as it would in a coalition of any smaller size it must be functioning inefficiently in the Paretean sense.

Another approach extends this idea to some extent. It is argued that there is a fundamental difference between cross-subsidy-free prices in the traditional sense and pricing in the postal services. Whereas efficiency within the postal service demands that cross-subsidy-free prices be used for accounting

purposes, our concern for mass information may require that consumers pay lower prices for some items and higher prices for some others. In this case we recommend that while cross-subsidy-free prices be used within the post office, the final consumer prices can be different and these differences can be looked upon as ordinary indirect taxes/subsidies. This is the so-called eclectic approach which we have discussed at length in Chapter 4.

Yet another approach to postal pricing that has been much discussed in the literature and also in this report is the so-called second best Ramsey pricing. Here there is a specific admission that Pareto-efficient pricing is being given up and one is functioning in the realm of second best. Standard second best formulae relating pricing of different products to their respective price elasticities of demand and redistributive objectives of government have been derived and used in several countries.

However, there are some problems with applying this approach in a simple manner. For instance, in Canada it has been discovered that there is a strong correlation between the size of customer and his sensitivity to prices. High-volume users often have considerable resources and, therefore, may opt for alternative means for the conveyance of information. Their demand is often quite price elastic. In Canada, and several other countries, the post office implemented quantity dependent prices. Such a policy does, of course, sound discriminatory but the counter-arguments that have often been put forward are: (i) This discrimination would help maintain a high level of traffic and optimise revenue. This was in the best interest of all. (ii) Since the provision of postal services invariably involves economies of scale, large-volume users effect some savings for the post office. It would be fair, it is argued, to return some of these savings.

Furthermore, demand for postal services is also sensitive to several other variables. In Germany it has been discovered that general economic trends, seasonal variations and dates of elections significantly influence demand. In India one could safely add the timing of the marriage season to this list.

Another problem with accurately estimating demand for postal services is that postal tariff rates change only infrequently. In Germany, for instance, postal prices are often termed political prices. In India, too, postal prices particularly of those items that are used in large measure by the less affluent sections of society, are difficult to increase because such increases, it is feared, may adversely affect the fortunes of the political party in power.

This kind of constraint has led to some discussion about the composition of the authority that regulates postal tariffs. In several countries the idea of setting up an independent authority to fix postal rates in the light of the public interest has been put forward. But even in such countries the constitution and rules of such an authority are governed by the appropriate legislative bodies. Some countries require these authorities to hold public hearings before postal rates are changed.

In India, however, no such authority exists and postal prices have remained ''political prices'' for long periods of time. There is certainly some need here to move in the direction of creating an authority that could oversee postal tariffs and costs in a more objective manner.

One must also realise that the setting of postal tariffs is only one aspect of the overall price and cost problems of the post office. Equally important problems are, among others, the absorption of new technology and the corresponding adjustment of prices and costs; and the forecasting of demand of existing and new (yet unknown) postal services.

To some extent the post office merely reacts to these changes. If trains run at greater speed the post gets delivered sooner. However, particularly in the area of designing new products and effecting improvements in office management technology, the post office has a responsibility. If the post is to compete successfully with newer means of communication, it has to, perhaps, be committed to serious and ongoing market research. In India we have been lagging behind in this respect. The post office could

easily have anticipated the boom in the courier service business much earlier, for instance.

The identification of new sources of demand can of course give some flexibility to the post office in setting rates. So can finer segmentation of the existing post. Thus, for instance, it may be possible to discriminate between ordinary book post and greetings cards and a higher tariff may safely be applied to the latter.

In these and other areas much work needs to be done in India. Unfortunately, the data base for analysing the performance of the postal services is quite poor and subject to wide margins of error. In this regard there is considerable work to be done. It is beyond the scope of the present report to comment on the structure of the data to be compiled and, indeed, for which a proper infrastructure still remains to be built.

## 4. Conclusion

In this introduction to our report, we have discussed some of the considerations that have figured prominently in the academic and organisational literature on postal tariffs. It has been emphasised that both with regard to the pricing of individual items and the overall deficit/surplus position of the postal budget, there are a number of opinions. We have attempted an evaluation of some of these arguments and found that it is hard, *a priori,* to unambiguously favour one approach or the other. As a matter of fact, we have found that post offices in many countries have used different arguments.

# 2. A Critique of Current Practices for Fixing Postal Tariffs in India

## 1. Introduction

In this chapter we try to highlight some of the weaknesses of the current practices for fixing postal tariffs in India. Such weaknesses may be broadly classified under five headings:

    (i)     Problems of setting postal rates
    (ii)    Problems of costing
    (iii)   Problems of evaluating and justifying postal deficits
    (iv)   Problems of capacity expansion
    (v)    Problems with data

## 2. Problems of Setting Postal Rates

The pricing strategy followed by IPD can be described as one involving cross-subsidisation and an overall budgetary deficit. We must first point out that the extent of cross-subsidisation actually involved is different from the IPD's measure of cross-subsidisation for the following reasons:

(a) The IPD follows, in our view, an inappropriate method of allocating joint costs and

(b) there is a difference between the economic cost and the cost adopted by IPD.

The principles followed by the postal departments in the

advanced countries to fix the postal tariffs cannot be replicated
unconditionally in a developing country like India. Full cost
prices with the balanced budget that are mostly adopted by the
developed countries may not be appropriate for India since the
postal services are the only means of communication available
to poor people separated by long distances geographically.
Therefore, social objectives like the rapid dissemination of
information and the income distribution in the country can also
be the basis for fixing the postal tariffs in India apart from the
cost effectiveness. In this context, the pricing schemes involving
either cross-subsidisation with the balanced budget for IPD or
price subsidies to certain postal services with the budgetary
deficits of IPD financed from the general revenue become relevant
options for fixing the postal tariffs in India. The current practice
of financing the deficits of IPD from the general revenues
of the government may be legitimised, if the deficits are shown
to be the result of price subsidies to meet the social objectives.
This may be achieved if the annual budget of IPD is prepared
and presented to Parliament as the railway budget is
presented.

The current method of pricing followed by IPD (cross-
subsidisation with budgetary deficits) is arbitrary because subsidies
for certain services and mark-ups for the other services are fixed
without careful economic evaluation. The present report puts
forward four pricing strategies that could be followed and discusses
their welfare  properties.

## 3. Problems of Costing

An additional problem is the evaluation of costs. Since the
IPD is a multi-product firm a significant portion of the costs are
joint. Broadly speaking, the IPD distinguishes three categories
of costs, *viz.*, (i) directly attributable costs, (ii) indirectly attributable
costs and, (iii) joint or non-attributable costs. The IPD allocates
joint costs by the criterion of relative volume. But, as argued in
Chapter 7,  this method is arbitrary and does not yield efficient
cost-based prices for the postal services. The literature on the

problem of public utility pricing suggests that it is better to allocate joint costs by the method of attributable cost. Indeed, this is the principle adopted in this report. As argued in Chapter 7, this method ensures efficient cost-based prices for certain types of cost functions. The key to the implementation of this method is the proper identification and measurement of attributable costs for various postal services.

One can find fault with the IPD's treatment of cost of capital as well as its treatment of depreciation. In this report we have tried to circumvent these difficulties in a manner that is consistent with sound empirical practice. The methodology adopted for costing is made explicit in this report and it is to be hoped that IPD would, broadly, follow the same approach.

## 4. Problems of Deficit

As has been discussed, the pricing and costing practices followed by IPD are such that it is hard to justify the deficit in welfare theoretic terms. The deficits of the IPD have to be evaluated along with surplus/deficits of other government departments if we are to ensure the best use of public funds.

However, although an exercise involving the evaluation of the overall budgetary policies of the government is outside the scope of the present report, we must ensure that deficits of the IPD are the outcome of efficient costing methods and a pricing strategy that has a sound rationale in welfare theoretic terms.

As argued above, this is difficult to ensure with the essentially *ad hoc* pricing and costing practices adopted by IPD. On the operational side, since it has been possible for IPD to obtain funds at almost any time, it could be the case that IPD deficits have become harder to control in addition to being impossible to rationalise.

With the approaches followed in this report, no such arbitrariness in the treatment of deficits is possible.

## 5. Problems of Capacity Expansion

The supplies of various services by IPD are demand constrained. The data on output and cost of IPD during the period 1950-51 to 1982-83 show that IPD has planned its expansion in disregard of the demand for its services. The increased expansion of capacity coupled with the economies of scale of joint production has contributed to the presence of excess capacity in the IPD. Therefore, matching of capacity expansion with the growth of demand for its services should be an important consideration for the planned development of IPD in the future.

## 6. Problems with Data

The data presented by IPD leave much to be desired. For instance, if one examines the traffic demand figures one realises that for unregistered traffic the demand is highly exaggerated. Moreover, different statements prepared by IPD (e.g., Annual Reports and Statistical Digests of IPD) give widely divergent estimates of traffic demand for the same year.

The IPD aims at setting prices to effect some redistribution of income in society. However, whether this has happened, or indeed, is possible can be discovered only after a thorough investigation of the demand for postal items by different income categories. But the data for such an investigation are simply non-existent. These data can be collected by IPD on an annual basis for a representative sample of households in the Indian economy. The IPD should make all efforts to develop a sound data base and collect these data.

# 3. Summary and Recommendations

## 1. Introduction

In formulating the principles of postal tariff policy two issues are of prime concern. These are (i) the basis for pricing of various postal services; (ii) an economic evaluation of the claim of the IPD on the general revenues of the government. In this chapter we present a summary of our recommendations and analysis of these issues and recommendations based on the results of the analysis. Additionally we comment on some aspects of the financing of the IPD.

## 2. Pricing of Individual Postal Services

At the broadest level there are three possible approaches to the pricing of individual postal services. These are : (i) "political" rates, (ii) commercial rates, and (iii) economic rates. Postal pricing in India seems to have been based on an amalgam of all three approaches, but not in any rational manner. The principle behind the political rates appears to be that prices of postal services have an important social function and, therefore, social/political considerations prevail over others in their determination. Typically, then, the problem of costing postal services would not be of much relevance in their pricing.

Commercial rates tend to exploit, for profit, the position of the post office as a monopoly supplier of postal services. Correspondingly, costing is a relevant consideration although the objective of the postal department in this case is, explicitly,

to earn a positive return over cost and not necessarily maximising it.

Postal services being in the nature of a public utility constituting a basic infrastructure for development, its pricing purely on commercial principles might not maximise social welfare. At the same time, prices unrelated to costs or at least a clear accounting to costs often leads to waste and inefficient use of scarce resources. Also, pricing on political considerations alone without any regard for costs may confer unduly large benefits on sections who do not deserve it and place the burden on weaker sections. Hence the need for basing the prices of postal services on economic principles, whereby the services provided by post offices do not lead to waste and inefficiency and at the same time the objectives of social justice are also taken duly and explicitly into account.

In this report we purport to concentrate exclusively on economic rates. In designing these economic rates some well defined norms of social welfare are invoked. The theoretical basis for such norms are discussed at some length in Chapter 7 of this report.

We provide a set of four approaches to the economic pricing of postal services. These are :

i. *First best/cross-subsidy-free prices with a balanced budget for the postal department.*

With this method prices of individual postal services reflect fully allocated costs. Correspondingly the budget of the postal department is exactly balanced.

The basic rationale behind this approach is that the pricing structure should be such that each constituent service of the IPD must earn at least as much as it would as a separate service or constituent of any smaller group of services. If this (potential) alternative is visualised as competitive supply, then it would follow that the postal department would be supplying its services in the most efficient manner.

ii. *Two-tier pricing with cross-subsidy-free prices and an overall subsidy--the eclectic approach.*

Cross-subsidy-free prices, although efficient, might involve "high" prices for several items. In the case of IPD a perusal of Table 5.6 of Chapter 5 will readily indicate this to be the case.

Such prices, it may be argued, conflict with some other objectives of the government, e.g., caring for the poor (redistribution of incomes) or widest dissemination of information through the use of postal services. If, for instance, it is felt that the full cost prices of items used in relatively large amounts by the less well-off sections of society are too high, there might be a case for subsidising some of these items.

The approach taken in this report to tackle this problem is the following: For purposes of internal accounting within the IPD, cross-subsidy-free prices are used. This ensures efficiency within the postal department itself. For purposes of fixing the consumer prices however the government is free to levy tax/ subsidy on these first best accounting prices. That is to say, the equity objectives are taken care of by transfers from the general budget. This 'eclectic' approach then combines efficiency within the postal department with the redistributive objectives of the government. Under certain circumstances this approach has some desirable welfare properties.

iii. *Second best prices.*

If (competitive) efficiency is not the sole consideration, then there can be at least two reasons why prices of postal services can be different from cross-subsidy-free prices: (a) The IPD may not be a monopoly or a competitor in all markets and (b) the government may have specific redistributive objectives.

In such cases it might become necessary to compute second best prices for postal services. This computation involves a clear enunciation of government's welfare function that takes into account the governmental objectives like equity and resource

mobilisation. This welfare function is maximised with respect to postal prices and this maximisation is subject to an overall budgetary constraint of the government. Since this maximisation is subject to the budget constraint, the resulting postal prices are second best optimal. We would typically expect them to involve lower prices for distributionally significant items such as letter cards and post cards and higher prices for less significant items such as registered letters in comparison to first best prices. In Table 5.17 (Chapter 5) we provide detailed estimates of second best optimal prices on the assumption of certain weightage pattern for services based on considerations like distributive justice.

· In Chapter 6 we recommend dual prices for certain postal services from the point of view of balanced regional development and regional income distribution. In particular, we recommend concessional prices for demands for postal services originating from less developed regions in the country. We believe that this dual pricing scheme is practicable and can be implemented without additional financial burden on IPD.

### iv. *Cross-subsidisation with overall budgetary deficit*

This approach is currently being practised by IPD. In Table 5.10 of Chapter 5 we present estimates of cross-subsidisation of major services provided by the IPD. In Table 5.11 of Chapter 5 the corresponding budgetary deficits are reported.

This method does not have any welfare optimality properties unless it can be demonstrated that the existing subsidies and the budgetary deficit are derived from a specific welfare maximisation exercise, e.g., the second best approach outlined above. In any event, all pricing strategies that prescribe cross-subsidisation involve the risk that successful competitive services may eventually be provided by private agencies.

Our purpose in describing the four approaches to pricing is to clearly articulate the possibilities available to the IPD. For obvious reasons we single out first best and second best pricing

strategies for exhaustive discussion in this report. So far as the eclectic approach is concerned, taxes/subsidies on individual postal services have to be set as part of the overall budgetary policies of the government. In other words, taxes/subsidies on individual postal services have to be evaluated along with the taxes/subsidies on commodities in general. Since redistributive concerns form the *raison d' etre*, for a departure from first best pricing in the eclectic approach, a broad principle of such departure could be to subsidise those services that are used in disproportionately large measure by the poor and tax those that are used relatively more by the more affluent sections of society.

As we had remarked earlier, cross-subsidisation with a budgetary deficit for IPD has no claim to welfare optimality unless it can be demonstrated that this approach corresponds to, say, second best pricing. Hence we realise that first best or second best pricing rules are the bases that any sound pricing strategy must adopt. Correspondingly, in this study we undertake an exhaustive study of first and second best pricing rules.

Average price computations under these two regimes are reported in Table 5.6 (Chapter 5) for first best prices (for the years 1981-82 to 1985-86). There is some reason to believe that price schedules for some postal services must be such that marginal prices may differ from average prices. This may be because government may want to discriminate among categories of buyers by their quantum of purchases for redistributive reasons. Additionally, it could be argued that typically larger volume users display greater elasticity of demand than smaller volume users. Since larger volume users help the IPD to exploit economies of scale, it would only be fair to return to such users some of the savings they help attain. In Tables 6.18 to 6.21 (Chapter 6) we report marginal prices computed as per the declining block scheme that are consistent with the average prices reported in Chapter 5.

These calculations summarise our recommendations with respect to the pricing of individual services supplied by the IPD.

## 3. Deficits of the IPD

A virtue of economic pricing is that pricing policies and deficits have to be analysed jointly. In the eclectic approach, deficit that results must be justified because taxes/subsidies on individual postal services are evaluated along with taxes/subsidies in general. In the second best approach, revenues from postal services are evaluated against revenues from other sources, e.g., indirect taxes. Hence it is no longer necessary to think of the deficits of the IPD as the excess of expenditure over receipts.

However, in the case of the pricing policy that is actually practised, *viz.*, cross-subsidisation with overall deficit, the deficit is essentially the residual. Further, in the case of the IPD, there is some inconsistency in the data because the sum of the deficits/ surpluses on individual postal services does not add up to the overall deicit of the IPD. The estimates of deficit as reported in Table 5.11 of Chapter 5 are derived from the Appropriation Accounts. Our estimates of deficit are different from those of the IPD because our notion of cost is economic cost which must include cost on account of all factors of production, e.g., labour, capital and materials, whereas in the case of the IPD only accounting costs are considered.

In any event it is not possible to justify this deficit in terms of any welfare calculus unless it can be demonstrated that the pricing structure is derived from, say, a second best optimisation exercise. Our exercises suggest that the pricing practised by IPD does not follow any rational principle and is the outcome of *ad hoc* decisions made over the years without any attempt to take an overall look or rationalise the structure. As a result one notices an overall deficit subsidised by the general budget along with surpluses derived from services which *prima facie* are used mainly by the Department.

## 4. Financing of the IPD

In its 1968 Report to the Administrative Reforms Commission, the Working Group on Post and Telegraphs had emphasised that

the P & T Department should present its own budget to Parliament. It had further recommended that (the then) P & T department should be made accountable for its revenue and expenditure. The present practice in IPD seems to be that although this department does maintain separate accounts it can potentially draw upon the general revenues of the government at almost any time. Many observers have expressed the view that such latitude is inimical to financial accountability.

Short of making the IPD an independent corporation, it is possible to increase its financial accountability by making it possible for the IPD to draw, ordinarily, only from a revolving fund. The government can help set up the fund and all surpluses of the IPD can be credited to it. It is felt in some quarters that this practice might restrain IPD claims on the general exchequer.

The idea of a revolving fund merits attention from financial analysts and accountants. As economists we can say that creation of such a fund does not obviate the necessity of a sound and rational price policy. Year-to-year deficits will still have to be justified.

## 5. Revision of Tariffs by IPD

The frequency with which IPD may revise its tariffs is an important issue. There is an argument that postal prices should not be changed very frequently. It is contended that stable postal prices help in lowering inflationary expectations. Further, since certain items of the post are used predominantly by the poorer sections of society, frequent hikes in postal rates may be regressive.

However, we find the counter-arguments more tenable. Postal tariffs should not remain out of line with postal costs for too long. This is particularly important in the case of the eclectic approach where taxes/subsidies on individual postal items have to be evaluated against taxes/subsidies on other items in the general budget of the government. Moreover, the social cost of

the deficits of the IPD have to be evaluated as part of the overall policies of the government. Furthermore, frequent revisions of tariffs of IPD need not mean that the tariff structure would become regressive. This is because it is always possible to subsidise items that are largely used by the poorer sections and tax those that are used by the richer sections of society.

We, therefore, recommend that IPD may revise its tariffs annually by following any one of these procedures:

(a) Using the method described in Section 1 of Chapter 5 the estimation of full cost prices for postal services may be attempted by IPD every year, taking into account changes in the prices of labour, capital and material inputs. Adopting full cost prices as base prices, subsidies for some services and mark-ups for the other services may be fixed so that IPD balances its budget and realises its various social objectives. This results in the cross-subsidisation with balanced budget for IPD as described in detail in Section 2 of Chapter 5 and Section 4 of Chapter 6.

(b) Alternatively, IPD may set the prices for its services by preparing and presenting an annual budget to Parliament as its sister department, Railways, does in India. The preparation and presentation of annual budget by IPD will provide it autonomy to fix prices for its services and also facilitate public scrutiny and debate over its policies. In this process, the budgetary deficits created by the pricing policies of IPD to achieve various social objectives will have prior approval of Parliament and the public. This procedure is akin to the eclectic approach described in Section 5 of Chapter 7 for the postal budget, like the budget of Railways, will be very much part of the annual budget of the Union Government.

## 6. Conclusions

In this chapter we have briefly commented on the approach to postal tariffs that is adopted in this report. We have also

commented briefly on IPD's deficits as well as on a suggestion for improving the financial accountability of IPD.

The plan of the rest of the report is as follows. In Chapter 4 we define an index of productivity of IPD and trace its development over the period 1950-51 to 1983-84. In Chapter 5 we compute average first best and second best (with balanced budget) prices for IPD for a few representative years. In Chapter 6 we present our estimates of marginal (declining block) prices under these two regimes. Chapter 7 details various approaches to public utility pricing and discusses the theoretical rationale for adopting the four pricing strategies detailed in the chapter.

# 4. Efficiency of Indian Postal Services

## 1. The Concept of Efficiency and Data for its Estimation

A commonly held belief is that the Indian Postal Department (IPD) has been operating inefficiently. In this chapter, we try to comment on this popularly held belief by making estimates of productivity of real resources used in the Postal Department during the period 1950-51 to 1983-84.

The IPD supplies a large number of services jointly comprising unregistered and registered mail items, and services like postal insurance, savings banks accounts and savings certificates. Suppose we have an estimate of the supply of various services by the postal department in a given year in homogeneous units; such as, post card equivalents. Given also an estimate of resource cost of IPD expressed, say, in rupees in a given year, we may obtain an estimate of productivity of a rupee spent in the postal department in that year. By comparing the productivity estimates so made for different years, we may be in a position to comment on productivity changes in IPD over a longer period of time.

The estimation of output of IPD in post card equivalent units requires data on the quantities of various services offered and their prices. For example, if postal services are supplied in the free market and market prices represent revealed preferences of users of these services, the post card equivalent units of postal services supplied can be estimated by taking post card as numeraire. But the postal services in India as

well as in many other countries are supplied by public utilities at regulated prices. If the regulated prices are any guide to revealed preferences of society for postal services, the post card equivalent units of supply of these services can be estimated by again taking post card as numeraire.

We have obtained from IPD data on the regulated prices for the various postal services in India during the period 1854-1987. A close look at this data shows that most of these prices have been changing quite infrequently. Table A.1 in the Appendix provides detailed data on traffic demands for various postal services in India during the period 1950-51 to 1983-84. The traffic demands data for the registered postal items give the actual demands while the traffic demand for unregistered postal items are the estimates. Given the highly exaggerated data about the traffic demands for unregistered mail which are obtained by a periodic enumeration of a selected number of post offices in the country, IPD has attempted to make realistic estimates of unregistered traffic by using the data on the actual revenue collected from various unregistered mail items.[1] Given these data, we may be in a position to estimate the supply of postal services in post card equivalent units during the period under study: 1950-51 to 1983-84. Since these estimates depend upon the structure of societal preferences as reflected in the regulated prices of postal services and regulated prices have been changing over time, they may not be comparable over time. However, if we rely on the estimates of productivity per rupee to comment on the efficiency of IPD during 1950-51 to 1983-84 we will need estimates of the supply of postal services in comparable units over time.

One method of arriving at comparable estimates over time for the supply of postal services is to have societal preferences

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1. The actual revenue collected from the unregistered mail items constitutes approximately 35 per cent of revenue estimated from these items, using data from enumeration during the years 1980-81 to 1985-86.

for postal services (revealed through regulated prices) during a particular year as standards. Adopting, say, the regulated prices of the year 1950-51 as standards, and given the estimates of traffic demands for various services for all the years during 1950-51 to 1983-84, we may obtain comparable estimates of supply of postal services in post card equivalent units. But as mentioned earlier, the data on traffic demands for unregistered mail are not reliable. However, we have reliable data on the revenue realised by the IPD during the period 1950-51 to 1983-84 from Appropriation Accounts of Department of Post and Telegraph. These revenue figures may approximately represent output supplied by the Department of Posts if they are corrected for index numbers of regulated prices of postal services. Column (5) of Table 4.1 and Column (4) of Table 4.2 respectively provide information about the revenue of IPD and price index number of postal services. Using this information, we have estimated the revenue at constant prices and reported it in Column (3) of Table 4.3. The revenue at constant prices so estimated may approximately represent output of IPD in rupees at constant prices and be comparable over time. Now, by dividing the revenue at constant prices by the price of a post card in the year 1950-51, we have made estimates of postal services in post card equivalent units which are comparable over time. These estimates are provided in Column (4) of Table 4.3.

The resource cost of providing postal services in India during a given year can be estimated given the data about capital stock, labour employment, material inputs used, the price of capital services, wage rates and prices of material inputs for IPD. The Annual Reports and Appropriation Accounts published by IPD provide data about capital stock and annual expenditure on wages and salaries and material inputs for IPD, as given in Appendix Table A.3. Given an estimate of value of capital stock at constant prices ($K_0^t$) and the price of capital services of a rupee worth of capital at constant prices ($p_k^t$), the cost of capital services for IPD in a given

TABLE 4.1

## Estimates of Total Economic Cost and Gross Revenue at Current Prices of Indian Postal Department

(Rs. in Million)

| Year<br><br>(1) | Cost of Capital<br>Services<br>(2) | Other<br>Costs<br>(3) | Total<br>Cost<br>(4) | Total Revenue<br><br>(5) |
|---|---|---|---|---|
| 1950-51 | 0.94 | 230.0 | 230.94 | 210.4 |
| 1951-52 | 0.98 | 258.7 | 259.68 | 220.4 |
| 1952-53 | 0.96 | 279.1 | 280.06 | 241.4 |
| 1953-54 | 1.08 | 288:0 | 289.08 | 265.3 |
| 1954-55 | 1.28 | 305.3 | 306.58 | 279.3 |
| 1955-56 | 1.44 | 321.3 | 322.74 | 294.2 |
| 1956-57 | 1.61 | 335.2 | 336.81 | 327.4 |
| 1957-58 | 4.24 | 391.7 | 395.94 | 348.8 |
| 1958-59 | 2.31 | 394.7 | 397.01 | 378.7 |
| 1959-60 | 3.19 | 415.5 | 418.69 | 392.2 |
| 1960-61 | 2.93 | 452.4 | 455.33 | 407.8 |
| 1961-62 | 3.04 | 484.3 | 487.34 | 456.2 |
| 1962-63 | 3.38 | 558.8 | 562.18 | 509.5 |
| 1963-64 | 3.84 | 590.9 | 594.74 | 566.2 |
| 1964-65 | 3.75 | 670.1 | 673.85 | 593.2 |
| 1965-66 | 4.73 | 766.6 | 771.33 | 660.0 |
| 1966-67 | 4.90 | 865.8 | 870.70 | 701.5 |
| 1967-68 | 5.29 | 968.1 | 973.39 | 742.3 |
| 1968-69 | 5.85 | 1086.8 | 1092.65 | 939.8 |
| 1969-70 | 6.87 | 1124.0 | 1130.87 | 978.1 |
| 1970-71 | 7.59 | 1242.2 | 1249.79 | 1105.4 |
| 1971-72 | 10.40 | 1321.5 | 1331.90 | 1106.4 |
| 1972-73 | 11.21 | 1461.3 | 1472.60 | 1182.5 |

| Year | Cost of Capital Services | Other Costs | Total Cost | Total Revenue |
|------|--------------------------|-------------|------------|---------------|
| (1) | (2) | (3) | (4) | (5) |
| 1973-74 | 11.16 | 1639.1 | 1650.26 | 1342.5 |
| 1974-75 | 10.22 | 1973.3 | 1983.52 | 1420.7 |
| 1975-76 | 9.50 | 2344.6 | 2354.10 | 1678.5 |
| 1976-77 | 10.53 | 2476.8 | 2487.33 | 1939.6 |
| 1977-78 | 12.11 | 2334.5 | 2346.61 | 2069.0 |
| 1978-79 | 13.99 | 2631.8 | 2645.79 | 2391.7 |
| 1979-80 | 14.15 | 2527.6 | 2541.75 | 2592.2 |
| 1980-81 | 15.18 | 3794.9 | 3810.08 | 2708.4 |
| 1981-82 | 16.30 | 4433.7 | 4450.00 | 3094.1 |
| 1982-83 | 19.09 | 5169.2 | 5188.29 | 3780.1 |
| 1983-84 | 23.02 | 5705.2 | 5728.22 | 4345.4 |
| 1984-85 | 28.63 | 6351.2 | 6379.83 | 4414.1 |
| 1985-86 | 32.58 | 7252.0 | 7284.58 | 4768.4 |

TABLE 4.2

## Index Number of Wage Rate/Capital Cost Postal Tariff

| Year | Wage Rate | Capital Cost | Postal Tariff |
|------|-----------|--------------|---------------|
| 1950-51 | 100 | 100 | 100 |
| 1951-52 | 96.41 | 110 | 100 |
| 1952-53 | 97.91 | 117 | 100 |
| 1953-54 | 100.58 | 115 | 111 |
| 1954-55 | 97.63 | 114 | 111 |
| 1955-56 | 95.96 | 111 | 111 |
| 1956-57 | 91.44 | 108 | 116 |

| Year | Wage Rate | Capital Cost | Postal Tariff |
|------|-----------|--------------|---------------|
| 1957-58 | 99.08 | 267 | 125 |
| 1958-59 | 98.69 | 127 | 125 |
| 1959-60 | 96.13 | 155 | 125 |
| 1960-61 | 101.84 | 133 | 125 |
| 1961-62 | 104.58 | 133 | 129 |
| 1962-63 | 111.13 | 138 | 129 |
| 1963-64 | 113.08 | 139 | 133 |
| 1964-65 | 129.02 | 134 | 138 |
| 1965-66 | 151.35 | 148 | 138 |
| 1966-67 | 166.36 | 152 | 138 |
| 1967-68 | 200.15 | 160 | 148 |
| 1968-69 | 200.92 | 152 | 171 |
| 1969-70 | 202.95 | 149 | 187 |
| 1970-71 | 212.27 | 151 | 204 |
| 1971-72 | 227.60 | 183 | 213 |
| 1972-73 | 249.67 | 154 | 217 |
| 1973-74 | 277.25 | 154 | 221 |
| 1974-75 | 334.28 | 178 | 250 |
| 1975-76 | 392.65 | 173 | 254 |
| 1976-77 | 390.53 | 173 | 303 |
| 1977-78 | 398.05 | 172 | 303 |
| 1978-79 | 465.41 | 177 | 332 |
| 1979-80 | 465.77 | 181 | 351 |
| 1980-81 | 521.63 | 191 | 371 |
| 1981-82 | 565.33 | 196 | 376 |
| 1982-83 | 660.31 | 209 | 381 |
| 1983-84 | 760.89 | 220 | 433 |

TABLE 4.3

## Estimates of Economic Cost and Revenue at 1950-51 Prices and Index of Economic Efficiency of Entire Postal Services

| Year | Total Economic Cost | Total Revenue | Post Card Equivalent of Total Revenue | Revised Productive Efficiency | Index of Economic Efficiency |
|------|------|------|------|------|------|
| (1) | (2) | (3) | (4) | (5) | (6) |
| | (In Rs. million) | | ( Nos. ) | ( Nos. ) | |
| 1950-51 | 230.94 | 210.4 | 4488.5 | 19.44 | 1.00 |
| 1951-52 | 264.89 | 220.4 | 4701.9 | 17.75 | 0.91 |
| 1952-53 | 288.52 | 241.4 | 5749.8 | 19.93 | 1.03 |
| 1953-54 | 289.06 | 239.1 | 5100.8 | 17.65 | 0.91 |
| 1954-55 | 312.62 | 251.6 | 5538.1 | 17.72 | 0.91 |
| 1955-56 | 328.20 | 265.0 | 5653.3 | 17.23 | 0.89 |
| 1956-57 | 353.29 | 282.2 | 6020.3 | 17.04 | 0.88 |
| 1957-58 | 381.89 | 279.0 | 5952.0 | 15.59 | 0.80 |
| 1958-59 | 388.82 | 303.0 | 6464.0 | 16.62 | 0.85 |
| 1959-60 | 417.56 | 313.8 | 6694.4 | 16.03 | 0.82 |
| 1960-61 | 433.10 | 326.2 | 6958.9 | 16.07 | 0.83 |
| 1961-62 | 454.89 | 353.6 | 7543.5 | 17.35 | 0.89 |
| 1962-63 | 467.05 | 395.0 | 8426.7 | 18.04 | 0.93 |
| 1963-64 | 512.16 | 425.7 | 9081.6 | 17.73 | 0.91 |
| 1964-65 | 522.30 | 429.9 | 9171.2 | 17.56 | 0.90 |
| 1965-66 | 517.70 | 478.3 | 10203.7 | 19.71 | 1.01 |
| 1966-67 | 534.40 | 508.3 | 10843.7 | 20.29 | 1.04 |
| 1967-68 | 507.51 | 501.6 | 10700.8 | 21.08 | 1.08 |
| 1968-69 | 564.05 | 549.6 | 11724.8 | 20.79 | 1.07 |
| 1969-70 | 575.21 | 523.0 | 11157.3 | 19.40 | 0.99 |

| Year | Total Economic Cost | Total Revenue | Post Card Equivalent of Total Revenue | Revised Productive Efficiency | Index of Economic Efficiency |
|------|------|------|------|------|------|
| (1) | (2) | (3) | (4) | (5) | (6) |
| | (In Rs. million) | | ( Nos. ) | ( Nos. ) | |
| 1970-71 | 608.03 | 541.9 | 11560.5 | 19.01 | 0.98 |
| 1971-72 | 606.38 | 519.4 | 11080.5 | 18.27 | 0.94 |
| 1972-73 | 613.58 | 544.9 | 11624.5 | 18.95 | 0.97 |
| 1973-74 | 592.04 | 607.5 | 12960.0 | 21.89 | 1.13 |
| 1974-75 | 597.94 | 568.3 | 12123.7 | 20.28 | 1.04 |
| 1975-76 | 617.99 | 660.8 | 14097.1 | 22.81 | 1.17 |
| 1976-77 | 655.40 | 640.1 | 13653.3 | 20.83 | 1.07 |
| 1977-78 | 608.23 | 682.8 | 14139.7 | 23.25 | 1.20 |
| 1978-79 | 625.89 | 720.4 | 15368.5 | 24.56 | 1.26 |
| 1979-80 | 628.39 | 738.5 | 15754.7 | 25.07 | 1.29 |
| 1980-81 | 812.53 | 730.0 | 15573.3 | 19.17 | 0.98 |
| 1981-82 | 860.74 | 812.1 | 17324.8 | 20.13 | 1.04 |
| 1982-83 | 910.01 | 873.0 | 18624.0 | 20.47 | 1.05 |
| 1983-84 | 873.51 | 950.9 | 20285.8 | 23.22 | 1.19 |

year can be estimated as

$$C_k^t = K_o^t \quad P_k^t \qquad (1)$$

Following a method prescribed by Jorgenson and Griliches, the price of capital services can be estimated as

$$p_k^t = R_k^t + d_k^t - \frac{P_k}{P_k^t} \qquad (2)$$

where $R_k^t$ is the rate of return on capital in the year t,

$d_k^t$ is the rate of depreciation of capital in the year t, $P_k/P_k^t$ is the rate of appreciation of value of capital, where $P_k$ is $dp_k/dt$. We have used data on rates of return on long-term government bonds and securities during the period 1950-51 to 1986-87 as estimates of $R_k^t$. The annual reports of IPD provide data on depreciation. Using these data and the data on capital stock, we have obtained the estimates of $d_k^t$. Table 4.4 provides the estimates of $R_k^t$, $d_k^t$ and $p_k^t$ for IPD during the years 1950-51 to 1986-87. In the estimation of $p_k^t$ we have not attempted the correction for the appreciation of the value of capital stock. Table 4.1 provides

TABLE 4.4

**Estimates of Average Rate of Return on Long Term Government Securities and Rate of Depreciation and Estimates of Price of Capital Services for IPD**

(in percentages)

| Year | Annual Average Rate of Return | Rate of Depreciation | Total |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| 1951-51 | 3.11 | 1.11 | 4.22 |
| 1951-52 | 3.56 | 1.10 | 4.66 |
| 1952-53 | 3.94 | 0.98 | 4.92 |
| 1953-54 | 4.00 | 0.86 | 4.86 |
| 1954-55 | 4.06 | 0.73 | 4.79 |
| 1955-56 | 4.07 | 0.63 | 4.70 |
| 1956-57 | 4.02 | 0.54 | 4.56 |
| 1957-58 | 3.96 | 0.97 | 4.93 |
| 1958-59 | 3.98 | 1.39 | 5.37 |
| 1959-60 | 4.13 | 2.39 | 6.52 |
| 1960-61 | 4.08 | 1.53 | 5.61 |
| 1961-62 | 4.07 | 1.53 | 5.60 |
| 1962-63 | 4.30 | 1.53 | 5.83 |

| Year (1) | Annual Average Rate of Return (2) | Rate of Depreciation (3) | Total (4) |
|---|---|---|---|
| 1963-64 | 4.32 | 1.53 | 5.85 |
| 1964-65 | 4.48 | 1.18 | 5.66 |
| 1965-66 | 5.07 | 1.16 | 6.23 |
| 1966-67 | 5.28 | 1.14 | 6.42 |
| 1967-68 | 5.25 | 1.52 | 6.77 |
| 1968-69 | 5.04 | 1.39 | 6.43 |
| 1969-70 | 5.04 | 1.25 | 6.29 |
| 1970-71 | 5.15 | 1.22 | 6.37 |
| 1971-72 | 5.37 | 2.37 | 7.74 |
| 1972-73 | 5.37 | 1.12 | 6.49 |
| 1973-74 | 5.37 | 1.13 | 6.50 |
| 1974-75 | 6.16 | 1.24 | 7.40 |
| 1975-76 | 6.28 | 1.02 | 7.30 |
| 1976-77 | 6.24 | 1.07 | 7.31 |
| 1977-78 | 6.24 | 1.00 | 7.24 |
| 1978-79 | 6.42 | 1.05 | 7.47 |
| 1979-80 | 6.57 | 1.06 | 7.63 |
| 1980-81 | 6.96 | 1.10 | 8.06 |
| 1981-82 | 7.22 | 1.07 | 8.29 |
| 1982-83 | 7.73 | 1.09 | 8.82 |
| 1983-84 | 8.24 | 1.05 | 9.29 |
| 1984-85 | 9.22 | 0.96 | 10.18 |
| 1985-86 | 9.94 | 1.13 | 11.07 |
| 1986-87 | 10.19 | 1.29 | 11.48 |

estimates of cost of capital services, labour and other costs and total resource cost at current prices during the period 1950-51 to

1986-87 for IPD. The estimates of real resource cost of IPD have to be obtained by making the corrections in the estimates of cost at current prices for the index numbers of prices of capital services, wages and salaries and material inputs. Table 4.2 provides estimates of index numbers of price of capital services and wages and salaries for the postal department during the period 1950-51 to 1986-87 while the index numbers of prices of material inputs for IPD are assumed to be the wholesale price index numbers of paper and paper products in India. After making the corrections for these index numbers, the real resource cost estimates for IPD are obtained as given in Column (2) of Table 4.3.

## 2. Estimates of Efficiency

The estimates of output per rupee of resource cost spent by IPD are given in Column (5) of Table 4.3 while Column (6) of the same table provides the index numbers of productivity/ efficiency of postal department. Before we comment on the estimates of productivity of IPD, we have to recognise that the supplies of postal services in India are demand constrained. Given the existence of joint costs and the increasing returns to scale in joint production in the provision of these services, there may be an excess capacity in the Department of Posts in a given situation. Therefore, falling productivity of IPD in the fifties may be a reflection of the increasing of excess capacity during this period. The fifties have witnessed the growth of both cost and output for IPD, but output growing at a lower rate than cost. Given the existence of excess capacity in early fifties, the growing demand for postal services in India might have been met efficiently during the later years of the fifties by increasing the expenditure of joint cost nature at a rate lower than the rate of growth of output. However, in the sixties and seventies, even though the costs of IPD and the demands for its services were increasing, it would appear that the demand-constrained supplies of postal services were such that the economies of scale of joint production were exploited beneficially. This phenomenon is reflected in a gradual increase in the output per rupee of resource cost incurred

by IPD during this period. Estimates of productivity of IPD show that the same development has been discerned during the early eighties.

Now, looking at the efficiency index of IPD which is estimated by taking the year 1950-51 as base, there is a fall in the efficiency index during the fifties followed by gradual rise during the sixties. During the sixties, IPD was more efficient than it was in 1950-51 during the four-year period 1965-66 to 1968-69. During the early seventies IPD was less efficient that it was in 1950-51. Since 1973-74, there was a gradual rise in the efficiency of IPD, culminating in the highest efficiency for all the time during the year 1978-79. In fact IPD is 29 per cent more efficient in 1978-79 than it was in 1950-51. After a sudden fall in the year 1980-81, the efficiency of IPD has registered a gradual increase in the eighties.

Thus, a properly computed index of efficiency of overall productivity clearly establishes the proposition that there has been a long-term improvement in the efficiency of the IPD. Once this is accepted it is important to identify the source(s) of this improvement. In order to do this we regressed log of total economic costs $(C_t)$ against log of composite output in post card equivalent units $(Q_t)$ and time (t). The results of that regression are given below. The time period covered is 1950-51 to 1983-84.

$$\ln C_t \quad = \quad 0.616 \quad \ln Q_t + \quad 0.0033 \quad t$$

$$(0.253) \qquad\qquad (0.004)$$

$$R^2 \quad = \quad 0.942$$

(Figures in parentheses denote standard errors)

This regression presumes that the sources of improvement in efficiency can be traced to economies of scale and (neutral) technical progress.

We find that the elasticity of cost with respect to output is less than one and significant. Hence clearly there are economies of scale in the IPD. Moreover, the coefficient on time (t) is very small and insignificant. Hence technical progress cannot explain the improvement in efficiency.

We must also note the fact that the increase in efficiency has been fluctuating over the years. These vicissitudes have been ascribed to differences in the rate of growth of output as compared to the rate of growth of costs. These, in turn, are linked to two salient features of the IPD: (i) output is often demand-constrained and (ii) there has been an uneven expansion of capacity and, consequently, joint cost.

## 3. Conclusions

The commonly held belief that the efficiency of IPD has been falling over time does not find support from the estimates of productivity of the department for the period 1950-51 to 1983-84. The estimates of output of IPD (expressed in post card equivalent units) per rupee of resource cost show that there was a fall in the productivity of IPD during the fifties while it has been gradually rising since the beginning of the sixties. The index of productivity of IPD is 1.19 in 1983-84 with the year 1950-51 as base and the index in fact has become as high as 1.29 in the year 1979-80. There have been increasing returns to scale in IPD as indicated by an estimate of the elasticity of cost with respect to output (amounting to 0.616 during the period 1950-51 to 1983-84). We may therefore consider the inefficiency of IPD as one of scale inefficiency which increased in the fifties but has been followed by gradual decrease since the sixties.

# 5. Pricing Rules for Postal Services

## 1. Cross-Subsidy-Free/First Best Prices for Postal Services

In the literature on pricing in public enterprises, marginal cost pricing is generally regarded as a first best/Pareto optimal rule. However, for a multi-product firm this may not be the best pricing rule. There are two reasons for this: (i) It may be difficult or even impossible, *a priori*, to allocate the costs among the various products; and (ii) since joint production often involves economies of scale there is always the risk that, if left to the free market, these enterprises may become natural monopolies. For both these reasons such enterprises must be regulated.

The next question, naturally, is: What should be the cost minimising (optimal) prices for jointly supplying commodities by a publicly regulated utility such as IPD? Given the long-run cost function for a public utility like IPD, the cost minimising or the first best prices for a given service can be computed as a weighted average of marginal costs of that service at different scales of operation of the firm.[1] The weights in this case are defined by the normalised incremental scales of an expanding firm. In the case of a short-run cost function of a public utility, we should distinguish between the variable cost and the fixed cost which may also be a joint cost. The variable cost component of the price of a given . service jointly supplied with other services, may be computed as the weighted average of marginal costs of this service at different levels of operation of the firm. But the identification of joint/fixed cost component of the price of a given service poses formidable problems. The methods that are normally used for cost accounting among

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1. See Chapter 7, Section 3, for details.

various services of a firm having output or revenue as basis are
arbitrary in that they may not yield first best or cross-subsidy-free
prices. However, there is one method, the attributable cost method,
for the allocation of joint costs among various services which yields
first best prices or cross-subsidy-free prices for public utilities
having a particular class of cost functions.[2] Following this method
the cross-subsidy-free prices $(p_i)$ may be computed by using the
following formula.

$$P_i = (c_i + \frac{c_i\, q_i}{q_i\, \Sigma\, c_i\, q_i} \times J) \qquad i = 1, 2, \ldots, N \quad (1)$$

$$P_i = c_i \left(1 + \frac{J}{A}\right)$$

where

$p_i$ : Cross-subsidy-free price of $i^{th}$ service

$c_i$ : Per unit attributable cost

$q_i$ : Quantity of $i^{th}$ service supplied

$J$ : Joint cost

$A$ : Attributable cost.

The data supplied by IPD about its cost structure during the
years 1980-81 to 1985-86 provide details about various components
of cost to each service. Some of the components may be regarded
as joint costs while others are attributable costs to each service. We
have no knowledge of the method followed by IPD for distributing
joint costs among different services while calculating the average
costs reported in Table 5.1. We have estimated attributable cost of
each service by assuming that cost of printing and stationery and
transport cost (by Railway Mail Service, Surface and Air) are

2. See Chapter 7, Section 3, for details.

attributable costs. Then an estimate of joint costs of postal service is obtained by deducting the estimate of total attributable costs from the estimate of total economic cost reported in column (4) of Table 4.1. Given these estimates, we have made estimates of cross-subsidy-free prices for different postal services in India during the period 1981-82 to 1985-86. Table 5.2 presents these estimates.

A comparison of Tables 5.1 and 5.2 reveals that the estimates of cross-subsidy-free prices are significantly different from the estimates of per unit costs made by IPD for different services. The cross-subsidy-free prices are higher for all first class and second class unregistered mail services than the per unit costs calculated by IPD. The differences may in the main be attributed to some arbitrary method used by IPD for distributing joint costs among various services.

Table 5.3 provides estimates of average revenue per unit for different postal services. These may be regarded as implicit tariff rates for postal services which can be slightly different from statutory rates fixed by IPD for the first class and second class unregistered mail. However, for the registered mail they are averages since statutory rates vary with weight/amount of the mail. Now, a comparison of implicit tariff rates in Table 5.3 shows that the tariff structure of IPD is substantially different from the structure of cross-subsidy-free prices. Therefore the tariff structure of IPD for each year during 1981-82 to 1985-86 contributes to significant cross-subsidisation. The unregistered first class mail consisting of post cards, letter cards and letters and the second class mail comprising newspapers and other articles enjoy a fairly large subsidy at the cost of registered mail items. For example, during the year 1985-86, the implicit tariffs for post cards, letter cards and letters are respectively given as Re. 0.18, 0.35 and 0.70 while their corresponding cross-subsidy-free prices are Re. 0.87, Rs. 1.27 and 1.29. For a registered newspaper (single) the cross-subsidy-free price is Rs. 1.56 while the postal tariff is only Re. 0.11 during the year 1985-86.

TABLE 5.1
**Estimates of Total Per Unit Cost of
Postal Services**

(in Rs.)

| Item | 1981-82 | 1982-83 | 1983-84 | 1984-85 | 1985-86 |
|---|---|---|---|---|---|
| Post cards | 0.45 | 0.50 | 0.54 | 0.61 | 0.67 |
| Letter cards | 0.50 | 0.56 | 0.59 | 0.71 | 0.77 |
| Letters | 0.51 | 0.57 | 0.60 | 0.69 | 0.76 |
| Regd. newspapers | | | | | |
| (i) Single | 0.51 | 0.58 | 0.66 | 0.75 | 0.82 |
| (ii) Bundle | 0.61 | 0.69 | 0.81 | 0.93 | 1.01 |
| Book post | | | | | |
| (i) Book patterns | 0.54 | 0.61 | 0.70 | 0.79 | 0.88 |
| (ii) Printed Books | 0.64 | 0.72 | 0.85 | 0.97 | 1.06 |
| (iii) Other periodicals | 0.69 | 0.78 | 0.93 | 1.06 | 1.16 |
| Parcels | 3.89 | 4.40 | 5.73 | 6.63 | 7.20 |
| Registration | 3.23 | 3.58 | 3.91 | 4.32 | 4.88 |
| Value payables(VPP) | 1.94 | 2.37 | 2.68 | 2.96 | 2.48 |
| Insurance | 4.73 | 4.87 | 5.26 | 5.89 | 6.67 |
| Acknowledgements | 0.40 | 0.45 | 0.48 | 0.55 | 0.61 |
| MO | 4.29 | 4.66 | 5.26 | 5.93 | 6.83 |
| TMO | 4.01 | 4.53 | 5.31 | 5.82 | 6.54 |
| IPO | 2.09 | 2.32 | 2.66 | 3.02 | 3.51 |
| Savings Bank | 2.27 | 2.50 | 2.98 | 3.25 | 3.48 |
| Saving Certificates | 3.28 | 3.47 | 4.13 | 4.43 | 5.48 |
| BRLs | 4.45 | 4.47 | 5.92 | 6.29 | - |
| Recorded delivery | - | - | 1.92 | 3.24 | 3.59 |

TABLE 5.2
## Cross-Subsidy-Free Prices for Postal Services

(in Rs.)

| *Item* | *1981-82* | *1982-83* | *1983-84* | *1984-85* | *1985-86* |
|---|---|---|---|---|---|
| Post cards | 0.61 | 0.66 | 0.71 | 0.73 | 0.87 |
| Letter cards | 0.77 | 0.91 | 0.89 | 1.12 | 1.27 |
| Letters | 0.82 | 0.94 | 0.94 | 0.96 | 1.15 |
| Regd. newspapers | | | | | |
| (i) Single | 0.84 | 1.00 | 1.24 | 1.32 | 1.56 |
| (ii) Bundle | 1.18 | 1.41 | 1.93 | 1.99 | 2.33 |
| Other unregd. articles | | | | | |
| (i) Book patterns | 0.91 | 1.07 | 1.33 | 1.41 | 1.69 |
| (ii) Printed books | 1.23 | 1.47 | 1.93 | 2.08 | 2.44 |
| (iii) Other periodicals | 1.41 | 1.67 | 2.23 | 2.40 | 2.81 |
| Registration | 3.09 | 3.52 | 3.53 | 3.59 | 4.33 |
| Acknowledgement | 0.47 | 0.55 | 0.54 | 0.57 | 0.69 |
| Parcels | 7.41 | 8.79 | 12.94 | 14.23 | 16.65 |
| VPP | 0.27 | 0.27 | 0.23 | 0.46 | 1.29 |
| Insurance | 3.74 | 4.12 | 3.93 | 4.38 | 5.79 |
| MO | 0.76 | 0.88 | 0.84 | 0.91 | 1.27 |
| TMO | 0.76 | 0.88 | 0.84 | 0.91 | 1.27 |
| IPO | 0.61 | 0.64 | 0.57 | 0.99 | 1.25 |
| Savings Banks | 0.31 | 0.35 | 0.30 | 0.34 | 0.60 |
| Saving Certificates | 0.11 | 0.19 | 0.15 | 0.14 | 0.25 |
| BRLs | 0.37 | 0.36 | 0.35 | 0.42 | |
| Recorded delivery | - | - | 0.14 | 3.54 | 0.30 |

TABLE 5.3
## Average Revenue on Tariff of Postal Services
( in Rs.)

| *Item* | *1981-82* | *1982-83* | *1983-84* | *1984-85* | *1985-86* |
|---|---|---|---|---|---|
| Post cards | 0.15 | 0.16 | 0.16 | 0.17 | 0.18 |
| Letter cards | 0.25 | 0.33 | 0.35 | 0.35 | 0.35 |
| Letters | 0.51 | 0.66 | 0.71 | 0.69 | 0.70 |
| Regd. newspapers | | | | | |
|   (i) Single | 0.07 | 0.10 | 0.10 | 0.10 | 0.11 |
|   (ii) Bundle | 0.20 | 0.26 | 0.26 | 0.27 | 0.30 |
| Book post | | | | | |
|   (i) Book patterns | 0.38 | 0.43 | 0.44 | 0.44 | 0.53 |
|   (ii) Printed books | 0.19 | 0.28 | 0.29 | 0.28 | 0.33 |
|   (iii) Other periodicals | 4.47 | 0.48 | 0.50 | 0.51 | 0.45 |
| Parcels | 4.28 | 4.19 | 5.73 | 5.64 | 7.24 |
| Registration | 2.29 | 2.75 | 2.75 | 2.75 | 2.75 |
| VPP | 1.27 | 1.25 | 1.27 | 2.39 | 2.28 |
| Insurance | 5.36 | 5.37 | 5.26 | 8.43 | 7.56 |
| Acknowledgement | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| MO | 2.89 | 3.50 | 3.73 | 3.71 | 4.30 |
| TMO | 2.80 | 2.80 | 2.84 | 2.65 | 2.67 |
| IPO | 0.25 | 0.33 | 0.41 | 0.48 | 0.46 |
| Savings banks | 1.95 | 1.93 | 2.19 | 3.33 | 3.96 |
| Saving certificates | 2.63 | 2.59 | 2.97 | 4.82 | 5.87 |
| BRLs | 4.48 | 4.70 | 4.77 | 4.91 | - |
| Recorded delivery | - | - | 1.00 | 1.00 | 1.00 |

Table 5.4 provides the estimates of rates of subsidies for the first class mail and the registered newspapers (single) during the period 1981-82 to 1985-86.

Newspapers have the highest per unit subsidy followed by letter cards, post cards and letters. Table 5.5 provides mark-up over cross-subsidy-free prices for some of the registered mail services. For most of the registered mail items (with the exception of parcels, registered letters and IPOs), there are positive mark-ups over cross-subsidy-free prices. During 1985-86, money orders, savings banks and savings certificates have mark-ups respectively of Rs. 3.03, 3.36 and 5.62

Table 5.6 provides estimates of total subsidies/profits for different postal services during the period 1981-82 to 1985-86. Out of 17 services reported in the table there were 7 profit-earning services during the year 1985-86. Table 5.7 provides our estimates and the estimates of IPD for budgetary deficit of the Department of Post. Our estimated deficits are substantially higher than the estimates of IPD. The differences between these two estimates are attributable to differences in the definition adopted by IPD. The differences between our cost estimates and cost estimates of IPD arise mainly because of differences with respect to treatment of cost of capital services and inter-departmental transfers. Our estimate of cost of capital services includes depreciation as well as return on capital in the alternative uses in the economy while IPD takes only depreciation as the cost of capital services. Inter-departmental payments like recoveries made by IPD for the agency services like postal savings and savings certificates, are mere transfer flows which will not be relevant for the estimation of economic cost of IPD. For example, if these payments are made by the Ministry of Finance, they should be almost treated as a subsidy given by this Ministry to IPD for providing these services.

TABLE 5.4

## Rates of Subsidies for First Class Mail and Registered Newspaper (Single)

| Item | 1981-82 (1) | 1982-83 (2) | 1983-84 (3) | 1984-85 (4) | 1985-86 (5) |
|---|---|---|---|---|---|
| Post cards | -0.46 | -0.50 | -0.55 | -0.56 | -0.69 |
| Letter cards | -0.52 | -0.58 | -0.54 | -0.77 | -0.92 |
| Letters | -0.31 | -0.28 | -0.23 | -0.27 | -0.45 |
| Newspapers | | | | | |
| (single) | -0.77 | -0.90 | -1.13 | -1.22 | -1.45 |
| (bundle) | -0.98 | -1.15 | -1.67 | -1.72 | -2.03 |

TABLE 5.5

## Estimates of Mark-Ups Over Cross-Subsidy Free Prices for Some Registered Mail Services in India During 1981-82 to 1985-86

| Item | 1981-82 (1) | 1982-83 (2) | 1983-84 (3) | 1984-85 (4) | 1985-86 (5) |
|---|---|---|---|---|---|
| Parcels | -3.13 | -4.60 | -7.21 | -8.59 | -9.41 |
| Registered letters | -0.80 | -0.77 | -0.78 | -0.84 | -1.58 |
| VPP | 0.99 | 0.98 | 1.04 | 1.93 | 0.99 |
| Insurance | 1.62 | 1.25 | 1.33 | 4.05 | 1.77 |
| Money orders | 2.13 | 2.62 | 2.89 | 2.80 | 3.03 |
| IPOs | -0.36 | -0.31 | -0.16 | -0.51 | -0.79 |
| Savings banks | 1.64 | 1.58 | 1.89 | 2.99 | 3.36 |
| Savings certificates | 2.52 | 2.40 | 2.82 | 4.68 | 5.62 |
| BRLs | 4.11 | 4.34 | 4.41 | 4.93 | - |

TABLE 5.6
## Cross-Subsidisation of Postal Services
(Rs million)

| Item | 1981-82 | 1982-83 | 1983-84 | 1984-85 | 1985-86 |
|---|---|---|---|---|---|
| 1. Post cards | -437.55 | -487.67 | -527.01 | -487.26 | -621.21 |
| 2. Letter cards | -450.39 | -485.98 | -468.2 | -621.02 | -776.02 |
| 3. Letters | -443.21 | -439.83 | -332.44 | -385.34 | -649.40 |
| 4. Regd letters | | | | | |
| (i) Single | -162.93 | -214.56 | -254.36 | -267.67 | -335.53 |
| (ii) Bundle | -31.26 | -40.94 | -56.11 | -73.27 | -70.24 |
| 5. Book post | | | | | |
| (i) Book pattern | -129.11 | -147.39 | -219.56 | -222.81 | -282.92 |
| (ii) Printed books | -46.49 | -50.46 | -74.78 | -.76.68 | -94.74 |
| (iii) Other periodicals | -22.00 | -26.06 | -40.66 | -41.01 | -54.99 |
| 6. Parcels | -194.37 | -294.86 | -423.95 | -42.21 | -580.60 |
| 7. Registration | -194.56 | -197.43 | -207.87 | -231.25 | -421.86 |
| 8. VPP | +12.47 | +12.35 | +12.27 | +22.97 | +10.49 |
| 9. Insurance | +13.77 | +10.88 | +13.17 | +38.48 | +16.64 |
| 10. Acknowledgements | -29.61 | -49.11 | -46.78 | -52.73 | -79.09 |
| 11. MO | +252.83 | +319.38 | +360.67 | +365.96 | +378.45 |
| 12. TMO | +5.54 | +6.81 | +7.51 | +7.56 | +8.18 |
| 13. IPO | -5.80 | -5.30 | -3.31 | -10.46 | -18.96 |
| 14. Savings banks | +350.14 | +362.14 | +402.00 | +679.93 | +803.04 |
| 15. Saving certificates | +29.23 | +36.48 | +51.61 | +126.83 | +195.58 |
| 16. BRLs | +48.91 | +64.67 | +53.36 | +63.60 | - |
| 17. Recorded delivery | - | - | +7.05 | +21.59 | +6.16 |

TABLE 5.7

**Estimates of Budgetary Deficits of IPD**

(Rs. million)

| Item | 1981-82 | 1982-83 | 1983-84 | 1984-85 | 1985-86 |
|------|---------|---------|---------|---------|---------|
| IPD Estimates | 881.5 | 839.9 | 732.3 | 1242.5 | 1635.5 |
| Our Estimates | 1355.9 | 1408.2 | 1382.8 | 1935.7 | 2516.2 |

Therefore, our estimates of costs are fully attributable to resources used by IPD, namely, labour, capital and material inputs. But whatever may be the magnitudes of these deficits, they have to be financed from the general revenues of Union Government.

Given that there have been substantial budgetary deficits even after allowing cross-subsidisation by the department, the problem is to determine the tolerable level of budgetary deficit for IPD. Since budgetary deficits have to be met from the general revenue, there is a trade-off between cross-subsidisation and budgetary deficit. The optimum levels of cross-subsidisation and budgetary deficits for IPD have to be determined as part of the overall revenue policy of the government. The next section discusses some issues related to this problem. .

Finally we recommend the following rule for computing cross-subsidy-free prices for its services:

**Rule 1:** Cross-subsidy-free prices for a public utility with joint production are the first best prices or Pareto optimal prices. In computing these prices for the Indian postal services, the attributable cost method as described above can be followed for determining the joint cost component of the price of each service.

## 2. Distributional Equity and Prices for Indian Postal Services

We have observed in the preceding section that the actual tariffs/prices charged by the postal department are different from

the cross-subsidy-free prices for its various services. Also, there has been a budgetary deficit for IPD (even after cross-subsidisation) which has had to be financed from general revenues of the government. The question that arises then is : Why does IPD have prices for its services which are substantially different from the cross-subsidy-free prices?

In the theory of public sector pricing there are various arguments for the deviations from the first best marginal cost prices. Several such arguments are also relevant for a public utility supplying jointly many commodities. Some such arguments are:

a. Deviations from cross-subsidy-free prices may be necessitated because of differences in the market structure for different services. In several market situations the IPD does not enjoy monopoly power. Therefore, a crucial distinction may have to be made between monopoly services and competitive services. Some services of IPD may also be provided by private agencies. For example, private agencies supply parcel services as well as courier services for first class mail. Also, with the existence of a well developed banking system the supply process of money order services, postal savings and postal orders have to be fixed after taking into account supply prices of similar services charged by banks. To protect its share of the market for these services, IPD may have to supply these services at subsidised (competitive) prices while charging (near) monopoly prices for other services. Given the revenue constraint of IPD, this may result in cross-subsidisation.

b. The IPD may like to fix its prices after taking into account the effects of these on the equity and efficiency objectives of the government, and the overall budgetary situation. Such prices are known as second best or Ramsey prices. In this section we estimate these prices for some categories of postal services. Below we describe the methodology adopted.

The postal services in general may be regarded as necessities with very inelastic demand with respect to price and income which is confirmed by the following estimated demand function for the postal services in India.

$$\ln D = 5.835 \; - 0.401 \; \ln p + 0.116 \; \ln Y + 0.059 \, t$$

$$\phantom{\ln D =} [5.236] \; [-3.920] \qquad [0.663] \qquad\; [7.047] \qquad (2)$$

$$\phantom{\ln D =} [1.115] \; [0.102] \qquad [0.175] \qquad\; [0.008]$$

$$\phantom{\ln D =} R^2 = 0.986, \; DWS = 1.512$$

where

D : Total demand for postal services expressed in post card equivalent units.

p : Index number of postal tariffs.

Y : Gross national product at constant prices.

t : Time.

(Figures in brackets give respectively t ratios and standard errors.)

This demand function is estimated using time-series data from 1950-51 to 1983-84. The own price elasticity of demand for postal services in India is -0.401 while the income elasticity is 0.116 with an exponential time trend of 0.059. The own price elasticity and exponential time trend are statistically significant at 5 per cent level. Given the poor quality of the data, we have not attempted to estimate a complete demand system for Indian postal services to test for inter-service substitution possibilities. As such, one may expect statistically significant cross-price elasticities of demand among first class mail services like letters, letter cards and post cards. Also the first class mail items being very essential services, demand for them can be relatively inelastic with respect to prices and income in comparison to demand for registered mail items.

To compute second best prices we need data about consumer

expenditure on each mail item by income/expenditure classes to comment on the relative importance of a given service from the point of view of distributional equity. Such data are simply not available, but there exist estimates of the distribution of demand for some postal services by various sectors like Government, Business and Households during the year 1986-87. A Report on Postal Traffic Survey conducted by the Department of Posts, Government of India provides these estimates. Table 5.8 provides estimates of percentage distribution of traffic originating from different sectors for first class mail items while Table 5.9 provides the same information for registered mail items. In the case of first class mail services, households' demand accounts for 89.78 per cent of post cards and letter cards, 49.32 per cent of envelopes and 72.73 per cent of total unregistered mail while the respective demands of business account for 9.27, 35.04 and 19.87 per cent and of government account for 0.95, 15.64 and 10.60 per cent. Table 5.10 provides estimates of distribution of postal traffic by rural and urban sectors.

From the point of view of income distribution, government is assumed to favour household demand over demand by business and its own demand. In order to compute second best prices taking into account governmental distributional preferences for various services, we consider three hypothetical scenarios of structure of governmental preferences. The distributional preferences of government depend upon its value judgement about income distribution in the economy. Each scenario represents a certain degree of governmental preferences for income distribution. The three scenarios A, B and C can be ordered in terms of degree of governmental distributional preferences in the sense that C implies stronger distributional preferences than B and B than A. Table 5.11 presents the income distributional weights to demands for postal services by government, business and households under three scenarios, assuming in each case preferences of government for its own demand for postal services as numeraire.

TABLE 5.8

**Unregistered Mail By Users During 1986-87**

| Users | Post Cards. Letter card | Envelopes | Secondary unregd. | Total unregd. | Unregd. Parcels |
|---|---|---|---|---|---|
| Government | 0.95 | 15.64 | 10.60 | 7.40 | 57.62 |
| Business | 9.27 | 35.04 | 20.77 | 19.87 | 29.97 |
| Households | 89.78 | 49.32 | 68.63 | 72.73 | 12.41 |

TABLE 5.9

**Percentage Distribution of Various Categories of Registered Post by Users During 1986-87**

| Users | Regd. Letters | VP Letters | Insured Letters | Insured VP Parcel | Utilisation of Parcel |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Government | 20.21 | 9.92 | 4.88 | 0.94 | 44.59 |
| Business | 50.22 | 48.58 | 8.82 | 11.21 | 37.44 |
| Households | 29.57 | 41.60 | 86.30 | 87.85 | 17.97 |

| Users | Utilisation of VP Parcel | Insured Parcel | Insured VPP | MO |
|---|---|---|---|---|
| | (7) | (8) | (9) | (10) |
| Government | 13.44 | 6.22 | 4.97 | 3.59 |
| Business | 17.65 | 63.91 | 81.99 | 13.62 |
| Households | 68.91 | 29.87 | 13.04 | 82.79 |

TABLE 5.10

## Percentage Distribution of Various Postal Services
## by Rural and Urban Sectors in India

|  | *Urban* | *Rural* |
|---|---|---|
| 1. Post cards | 62.3 | 37.7 |
| 2. Inland letter | 63.8 | 36.2 |
| 3. Envelopes | 71.2 | 28.8 |
| 4. Registered newspapers | 77.02 | 22.98 |
| 5. Book post | 78.05 | 21.95 |
| 6. Registered letters | 87.5 | 12.5 |
| 7. V P letters | 89.19 | 10.81 |
| 8. Insured letters | 93.73 | 6.27 |
| 9. Insured V P letters | 0.67 | 0.33 |

Now the distributional characteristic $(R_j)$ of $i^{th}$ postal service can be estimated as

$$R_j = b_1 w_{1j} + b_2 w_{2j} + b_3 w_{3j} \qquad (3)$$

where

$b_i$ :  Distributional weight to traffic demand of $i^{th}$ sector, i = 1,2,3.

$w_{ij}$ :  Proportion of $i^{th}$ sector's demand in total demand for $j^{th}$ service.

Table 5.12 provides the estimates of distributional characteristics of inland letter cards, envelopes, registered newspapers and book post, registered letters, VP letters and insured letters under alternative scenarios of income distributional preferences of government. As expected, inland letter cards are distributionally more important with the highest distributional characteristic. Then follow insured letters, registered newspapers, envelopes, etc., in declining order

from the point of view of income distribution. Registered letters have the least priority with the lowest income distributional characteristic in two of the scenarios.

TABLE 5.11

**Distributional Weights ($b_i$) to Postal Tariff Demands for the Three Sectors under Alternative Scenarios**

| Sector | Scenarios | | |
|---|---|---|---|
| | A | B | C |
| 1. Government | 1.00 | 1.00 | 1.00 |
| 2. Business | 0.75 | 0.50 | 0.25 |
| 3. Households | 1.25 | 1.50 | 1.75 |
| b | 1.00 | 1.00 | 1.00 |

TABLE 5.12

**Estimates of Distributional Characteristics of Postal Services under Alternative Scenarios**

| Scenario | Inland letter. | Envelopes | Registered newspapers & book post | Registered letters | VPL | Insured letters |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| A | 1.201 | 1.036 | 1.120 | 0.948 | 0.923 | 1.193 |
| B | 1.403 | 1.071 | 1.239 | 0.897 | 0.925 | 1.385 |
| C | 1.604 | 1.107 | 1.359 | 0.845 | 0.928 | 1.578 |

*Source* : Estimated as explained in the text.

For a public utility having equity and efficiency objectives and a revenue constraint in fixing prices for its services, the optimal (second best) prices ($p_i$) can be estimated by using the following formula :

$$\frac{p_i - m_i}{p_i} = \frac{(1-\bar{b}\,R_i)}{|e_i|}, \quad i = 1, 2, \ldots, N \qquad (4)$$

where

$m_i$ : Cross-subsidy-free price/full cost price of i-th service.

$p_i$ : Consumer of i-th service.

$e_i$ : Own price elasticity of demand for the i-th service.

b : Average of income distributional weights.

Using this formula, $p_i$ can be estimated given the estimates of $m_i$, $R_i$, b and $e_i$. We have obtained the estimate of aggregate price elasticity of demand for postal services as -0.401 which we assume to be the same for all the services. Table 5.2 and 5.12 respectively provide estimates of $m_i$ and $R_i$ for different postal services while Table 5.11 provides estimates of $B_j$ and b under alternative scenarios. Given all these estimates, we have obtained the estimates of second best prices for some of the postal services for the year 1985-86, as given in Table 5.13.

A comparison of second best prices with first best/ cross-subsidy-free prices shows that, out of six services we have considered in Table 5.13, only two services, viz., registered letters and VP letters have second best prices higher than the cross-subsidy-free prices. As expected, inland letter cards have highest subsidy followed by insured letters, registered newspapers and envelopes.

TABLE 5.13

### Estimates of Second Best Prices for Various Postal Services under Alternative Scenarios During 1985-86

(in Rs.)

| Scenario | Inland letter | Envelopes | Registered newspapers & book post | Registered letters | VPL | Insured letters |
|----------|---------------|-----------|-----------------------------------|--------------------|-----|-----------------|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| A | 0.85 | 1.06 | 1.20 | 4.98 | 1.45 | 3.91 |
| | (-0.50) | (-0.09) | (-0.30) | (0.13) | (0.11) | (-0.48) |
| B | 0.63 | 0.97 | 0.98 | 5.85 | 1.59 | 2.95 |
| | (-1.01) | (-0.18) | (-0.60) | (0.26) | (0.19) | (-0.96) |
| C | 0.51 | 0.91 | 0.82 | 6.98 | 1.57 | 2.37 |
| | (-1.51) | (-0.27) | (-0.90) | (0.38) | (0.18) | (-1.44) |

*Note :*    Figures in parentheses represent the ratio of difference between consumer price and full cost price and the consumer price.

*Source :*  Estimated as explained in the text.

Comparison of the estimates of second best prices for alternative scenarios about income distributional preferences of government indicates that the price subsidies on post cards, insured letters, registered newspapers and envelopes have increased and the mark-up over full cost price is increased for registered mail as distributional preferences of government grow stronger (for example a change from scenario A to scenario C). Given a balanced budget constraint for IPD, this indicates cross-subsidisation among postal services. That means profits earned from the registered letters have to be used by IPD to subsidise inland letter cards, registered newspapers, etc.

## 3. Conclusions

One of the important characteristics of IPD is that it has been having cross-subsidisation with budgetary deficits. That means price subsidies to some of its services are financed partly from cross-subsidisation and partly from general revenue. The cross-subsidy-free prices that are estimated using the attributable cost method for computing joint cost component of price of each service are much different from the actual prices charged by IPD for its services. All the first class mail items, newspapers, parcels, registered letters, and IPOs have subsidies while VPP, insurance, money orders, savings banks, savings certificates etc., have the actual prices higher than the cross-subsidy-free (full cost) prices. The estimates of budgetary deficits that are made taking cross-subsidy-free prices as base are much higher than the budgetary deficits declared by IPD during the period 1981-82 to 1985-86. This may be attributable to differences between our estimates of economic cost and estimates made by IPD.

The main problem then is to look for the justification of subsidies for some services at the cost of higher prices for other services and a budgetary deficit. Cross-subsidisation is shown to be justified if the IPD as a public utility has the objectives of efficiency, equity and a balanced budget. We also considered two other alternative scenarios of subsidies for some of the postal services. In one scenario, we had subsidies for some services with a matching budgetary deficit of IPD and this deficit was financed from the general revenues of the government. Another scenario considered was the one that represents the current practices of IPD for fixing prices for its services, i.e., subsidies to certain services the financing of which is shared by cross-subsidisation and budgetary deficits made good from the general revenue.

As they are very essential, postal services should have very low price elasticity of demand. The price elasticity of aggregate demand for the Indian postal services is -0.401. The estimates of sectoral distribution of demand for postal services show that household

sector consumes 72.73 per cent of unregistered mail services and 29.57 per cent of registered mail services. If the government/IPD has distributional preferences in favour of consumption of postal services by household sector in comparison to its own consumption and consumption by business sector, these preferences have to be reflected in the prices it charges for various services. Estimates of prices for Indian postal services under three alternative scenarios of income distributional preferences of the government show that first class mail items, newspapers, etc., have price subsidies while the registered letters have prices higher than the full cost prices. Therefore, if IPD has an equity objective with a revenue constraint, subsidies for some of its services are justified at the cost of prices higher than full cost prices for other services.

# 6. Block Pricing for Indian Postal Services

## 1. Introduction

CURRENTLY, IPD charges differential prices for several of their services depending on their value or weight. The services having block prices by weight are: letters, book packets, parcels, newspapers, etc. while money orders, postal orders have block prices by value. Table 6.1 provides information about block prices charged by IPD during the year 1985-86 for some of its services.

There are several arguments for justifying block pricing by IPD for some of its services. First of all, the cost of supplying a service may vary with the weight or value of the service. Secondly, there may be private market alternatives for bulk services, in terms of weight or value so that IPD has to offer concessional prices to keep its share of market of these services. Thirdly, concessional prices can be charged in respect of services which are known to be availed of more by the poorer sections on equity considerations.

In the case of letters, books, newspapers and parcels, the cost of providing the services may increase with the weight. Also, there may be private market alternatives for bulk services in weight so that IPD has to fix the prices at concessional rates to keep its share of market. Therefore, depending upon the relative weights that IPD gives to these opposing factors, the prices for different blocks of a given service often have to be fixed at varying rates.

Though this has not been tried in practice, it is also possible to have differential prices for a given service according to source of demand. If it has the objective of distributional equity, there is a justification for having differential prices for a given service depending upon whether its demand originates from rural or urban sectors, developed regions or backward regions, and business or household sectors in the economy. For example, (the case of IPD charging) different prices can be charged for traffic originating from developed regions and backward regions of the country. Depending upon a well defined criterion, one may be in the position to identify certain pockets of the country as developed and others as less developed. IPD can thus have dual prices for a given service: a lower price for less developed regions to promote the objective of reducing regional disparities. For registered mail originating from different regions, dual pricing scheme can be easily implemented while it may be necessary to make special efforts to implement it for unregistered mail. Post offices in the less developed regions may be supplied with specially embossed post cards, inland letters and envelopes with concessional prices notified on them which would be valid if the cards etc., are mailed through a post office in a backward region.

## 2. Block Prices for Letters

Letter is an important service which has differential prices fixed by IPD by weight classes. Column (5) of Table 6.1 shows the actual prices for letters charged by IPD by weight classes during the year 1985-86. These prices range from Rs. 0.35 to Rs. 1.65 for weights varying from 10 to 100 grams. On the other hand, the estimated cross-subsidy-free prices by weight classes, as given in column (4) of Table 6.2, range from Rs. 0.20 to Rs. 3.80 as the weight of the letter varies from 10 grams to 100 grams. These cross-subsidy-free prices are estimated by assuming that the supply cost of letters increases in direct proportion to their weight.

TABLE 6.1

## Block Prices Charged by IPD During the Year 1985-86

| Item | Rate charged (Rs. ) |
|---|---|
| Registration Fee | |
| (a) Fee | 2.00 |
| (b) Stationery charge | 0.10 |
| Insurance Fee | |
| (a) Upto Rs. 100/- | 1.00 |
| (b) Per Rs. 100/- thereafter upto Rs. 5,000/- | 0.50 |
| (c) Per Rs. 1000 thereafter upto Rs. 10,000/- | 3.00 |
| Money Order | |
| (a) Per Rs. 10/- upto Rs. 20/- | 0.25 |
| (b) Per Rs. 20/- beyond Rs. 20/- | 0.50 |
| VPP Posting Fee | |
| (a) Upto Rs. 10/- | 0.50 |
| (b) Exceeding Rs. 10 upto Rs. 20/- | 1.00 |
| (c) Exceeding Rs. 20/- | 1.50 |
| Demurrage charge on V P Articles | . |
| For detention beyond 7 days | |
| (a) Parcels | 0.25 |
| (b) Other articles | 0.15 |
| Indian Postal Orders | |
| (a) For each upto Rs. 10/- | 0.20 |
| (b) For each upto Rs. 20/- | 0.40 |
| (c) For each upto Rs. 30/- | 0.60 |
| (d) For each upto Rs. 40/- | 0.80 |
| (e) For each upto Rs. 50/- | 1.00 |
| (f) For each upto Rs. 100/- | 2.00 |

## Table 6.1 (Cont'd.)

| Item (in grams) | Rate charged (Rs.) |
|---|---|
| Letters | |
| (a) Upto 10gms | 0.50 |
| (b) For every 10gms thereafter | 0.20 |
| Book Patterns, Sample Parcel | |
| (a) Upto 50gms | 0.30 |
| (b) Every added 25gms in excess | 0.15 |
| Book Packets containing Printed Books | |
| (a) Upto 100gms | 0.15 |
| (b) For added 50gms or part thereof | 0.10 |
| Parcels | |
| (a) For first 500gms | 3.00 |
| (b) Every added 500gms or part thereof | 3.00 |
| Book Packets containing Periodicals (Registered) | |
| (a) For first 100gms | 0.25 |
| (b) Every added 50gms or part thereof | 0.30 |
| Newspapers (Single copies) | |
| (a) Upto 50gm | 0.05 |
| (b) Upto 100gm | 0.15 |
| (c) Every added 100gms or part thereof | 0.10 |
| Newspapers (Multiple copies) | |
| (a) Upto 100gms | 0.15 |
| (b) Per every added 100gms or part thereof | 0.10 |

TABLE 6.2

**Estimated and Actual Rate Charged According to Various Slabs for Letter Mail Services During the Year 1985-86**

| Weight slabs (in gms.) | Average weight | Relative frequency (Rs.) | Estimated Cross-subsidy-free Prices | Actual Prices (Rs.) | Estimated Prices with a distinction between Fixed and Variable costs (Rs.) |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 0-10 | 5 | 44.0 | 0.20 | 0.35 | 0.95 |
| 10-20 | 15 | 17.5 | 0.60 | 0.45 | 1.04 |
| 20-30 | 25 | 10.0 | 1.00 | 0.60 | 1.12 |
| 30-40 | 35 | 7.5 | 1.40 | 0.75 | 1.21 |
| 40-50 | 45 | 5.0 | 1.80 | 0.90 | 1.29 |
| 50-60 | 55 | 3.6 | 2.20 | 1.05 | 1.37 |
| 60-70 | 65 | 3.2 | 2.60 | 1.20 | 1.45 |
| 70-80 | 75 | 2.4 | 3.00 | 1.35 | 1.53 |
| 80-90 | 85 | 1.6 | 3.40 | 1.50 | 1.62 |
| 90-100 | 95 | 1.0 | 3.80 | 1.65 | 1.71 |
| 100-300 | 200 | 4.2 | 7.99 | 4.65 | 2.58 |

In actual practice, it may be the case that the cost of supplying a letter may be fixed and has to be incurred by IPD irrespective of the weight of the letter. In the case of letters, with the exception of transport cost (airmail, RMS and surface), all other costs may be taken as fixed costs. Column (6) of Table 6.2 provides estimates of prices of letters by weight classes assuming that transport costs vary with respect to weight. These costs differ significantly from the estimates of costs given in columns (4) and (5) of the same table. Given the price of Rs. 0.95 for a letter weighing 10 grams, the estimates show that price increases by 9 paise per every 10 grams increase in weight, whereas in the case of prices actually charged by

IPD, given the price of Rs. 0.35 for a letter weighing 10 grams, the price increases by 15 paise for every 10 grams increase in the weight of the letter. Therefore, the differences in the estimates of prices presented in columns (5) and (6) are attributable partly to differences in the fixed cost and partly to differences in incremental prices across the blocks.

Given that IPD practises differential pricing for letters by weight classes, though in an arbitrary fashion, we recommend that any one of the methods described may be followed above for fixing these prices. However, we are more inclined towards the method that distinguishes between fixed and variable costs with respect to the weight of the letter. Differential pricing for letters from the point of view of distributional equity may, however, be followed if there is any evidence to show that letters in the lower weight categories are used relatively more by the poor than those of higher weight.

## 3. Block Prices for Parcel Services

The actual prices charged by IPD for parcels bearing different weights are at the rate of Rs. 3.00 per 500 grams in 1985-86. But the estimated cross-subsidy-free prices are much higher than the actual prices as can be seen from columns (4) and (5) of Table 6.3. The cross-subsidy-free price is Rs. 10.68 per 500 grams.

In the case of parcels also we may assume all costs with the exception of transport cost to be constant with respect to weight. Transport cost increases with weight/volume of the parcel. Column (6) of Table 6.3 presents estimates of prices of parcels by weight classes assuming that the transport cost per every 500 grams is estimated to be Rs. 2.51 using the data for 1985-86. The fixed cost of a parcel is estimated to be Rs. 12.77 while the variable cost increases at the rate of Rs. 2.51 for every 500 grams increase in the weight of a parcel. On this basis, the price of a parcel should increase from Rs. 14.03 to Rs. 34.11 as the parcel size increases from 250 to 4250 grams, as can be seen in column (6) of Table 6.3. However, if we have prices based on incremental/marginal costs only, the price changes from Rs. 1.26 to Rs. 21.42 as the weight of parcel

increases from 250 to 4250 grams. Column (7) of Table 6.3 presents these estimates. As we can observe from columns (5) and (6), the discrepancy between the actual rates charged by IPD and the prices based on marginal costs is much less in relation to discrepancies between the other estimates and the actual prices.

It is recommended that one of the procedures described above may be adopted for fixing the prices for postal services. We feel again, that as in the case of letters, the method that distinguishes between variable cost and fixed cost with respect to the weight of a parcel is superior as it is based on sound economic logic.

TABLE 6.3

### Estimated and Actual Rate Charged According to Various Slabs on Parcel Services During the Year 1985-86

| Weight slab range (in gms.) | Average value | Relative frequency | Estimated Cross-sub-sidy-free Prices | Actual Prices | Estimated Prices with a dis-tinction between Variable & Fixed costs | Estimated Prices based on Marginal cost |
| | | | (Rs.) | (Rs.) | (Rs.) | (Rs.) |
| --- | --- | --- | --- | --- | --- | --- |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 0-500 | 250 | 51.91 | 5.38 | 3.00 | 14.03 | 1.26 |
| 500-1000 | 750 | 24.75 | 16.14 | 6.00 | 16.54 | 3.78 |
| 1000-1500 | 1250 | 10.04 | 26.90 | 9.00 | 19.05 | 6.30 |
| 1500-2000 | 1750 | 5.74 | 37.66 | 12.00 | 21.56 | 8.82 |
| 2000-2500 | 2250 | 2.48 | 48.42 | 15.00 | 24.07 | 11.34 |
| 2500-3000 | 2750 | 1.66 | 59.18 | 18.00 | 26.58 | 13.86 |
| 3000-3500 | 3250 | 1.01 | 69.94 | 21.00 | 29.09 | 16.38 |
| 3500-4000 | 3750 | 0.88 | 80.71 | 24.00 | 31.60 | 18.90 |
| 4000-4500 | 4250 | 1.53 | 91.47 | 27.00 | 34.11 | 21.42 |

## 4. Block Prices for Money Orders (MOs)

IPD charges differential prices for money orders by value classes. Actual commission charged by IPD for MOs during the year 1985-86 varies from Re. 1.00 for Rs. 50 to Rs. 24 for Rs. 1000 as can be seen from column (5) of Table 6.4. The cross-subsidy-free prices estimated under the assumption that cost of supplying MO services increases with the value of MO are much lower than the actual price. But given the peculiar characteristic of MO services, one cannot assume that the cost is an increasing function of the value of MO. For IPD the cost of supplying MO service may be the same irrespective of the value of MO unless one assumes a rapid increase in the risk factor with the rise in the value of the MO.

TABLE 6.4

**Estimated and Actual Rate of Commission Charged
According to Various Slabs on MO
During the Year 1985-86**

| *Value of MO slab wise* (Rs.) | *Average value* | *Relative frequency* | *Estimated Cross-subsidy-free Prices* (Rs.) | *Actual Prices* (Rs.) | *Estimated Prices with a distinction between Fixed and Variable costs* (Rs.) |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 0-50 | 25 | 34.85 | 0.20 | 1.00 | 2.00 |
| 50-100 | 75 | 24.32 | 0.59 | 2.00 | 2.00 |
| 100-200 | 150 | 16.83 | 1.18 | 4.00 | 2.00 |
| 200-300 | 250 | 8.57 | 1.97 | 6.50 | 2.00 |
| 300-400 | 350 | 3.63 | 2.76 | 9.00 | 2.00 |
| 400-500 | 450 | 4.82 | 3.55 | 11.50 | 2.00 |
| 500-600 | 550 | 1.83 | 4.34 | 14.00 | 2.00 |
| 600-700 | 650 | 1.0 | 5.13 | 16.50 | 5.00 |
| 700-800 | 750 | 1.3 | 5.92 | 19.00 | 5.00 |
| 800-900 | 850 | 0.5 | 6.71 | 21.50 | 5.00 |
| 900-1000 | 950 | 2.35 | 7.50 | 24.00 | 5.00 |

The distribution of cost of supplying MO services in direct proportion to the value of MOs may be justifiable only if IPD has other considerations like equity. In this case there may be a case for arguing that people living in rural India may avail this service for sending small amounts of money to their kith and kin mainly because they do not have access to banking. However, MOs involving larger amounts of money have to compete with the banking system in rural as well as in urban areas. The information relating to fees charged by commercial banks in India for demand drafts of various denominations is given in column (6) of Table 6.4. In order to compare these rates with the rates given in columns (4) and (5) of Table 6.4, we have to add to them the postal charges for sending a demand draft to the receiver. The differential charges for MOs by value classes have to be fixed keeping in mind all these considerations.

## 5. Conclusions

In this chapter we have discussed the rationale for variable marginal prices for selected postal items such as letters, parcels and money orders. In designing these block prices the postal authorities have to pay attention to the link between the cost of these services and their weight/value, and the price structure of competitive services.

As with several other areas of operation of IPD, detailed statistical work needs to be done in order to better quantify the factors that affect variable marginal prices. Detailed information on joint and variable costs, the distribution of costs by weight/ value and the tariff structure for competitive services should be obtained in order to develop a better structure of tariff for the services of IPD.

# 7. Approaches To Public Utility Pricing

## 1. Introduction

THIS chapter is an attempt to review some important problems in the theory of public utility pricing with particular emphasis on postal services. Some of these problems have their genesis in a distinguishing characteristic of many public utilities : joint production of several items with increasing returns to scale. This poses the difficult problem of allocation of joint costs among these items.

There are two interrelated but analytically  separable issues here:

(i) The fact that there are increasing returns to scale may lead to the development of the 'natural' monopoly.

(ii) Because several items are being jointly supplied, each such item must have adequate incentive to stay with the 'monopoly' or, alternatively, be able to face the competition from another agency that may be supplying just this item or a subset of such items. Any regulation of this 'monopoly' must pay heed to these issues.

One method of regulation that is able to give due emphasis to both these issues and which has been the subject of intense scrutiny in the literature is the so-called cross-subsidy-free prices which are Pareto aptimal.  Another such regulatory mechanism

is second best Ramsey pricing. In the following sections of this chapter we discuss some of the these pricing schemes for supplying public utility services.

The plan of the remaining part of this chapter is as follows. In Section 2 we consider the problem of determining the first best prices for a public utility that produces many goods jointly. In particular, we examine the proposition that subsidy-free prices are Pareto optimal. In Section 3 we study Aumann-Shapley prices which, it is claimed, are subsidy-free and have certain other desirable properties as well. Section 4 considers the problem of second best pricing of public utilities in the sense that the problem of cross-subsidisation is ignored and the public utility maximises a welfare function subject to a pre-specified budget constraint. Section 5 presents a case in which we have Aumann-Shapley prices for the public utility and welfare maximising subsidy/tax-inclusive prices for final consumers of utility services and the final section provides conclusions.

## 2. Subsidy-Free Prices

An important characteristic of many public utilities is that they provide many goods/services simultaneously and the cost of producing these goods/services are not completely allocable among them. The genesis of the problem lies in the fact that there are economies of scale in joint production which are left unexploited, if each item is produced by a different producer. The overall cost of provision of postal services would be higher if first class mail services like post cards were produced by one agency and parcel service was provided by another and so on. Suppose the postal department provides $N$ services, levels of which are denoted by $\bar{q}_1, \ldots, \bar{q}_N$. If $C(\bar{q}_1, \ldots, \bar{q}_N)$ is the cost of providing these services, then it follows that this cost would be lower than the cost that could be attained by the arrangement that permits the provision of these services by more than one agency, i.e., for every subset $S$ of these $N$ services it must be true that

$$C(\bar{q}_1, \ldots, \bar{q}_N) \leq C_s(\bar{q}_1, \ldots, \bar{q}_S) + C_{n-s}(\bar{q}_{s+1}, \ldots, \bar{q}_N) \qquad (1)$$

where $C_s$ (.) is the cost of providing S services at the required levels $q_1, \ldots, q_S$ and, correspondingly, $C_{N-s}$ (.) is the cost of providing the other services at the pre-specified levels.

In a market with free entry and free exit, inequality (1) implies that it is profitable to supply all services by one firm. But in an unregulated situation, the firm may become a 'natural' monopoly charging prices which are Pareto inefficient. The problem then is to look for a pricing scheme to regulate the firm for yielding Pareto efficient outcomes. Faulhaber (1975) has derived in a pioneering paper one such set of pricing rules using the theory of cooperative games. If we designate each service as a player in a cooperative game, given the inequality (1), it is profitable to have a grand coalition rather than forming smaller and less profitable sub-coalitions of players and services. Then the problem is to find out the prices which will induce and preserve the grand coalition, i.e., the single supplier arrangement. For example, in the case of Indian postal services, although the various services of the Post Office are technically not free to form smaller sub-coalitions, there is still the problem that it might be profitable for other (private) agencies to provide some of these services. In either case, in the absence of right structure of prices, the grand coalition is potentially unstable.

Suppose that such a set of prices which induces each constituent service to stay in the grand coalition has been found. What must be its characteristics? These must relate to (for any constituent services) profitability inside and outside the grand coalition. Let $P_1, \ldots, p_N$ be the prices for these N services that induce all of them to stay in the grand coalition. Assuming independent demands, the demand for service i at price $p_i$ is $q_i$ $(p_i)$ for $i = 1, 2 \ldots, N$. Then it must be true that

$$\sum_{i=1}^{N} p_i \, q_i - C(q_1, \ldots, q_N) = \pi \, (.) = 0 \qquad (2)$$

and that
$$\sum_{i=1}^{S} p_i q_i \leq C(q_1, \ldots, q_s) \qquad (3)$$

for any subset S of N services. By substracting (3) from (2) we have

$$\sum_{i=1}^{S} p_i q_i \geq C(q_i, \ldots, q_N) - C(q_{s+1}, \ldots, q_N) \qquad (4)$$

i.e., the revenue contributed by the set of services $S \leq N$ should be at least as great as the added cost of supplying S. The prices satisfying the inequality (4) are called subsidy-free prices.

"If the provision of any commodity (or group of commodities) by multi-commodity enterprise subject to a profit constraint leads to prices for the other commodities no higher than they would pay by themselves, then the price structure is subsidy-free. Thus, a subsidy-free price structure insures that the provision of each commodity by the enterprise is 'Pareto Superior' to non-provision" (Faulhaber, 1975). Since a set of subsidy-free prices defined above induces rational players in the game to cooperate and is stable against all possible coalitions, it belongs to the core of the game. An immediate corollary is that this solution is also Pareto optimal so far as these N services are concerned.

If we did not have cross-subsidy-free prices, some services would be subsidising others and, since they could do better in smaller coalitions, there would be incentives for the former to leave the grand coalition. Also, there could be incentives for some new agencies to supply those services that are subsidising others in the grand coalition. If cross-subsidisation does exist, then it follows that these agencies could profitably compete. Cross-subsidy-free prices are efficient prices. They also ensure that the grand coalition breaks even.

## 3.    Computation of Subsidy-Free Prices

If costs of production in a multi-product public utility were
fully allocable among the various services, then cross-subsidy-
free prices would require each service to have a price that just
covers its own cost. Figure 1 represents the long-run cost structure
of one of the services offered by a multi-product firm. Then the
question is, what is the price for the services that cover the full
cost at any given level of supply. This price may be defined as

$$p_i = \int_0^1 \frac{\delta C(tq_{1}, tq_{2}, \ldots, tq_{N})}{\delta q_i} \quad dt \; i = 1, 2, \ldots, N \quad (5)$$

where $C_i (q_1, q_2 \ldots q_N)$ is the long-run cost function with $0 \leq t \leq 1$. At the level of production $q_i^*$ the total cost of $q_i$ is given
as

$$C_i (q_i^*) = \int_0^{q_i^*} = \int_0^{q_i^*} \frac{\delta C_i}{\delta q_i} \; dq_i$$

which is equivalent to the shaded area in **Figure 1**. If $p_i$ ($i = 1$,
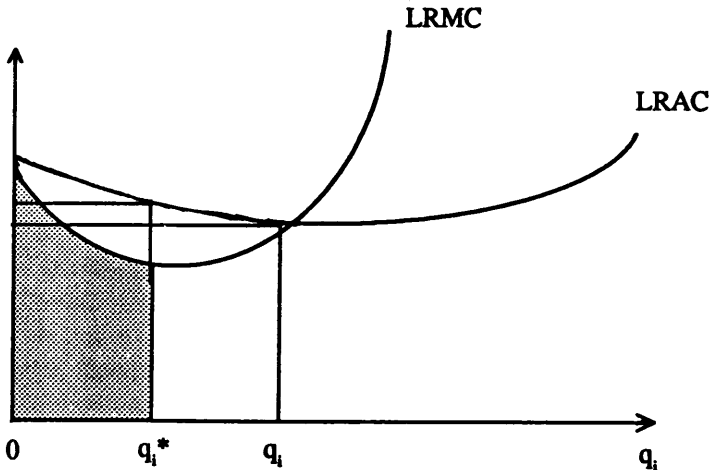$2, \ldots, N$) are full cost prices, we have



Figure - 1

$$\sum_{i=1}^{N} p_i (q_i^*) q_i^* = \sum_{i=1}^{N} \int_0^{q_i^*} \frac{C_i}{q_i} dq_i \qquad (6)$$

The prices defined in (5) are known as Aumann-Shapley prices (A-S prices).[1] For a cost-minimising firm with decreasing or constant returns to scale, A-S prices and marginal cost prices are the same. At cost-minimising quantity $q_i$, the price that is equal to marginal cost is also the A-S price that covers full cost, as can be seen in Figure 1. Also, for a single-product firm, the price defined in (5) is same thing as average cost. However, in the case of a multi-product firm with joint variable cost in the long run, the sharing of joint costs by different commodities is implicit in A-S prices which are free from cross-subsidisation. These prices may be used by regulated monopolies and public and quasi-public agencies to allocate the joint cost of production to different commodities produced by them. To compute A-S prices, only the cost structure and output vector must be known.

Billera and Heath (1982) and Mirman and Tauman (1982) have proposed an axiomatic approach to cross-subsidy-free or A-S prices for multi-product public utility. They have shown that A-S price mechanism is the only price mechanism which sastisfies the following five axioms for continuously differentiable cost functions with no fixed cost components.

1. *Cost Sharing* : The prices of various commodities of a multi-product firm are such that they cover the full cost of production

$$\sum_{i=1}^{N} p_i q_i = C (q_1, \ldots, q_N)$$

i.e., the total cost is equal to total revenue.

2. *Rescaling* : If the scales of measurement of commodities are

1.  See R. J. Aumann and L.S. Shapley (1974) and L.J. Billera, D.C. Heath and J. Raanan (1979).

changed, then the prices are changed accordingly. If the cost functions of a multi-product firm differ only with respect to scales of commodities

$$G(X_1, \ldots, X_N) = C(q_1, \ldots, q_N)$$

then

$$P(X_i) = \lambda p(q_i), i = 1, 2, \ldots, N.$$

3. *Consistency* : Each unit of the same good has the same price. If prices depend only upon cost functions and not demand functions, being the same good will mean, the good with same cost.

$$\text{Let } C (q_1, \ldots, q_N) = G( \sum_{i=1}^{N} q_i)$$

then

$$p_i = p ( \sum_{i=1}^{N} q_i), i = 1, 2, \ldots, N.$$

4. *Positivity* : If a cost function C increases at least as rapidly as the cost function G with respect to quantities of commodities, then the prices determined for C should be at least as high as those determined for G.

$$p_i (C) \geq p_i (G^*)$$

$$\text{if } \frac{\delta C}{\delta q_i} \geq \frac{\delta G^*}{\delta q_i} , i = 1, 2, \ldots, N$$

5. *Additivity* : If a cost function can be broken down into two components say C and $G^*$ (e.g., management and production), then calculating the price determined by the cost function for any level of production can be done by adding the price determined by C and $G^*$ respectively for that level of production. That means

$$p_i \ (C+G^*) = p_i \ (C) + p_i \ (G^*) \qquad i = 1, \ldots, N$$

A-S prices that satisfy these axioms can be computed given the long-run cost functions with no fixed-cost elements. However, the short-run cost functions have fixed-cost components which are normally joint costs for a multi-product firm. In this case allocation of fixed costs among different commodities may be possible, given the information about both long-run and short-run cost functions. Given the envelope theorem of long-run cost functions, the efficient portion of short-run technology coincides with long-run technology used by the firm. Using A-S prices for the long-run cost function, an allocation of fixed cost associated with the efficient (short-run) technology can be determined. Suppose the cost function is given by

$$G \ (q_1 \ , \ldots , q_N) = C \ (q_1 \ , \ldots , q_N) + F \qquad (7)$$

where C and F are respectively variable and fixed costs. A-S prices with long-run cost functions are given by

$$p_i = \int_0^1 \frac{\delta G(tq_1, \ldots , tq_N)}{dq_i} \ dt, \ i = 1, 2, \ldots , N \quad (8)$$

which cover both variable cost and fixed cost. We can then compute another set of prices $p_i, i = 1, 2 \ldots N$ which cover only variable cost as

$$\bar{p}_i = \int_0^1 \frac{\delta C(tq_1, \ldots , tq_N)}{dq_i} \ dt, \ i = 1, 2, \ldots , N \qquad (9)$$

Then we have

$$\sum_{i=1}^N (p_i - \bar{p}_i) \ q_1 = G \ (q_1 \ , \ldots , q_N) - C(q_1 \ , \ldots , q_N) = F \quad (10)$$

which obviously means that $(p_i - \bar{p}_i)$ is that part of price which may be thought of as covering fixed cost F.

In actual situations, there may be problems in allocating fixed costs among various commodities produced by a multi-

product firm. For example, when actual demands deviate from the expected demands for various commodities, short-run technology, which is optimal for the expected demand, may not necessarily be optimal with respect to actual or realised demand in the long-run. In this case the long-run cost function is irrelevant for the allocation of fixed cost in the short- run. Therefore, fixed costs must be allocated directly from the short- run cost function. However, the prices computed using normally used arbitrary methods based on relative outputs, gross revenue or attributable cost[2] for allocating fixed joint costs among various commodities violate some or all of the five axioms described above. Mirman, Samet and Tauman (1983) have proposed amendments in additivity axiom (Axiom 5) with the addition of Axiom 6 to show that there exist modified A-S prices for a short-run cost function that satisfy this new set of axioms.

Axiom 5* : If the short-run cost function of a multi-product firm is given by

$$G = C(q_1 , \ldots , q_N) + F$$

and C is decomposed into $C_1, C_2 , \ldots , C_M$

---

[2]

$$p_i = \frac{C_i}{q_i} + \frac{f_i \, F}{q_i} \, , i = 1, 2 , \ldots , N$$

where $f_i = \dfrac{q_i}{\Sigma q_i}$ (Relative output method)

$$= \frac{p_i \, q_i}{\Sigma \, p_i \, q_i}$$ (Relative revenue method)

$$= \frac{C_i}{\Sigma C_i}$$ (Attributable cost method).

such that $\sum\limits_{j=1}^{M} C_j = C$, then it is possible to decompose

F into $F_1, F_2, \ldots, F_M$ such that $\sum\limits_{j=1}^{M} F_j = F$ and

$$p\,(C + F) = \sum\limits_{j=1}^{M} P(C_j + F_j)$$

where p is a N x 1 vector of prices.

*Axiom 6 :* The part $F_i$ of fixed cost F that is associated with component $C_i$ of variable cost C should be at least as large as $F_j$ whenever the part $C_j$ of C is at least as large as $C_i$. That means

$$C_i \geq C_j \text{ implies } F_i > F_j$$

There now exists a price mechanism that satisfies axioms 1, 2, 3, 4, 5* and 6 which is given as

$$p_i = (1 + \frac{F}{C}\quad p_i^*, \ i = 1, 2, \ldots, N \tag{11}$$

where $\quad p_i^* \quad = \int\limits_{0}^{1} \frac{\delta C(tq_1, tq_2, \ldots, tq_N)}{\delta q_i}\ dt$

are the A-S prices associated with variable cost. We can see immediately that the modified A-S prices in (11) are the prices derived by distributing fixed cost in proportion to allocable variable cost among different commodities of a multi-product firm. We can alternatively write (11) as

$$p_i \quad = \quad \frac{p_i^* \, q_i}{q_i} + \frac{f_i\ F}{q_i}\quad i = 1, 2, \ldots, N \tag{12}$$

where $f_i = \dfrac{p_i^* \, q_i}{\sum\limits_{i=1}^{N} p_i^* q_i}$

Hence for a multi-product public utility having cost function satisfying axioms 1, 2, 3, 4, 5* and 6, the prices derived by attributable cost method are subsidy-free.

## 4. Cross-subsidisation with Balanced Budget for a Welfare Maximising Public Utility

We have observed in Sections 2 and 3 of Ch. 6 that A-S prices or cross-subsidy-free prices for a public utility are supply determined or prices calculated taking into account information about cost structure of a multi-product firm. However, prices determined by a welfare maximising firm with a balanced budget with either efficiency or equity objective may not be cross-subsidy-free. The familiar Ramsey price mechanism suggests that price-cost mark-up for a commodity supplied by a publicly regulated firm should be inversely proportional to its own price elasticity of demand. Assuming constant returns to scale in production and interdependent demands for a multi-product firm (take for example a firm producing two commodities), Ramsey price mechanism is described by the following formulae (if the firm has both efficiency and equity objectives).[3]

$$\frac{p_1 - m_1}{p_1} = \frac{e_{22}(\bar{b}R_1 - 1) - e_{12}(\bar{b}R_2 - 1)}{e_{11}e_{22} - e_{12}e_{21}} \tag{13}$$

$$\frac{p_2 - m_2}{p_2} = \frac{e_{11}(\bar{b}R_2 - 1) - e_{21}(\bar{b}R_1 - 1)}{e_{11}e_{22} - e_{12}e_{21}} \tag{14}$$

where   $p_i$ : price of i-th commodity

$m_i$ : constant marginal cost of i-th commodity

$e_{ij}$ : elasticity of demand for i-th commodity with respect to price of j-th commodity

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3. See Feldstein (1972) and Murty (1987)

$$b = \sum_{h=1}^{H} b_h/H \quad \text{average of income distributional}$$

weights where $b_h$ is the income distributional weight assigned to the h-th individual, (h = 1, 2 . . . H)

$$R_i = \frac{\sum_{h=1}^{H} q_i^h \, b_h}{q_i \, b} \quad \text{distributional characteristic of}$$

i-th commodity where $q_i^h$ is consumption of i-th commodity by h-th individual and

$$q_i = \sum_{h=1}^{H} q_i^h$$

If demands are independent (cross-price effects are zero) we have

$$\frac{p_1 - m_1}{p_1} = \frac{(\bar{b}R_1 - 1)}{e_{11}} = \frac{(1 - \bar{b}R_1)}{|e_{11}|} \tag{13'}$$

$$\frac{p_2 - m_2}{p_2} = \frac{(\bar{b}R_2 - 1)}{e_{22}} = \frac{(1 - \bar{b}R_2)}{|e_{22}|} \tag{14'}$$

The Ramsey price mechanism described in equations (13') and (14') clearly brings out the trade-off between equity and efficiency objectives in determining the welfare maximising prices for a publicly regulated multi-product firm. If a commodity is distributionally more important (having higher $R_i$) its price will be relatively lower, given the demand elasticity. However, a commodity which is distributionally more important may be having lower elasticity of demand because it is a necessity. The lower demand elasticity means higher price cost mark-up for that commodity as implied by formulae (13') and (14').

The assumption of constant returns to scale may not be tenable in the case of public utilities like Postal Services, Electricity Supply, etc. As explained in Sections 2 and 3, there may be increasing returns to scale for a multi-product firm supplying postal services. In this general case, Ramsey price mechanism may be described by the following equations[4]

$$\frac{m_1}{p_1} = \frac{e_{s1}}{e_{s1}+1} = \frac{1-\bar{b}R_1}{e_{d1}} \tag{15}$$

$$\frac{m_2}{p_2} = \frac{e_{s2}}{e_{s2}+1} = 1 \frac{1-\bar{b}R_2}{e_{d2}} \tag{16}$$

where　$e_{si}$　: Own price elasticity of supply of i-th commodity

　　　　$e_{di}$　: own price elasticity of demand of i-th commodity

　　　$i = 1, 2.$

It is now clear that in the case of a budget-balancing multi-product firm with equity and efficiency objectives, the optimal prices are not cross-subsidy-free. Some commodities have to be fixed prices higher than their marginal costs for giving subsidies to other commodities. Alternatively we may consider a case in which a public utility has access to the revenue raised through commodity taxes, income taxes, etc., to finance its production. The second best prices of a public utility will then be determined after taking into account the social cost of raising revenue through pricing of its services, commodity taxes, income taxes, etc.[5]

## 5. Aumann-Shapley Prices for a Multi-Product Public Utility and Price Subsidies from General Revenue

We have shown in Sections 2 and 3 of Ch. 6 that cross-subsidisation by a public utility results in Pareto inefficient

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4. See Jha and Murty (1987).

5. See Murty (1983).

prices and cross subsidisation is inevitable for a welfare maximising utility with efficiency and equity objectives. The problem then is to examine whether it is possible to have a case in which a public utility has Pareto efficient prices and welfare maximisation with equity and efficiency objectives is achieved through general revenue policies of government. In the literature of optimal commodity taxation we know that with the assumption of constant returns to scale in private production, there are constant producer prices which are Pareto efficient and there exist second best consumer prices/taxes for a welfare maximising government with equity and efficiency objectives that meet a pre-specified government revenue requirement. But if we have utility services in the economy, with increasing returns to scale in their production, public regulation may be necessary to provide these services at Pareto efficient/first best prices. Assuming that a publicly regulated utility is guided solely by Pareto efficient prices and the private sector production takes place with constant returns to scale, welfare maximising taxes/subsidies on public utility services and private sector commodities can be determined subject to a government revenue constraint.

Let there be n private sector commodities and m public utility services in the economy and constant returns to scale in private production and increasing returns to scale in the production of the services provided by a publicly regulated joint product firm so that it has Pareto efficient prices for its services, A-S prices which are defined for given levels of supply of these services. On the other hand, private sector commodities have constant producer prices which are equal to their marginal costs.[6] The consumer prices are now defined for the private sector commodities as

$$p_i = d_i + t_i \qquad i = 1, \ldots, N \qquad (17)$$

---

6. Marginal costs for private sector commodities are constant because of the assumption of constant returns in production.

where $p_i$, $d_i$ and $t_i$ respectively represent consumer prices, product prices and taxes.

In the case of the public utility which supplies goods j, j = N + 1 , . . . , N + M their producer prices are already fixed by consideration of fully distributed cost, e.g., A-S prices. Let $d_j$, j = N + 1 , . . . , N + M be the levels of these prices. As we have seen in Sections 2 and 3 these meet the requirement that each $d_j$ corresponds to a level of supply of commodity/service j. If $d_j$ were to change so would the supply of commodity j and *vice versa*. It is also clear that we have assumed that demand is always forthcoming to meet the supply implied by A-S price $d_j$, j = N + 1 , . . . , N + M.

The government is, however, free to price these commodities in a different manner for the consumers. We can assume that these commodities/services are procured by the government at prices $d_j$ which is then free to tax/subsidise various constituents of the public utility's service. The assumption that demand will be forthcoming to meet the supply is again implicit. Thus final consumer prices are

$$p_j = d_j + t_j \, j = N + 1 , \ldots , N + M \qquad (17)$$

where $p_j$ are the consumer prices and $t_j$ are the tax/subsidy rates. The overall revenue constraint of the government is now defined as :

$$\sum_{i=1}^{N+M} t_i \, q_i = R \qquad (18)$$

where $q_i$, i = 1 , . . . , N, N + 1 , . . . , N + M are the quantities of commodities demanded in the economy and R is the exogenously given revenue requirement of the government. The welfare function of the government is now defined as

$$W (V_1 , V_2 , \ldots , V_H) \qquad (19)$$

where $V_h = V_h ( P_1 , \ldots , P_N, P_{n+1} , \ldots , P_{N+M}, I_h)$ is the

indirect utility function of the h-th individual and $I_h$ is his income.

Maximisation of (19) subject to (18) with respect to $t_i$ yields welfare maximising $t_i$ for the given level of production of public utility services. Hence in this approach once cross-subsidy-free prices for the public utility are determined, the government evaluates these public utility services along with other goods in the economy. The second best problem solved at this stage gives us welfare maximising tax/subsidy rates for private sector commodities and public utilities services which meet the specific equity and efficiency objectives of the government while, at the same time, meeting the revenue requirements of the government.

## 7.6 Conclusions

We have discussed alternative pricing schemes (first best or second best) for a multi-product public utility with joint costs and increasing returns to scale. The first best prices are cross-subsidy-free or A-S prices. The A-S prices can be computed given the long run cost functions of a multi-product public utility. However, in the case of short-run cost functions with a distinction between fixed and variable costs, the A-S prices can be computed only for a class of cost functions. The cross-subsidy-free prices in this case correspond to prices computed with the familiar attributable cost method for a multi-product public utility.

The second best or Ramsey prices are not cross-subsidy-free. For a welfare maximising public utility with balanced budget, these prices are inevitable. Given the alternative sources of revenue like commodity taxes and income taxes to finance the public utility production, the welfare maximising prices for utility services with the assumption of balanced budget for public utility may not be globally optimal. For fixing globally optimal public utility prices we have to consider the social cost of raising

revenue through prices of public utility services, and other public sector commodities and income taxes, commodity taxes, etc. to fund public utility production.

We have suggested a pricing scheme for public utility services that takes A-S prices as the first best producer prices and subsidised or tax inclusive prices as consumer prices. In an economy having a public utility, private sector production, increasing returns to scale for public utility and constant returns to scale in private production, A-S prices for the public utility and prices that are equal to marginal costs (constant) for private sector commodities are Pareto optimal prices for given level of production of public utility services. Given these prices for public utility services and private sector commodities, the second best prices *á la* Ramsey can be determined by the welfare maximising government with revenue, efficiency and equity objectives.

# APPENDIX I

TABLE A.1

## Traffic Demands of Postal Services in India

(Figures in million nos. in physical unit)

| Year | LETR | POCR | LECO | Total RGNP (Single + Bundle) |
|------|------|------|------|------|
| (1) | (2) | (3) | (4) | (5) |
| 1950-51 | 305.90 | 324.10 | 6.65 | 46.90 |
| 1951-52 | 299.25 | 331.45 | 20.65 | 55.30 |
| 1952-53 | 316.40 | 348.60 | 36.40 | 60.20 |
| 1953-54 | 322.70 | 376.25 | 41.65 | 64.75 |
| 1954-55 | 318.15 | 365.40 | 56.00 | 66.50 |
| 1955-56 | 364.70 | 415.10 | 57.40 | 66.15 |
| 1956-57 | 390.60 | 444.85 | 75.95 | 68.50 |
| 1957-58 | 399.00 | 466.90 | 75.95 | 68.95 |
| 1958-59 | 412.30 | 513.80 | 96.60 | 69.30 |
| 1959-60 | 424.90 | 532.70 | 122.70 | 77.35 |
| 1960-61 | 447.30 | 552.65 | 122.50 | 88.20 |
| 1961-62 | 466.55 | 593.60 | 151.20 | 93.45 |
| 1962-63 | 521.15 | 672.00 | 176.05 | 98.70 |
| 1963-64 | 577.50 | 710.15 | 226.80 | 113.05 |
| 1964-65 | 606.55 | 719.25 | 273.35 | 129.50 |
| 1965-66 | 659.05 | 728.70 | 278.95 | 128.45 |
| 1966-67 | 650.30 | 742.00 | 317.80 | 130.20 |
| 1967-68 | 655.20 | 726.60 | 348.25 | 127.75 |
| 1968-69 | 655.55 | 694.05 | 349.65 | 119.35 |
| 1969-70 | 712.25 | 670.95 | 381.15 | 127.75 |
| 1970-71 | 731.50 | 687.75 | 394.10 | 133.70 |

*(Cont'd.)*

| Year | LETR | POCR | LECO | Total RGNP (Single + Bundle) |
|------|------|------|------|------------------------------|
| (1) | (2) | (3) | (4) | (5) |
| 1971-72 | 746.55 | 693.00 | 414.05 | 135.80 |
| 1972-73 | 745.15 | 716.45 | 425.25 | 137.55 |
| 1973-74 | 798.70 | 730.10 | 442.05 | 153.30 |
| 1974-75 | 823.20 | 722.05 | 483.00 | 155.40 |
| 1975-76 | 716.80 | 744.80 | 509.60 | 61.35 |
| 1976-77 | 910.70 | 731.15 | 562.10 | 166.60 |
| 1977-78 | 745.35 | 747.60 | 618.10 | 168.35 |
| 1978-79 | 1005.20 | 772.10 | 620.55 | 182.70 |
| 1979-80 | 1094.10 | 799.05 | 673.40 | 187.25 |
| 1980-81 | 1155.00 | 868.00 | 746.90 | 218.40 |
| 1981-82 | 1289.40 | 907.55 | 826.00 | 233.10 |
| 1982-83 | 1278.20 | 952.35 | 835.10 | 264.95 |
| 1983-84 | 1398.90 | 974.05 | 898.80 | 61.45 |

TABLE A.1 (Cont'd.)

| Year | OTUN Total of book patterns, printed books & other periodicals | INSL | INSP |
|------|---------------------------------------------------------------|------|------|
| | (6) | (7) | (8) |
| 1950-51 | 82.95 | 2.84 | 0.88 |
| 1951-52 | 88.55 | 2.95 | 0.89 |
| 1952-53 | 96.60 | 3.13 | 0.95 |
| 1953-54 | 94.85 | 2.97 | 0.89 |
| 1954-55 | 108.50 | 2.85 | 0.89 |
| 1955-56 | 111.30 | 2.80 | 1.17 |

*(Cont'd.)*

| Year | OTUN | INSL | INSP |
|------|------|------|------|
|  | Total of book patterns, printed books & other periodicals | | |
|  | (6) | (7) | (8) |
| 1956-57 | 128.80 | 2.75 | 1.26 |
| 1957-58 | 129.85 | 2.66 | 1.11 |
| 1958-59 | 130.20 | 2.80 | 1.10 |
| 1959-60 | 149.80 | 2.89 | 1.11 |
| 1960-61 | 158.55 | 2.97 | 1.14 |
| 1961-62 | 159.95 | 3.15 | 1.23 |
| 1962-63 | 170.80 | 3.35 | 1.30 |
| 1963-64 | 207.80 | 3.34 | 1.27 |
| 1964-65 | 218.75 | 3.64 | 1.32 |
| 1965-66 | 226.45 | 3.66 | 1.47 |
| 1966-67 | 241.50 | 4.09 | 1.52 |
| 1967-68 | 246.40 | 4.14 | 1.57 |
| 1968-69 | 238.70 | 4.06 | 1.57 |
| 1969-70 | 240.45 | 4.32 | 1.55 |
| 1970-71 | 248.85 | 4.45 | 1.53 |
| 1971-72 | 245.35 | 4.52 | 1.59 |
| 1972-73 | 247.10 | 4.74 | 1.70 |
| 1973-74 | 254.80 | 4.79 | 1.80 |
| 1974-75 | 260.75 | 4.45 | 1.86 |
| 1975-76 | 260.05 | 4.68 | 2.00 |
| 1976-77 | 264.60 | 4.57 | 1.87 |
| 1977-78 | 263.20 | 4.85 | 1.95 |
| 1978-79 | 274.75 | 5.00 | 2.06 |
| 1979-80 | 301.00 | 5.13 | 2.18 |
| 1980-81 | 332.85 | 5.36 | 2.41 |
| 1981-82 | 372.05 | 5.76 | 2.64 |
| 1982-83 | 370.65 | 5.93 | 2.71 |
| 1983-84 | 358.40 | 7.24 | 2.70 |

TABLE A.1 (Cont'd.)

| Year | Parcel | Registration | Acknowledgement | | Total of Money Money Orders/TMO |
|------|--------|--------------|------|------|-------------------|
|      |        |              | ORDL | ORDA |                   |
| | (9) | (10) | (11) | (12) | (13) |
| 1950-51 |  | 53.22 | 8.16 |  | 51.32 |
| 1951-52 |  | 56.72 | 4.99 |  | 53.89 |
| 1952-53 |  | 62.09 | 5.03 |  | 56.26 |
| 1953-54 |  | 62.57 | 5.47 |  | 58.01 |
| 1954-55 |  | 64.57 | 5.86 |  | 61.49 |
| 1955-56 |  | 69.70 | 9.93 |  | 65.05 |
| 1956-57 |  | 72.48 | 9.68 |  | 67.39 |
| 1957-58 |  | 71.12 | 9.18 |  | 66.92 |
| 1958-59 |  | 75.68 | 10.31 |  | 71.98 |
| 1959-60 |  | 80.24 | 11.12 |  | 74.98 |
| 1960-61 |  | 84.62 | 12.06 |  | 75.82 |
| 1961-62 |  | 93.58 | 12.88 |  | 80.21 |
| 1962-63 |  | 99.87 | 13.82 |  | 85.53 |
| 1963-64 |  | 104.97 | 14.43 |  | 94.20 |
| 1964-65 |  | 110.78 | 14.24 |  | 91.23 |
| 1965-66 |  | 121.82 | 15.11 |  | 91.33 |
| 1966-67 |  | 125.48 | 16.06 |  | 94.24 |
| 1967-68 |  | 131.15 | 16.20 |  | 96.42 |
| 1968-69 |  | 133.76 | 16.03 |  | 95.54 |
| 1969-70 |  | 135.97 | 16.11 |  | 94.38 |
| 1970-71 |  | 138.75 | 15.64 |  | 94.54 |
| 1971-72 |  | 142.81 | 15.15 |  | 102.38 |
| 1972-73 |  | 146.10 | 15.23 |  | 99.83 |
| 1973-74 |  | 150.70 | 15.78 |  | 99.25 |
| 1974-75 |  | 145.57 | 14.40 |  | 96.19 |
| 1975-76 |  | 160.92 | 13.58 |  | 103.72 |
| 1976-77 |  | 170.42 | 13.84 |  | 106.63 |

*(Cont'd.)*

| Year | Parcel | Registration | Acknowledgement | | Total of Money Money Orders/TMO |
|------|--------|--------------|--------|--------|--------|
| | | | *ORDL* | *ORDA* | |
| | (9) | (10) | (11) | (12) | (13) |
| 1977-78 | | 186.97 | 14.69 | | 107.87 |
| 1978-79 | | 197.87 | 15.90 | | 108.29 |
| 1979-80 | | 199.25 | 15.83 | | 108.70 |
| 1980-81 | | 207.93 | 16.46 | | 111.77 |
| 1981-82 | 62.1 | 222.24 | 17.35 | 174.2 | 119.35 |
| 1982-83 | 64.1 | 236.43 | 16.74 | 181.9 | 122.06 |
| 1983-84 | 58.8 | 244.67 | 22.50 | 194.9 | - |

## Table A.1 (Cont'd.)

| Year | IPOs | BRLs | Recorded deliveries | VPL | VPP | POSA |
|------|------|------|---------------------|-----|-----|------|
| | (14) | (15) | (16) | (17) | (18) | (19) |
| 1950-51 | | | | 3.82 | 4.80 | 4.09 |
| 1951-52 | | | | 7.11 | 1.41 | 4.45 |
| 1952-53 | | | | 8.29 | 1.35 | 4.83 |
| 1953-54 | | | | 9.16 | 1.17 | 5.07 |
| 1954-55 | | | | 10.95 | 1.13 | 5.38 |
| 1955-56 | | | | 3.16 | 3.92 | 6.00 |
| 1956-57 | | | | 3.68 | 3.82 | 6.38 |
| 1957-58 | | | | 3.21 | 3.27 | 6.92 |
| 1958-59 | | | | 3.43 | 3.15 | 7.72 |
| 1959-60 | | | | 3.46 | 3.06 | 8.45 |
| 1960-61 | | | | 3.39 | 3.05 | 9.21 |
| 1961-62 | | | | 3.68 | 3.37 | 9.48 |
| 1962-63 | | | | 4.08 | 3.59 | 10.03 |

| Year | IPOs | BRLs | Recorded deliveries | VPL | VPP | POSA |
|------|------|------|---------------------|-----|-----|------|
|      | (14) | (15) | (16)                | (17)| (18)| (19) |
| 1963-64 |   |      |       | 4.03 | 3.78 | 10.49 |
| 1964-65 |   |      |       | 5.26 | 3.92 | 12.10 |
| 1965-66 |   |      |       | 5.74 | 3.52 | 13.73 |
| 1966-67 |   |      |       | 7.92 | 3.48 | 15.19 |
| 1967-68 |   |      |       | 8.48 | 3.88 | 16.97 |
| 1968-69 |   |      |       | 7.27 | 3.36 | 18.39 |
| 1969-70 |   |      |       | 6.74 | 3.13 | 19.72 |
| 1970-71 |   |      |       | 5.41 | 2.73 | 20.58 |
| 1971-72 |   |      |       | 5.74 | 2.25 | 21.80 |
| 1972-73 |   |      |       | 5.57 | 2.68 | 23.11 |
| 1973-74 |   |      |       | 6.56 | 2.55 | 24.98 |
| 1974-75 |   |      |       | 6.34 | 2.62 | 27.80 |
| 1975-76 |   |      |       | 4.30 | 2.34 | 29.50 |
| 1976-77 |   |      |       | 5.00 | 2.10 | 25.05 |
| 1977-78 |   |      |       | .7.34 | 2.35 | 26.40 |
| 1978-79 |   |      |       | 7.85 | 2.44 | 25.09 |
| 1979-80 |   |      |       | 8.17 | 2.35 | 28.92 |
| 1980-81 |   |      |       | 8.57 | 2.58 | 33.41 |
| 1981-82 | 16.1 | 11.9 |      |      |      | 38.05 |
| 1982-83 | 17.1 | 14.9 |      |      |      | 39.94 |
| 1983-84 | 20.7 | 12.1 | 8.2  |      |      | -     |

## Abbreviations used in Table A.1

LETR    =    Letter
POCR    =    Post Cards

| | | |
|---|---|---|
| LECO | = | Letter Cards |
| RGNP | = | Registered Newspapers |
| OTUN | = | Other Unregistered Articles |
| ORDA | = | Ordinary Registered Letters |
| ORDL | = | Ordinary Registered Articles |
| MO | = | Money Orders |
| TMO | = | Telegraphic Money Orders |
| VPL | = | Value Payable Letters |
| VPP | = | Value Payable Parcels |
| POSA | = | Postal Savings |
| SB | = | Postal Savings Banks (No. of Accounts) |
| SC | = | Postal Savings Certificates |

TABLE A.2

**Estimates of Capital Stock and Employment for IPD**

| Year | Capital Stock Current Prices | Capital Stock at Constant Prices (1950-51) | Estimated Total No. of Persons Employed |
|---|---|---|---|
| | (Rs. in million) | | (in actual nos) |
| 1950-51 | 27.9 | 27.9 | 116853 |
| 1951-52 | 29.0 | 26.31 | 131826 |
| 1952-53 | 30.7 | 24.27 | 141523 |
| 1953-54 | 34.9 | 27.69 | 145723 |
| 1954-55 | 41.3 | 33.29 | 157799 |
| 1955-56 | 47.7 | 38.04 | 170701 |
| 1956-57 | 56.0 | 43.81 | 181079 |
| 1957-58 | 61.6 | 46.66 | 129970 |
| 1958-59 | 71.9 | 53.42 | 201687 |
| 1959-60 | 83.7 | 60.70 | 217897 |
| 1960-61 | 93.8 | 64.90 | 229219 |

*(Cont'd.)*

| Year | Capital Stock Current Prices | Capital Stock at Constant Prices (1950-51) (Rs. in million) | Estimated Total No. of Persons Employed (in actual nos) |
|------|---|---|---|
| 1961-62 | 100.1 | 67.49 | 237543 |
| 1962-63 | 111.5 | 72.01 | 256217 |
| 1963-64 | 130.8 | 81.54 | 273996 |
| 1964-65 | 152.9 | 91.91 | 286719 |
| 1965-66 | 163.8 | 94.34 | 292507 |
| 1966-67 | 175.8 | 94.77 | 301435 |
| 1967-68 | 190.3 | 97.03 | 309809 |
| 1968-69 | 223.6 | 112.89 | 318478 |
| 1969-70 | 272.2 | 135.45 | 333560 |
| 1970-71 | 319.4 | 147.78 | 358659 |
| 1971-72 | 384.3 | 206.75 | 367926 |
| 1972-73 | 456.5 | 214.28 | 369892 |
| 1973-74 | 521.7 | 213.07 | 382822 |
| 1974-75 | 548.1 | 171.33 | 397252 |
| 1975-76 | 608.4 | 161.45 | 411348 |
| 1976-77 | 672.7 | 178.73 | 422121 |
| 1977-78 | 781.2 | 207.56 | 439006 |
| 1978-79 | 920.3 | 232.28 | 455161 |
| 1979-80 | 1050.0 | 229.97 | 486800 |
| 1980-81 | 1205.3 | 233.67 | 510949 |
| 1981-82 | 1395.3 | 243.88 | 552665 |
| 1982-83 | 1628.1 | 268.40 | 561419 |
| 1983-84 | 1946.2 | 307.36 | 573100 |

TABLE A.3

## Index Number of Wages for Postal and Telegraph Department (Combined)

| Year | Wage Bill | Total No. of Persons Employed | Wage Bill per worker | Index of Wage taking 1950-51=100 |
|------|-----------|-------------------------------|----------------------|-----------------------------------|
| 1950-51 | 2626 | 194755 | 1348.36 | 100.00 |
| 1951-52 | 2856 | 219710 | 1299.90 | 96.41 |
| 1952-53 | 3114 | 235871 | 1320.21 | 97.91 |
| 1953-54 | 3294 | 242571 | 1356.28 | 100.58 |
| 1954-55 | 3462 | 262999 | 1316.35 | 97.63 |
| 1955-56 | 3681 | 284501 | 1293.84 | 95.96 |
| 1956-57 | 3721 | 301778 | 1232.94 | 91.44 |
| 1957-58 | 4230 | 316617 | 1335.99 | 99.08 |
| 1958-59 | 4473 | 336145 | 1330.68 | 98.69 |
| 1959-60 | 4707 | 363162 | 1296.12 | 96.13 |
| 1960-61 | 5246 | 382032 | 1373.18 | 101.84 |
| 1961-62 | 5586 | 395906 | 1410.09 | 104.58 |
| 1962-63 | 6399 | 427029 | 1498.49 | 111.13 |
| 1963-64 | 6963 | 456660 | 1524.77 | 113.08 |
| 1964-65 | 8313 | 477865 | 1739.61 | 129.02 |
| 1965-66 | 9949 | 487513 | 2040.77 | 151.35 |
| 1966-67 | 11269 | 502391 | 2243.07 | 166.36 |
| 1967-68 | 13935 | 516349 | 2692.76 | 200.15 |
| 1968-69 | 14380 | 530797 | 2709.13 | 200.92 |
| 1969-70 | 15161 | 555934 | 2727.12 | 202.25 |
| 1970-71 | 17109 | 597765 | 2862.16 | 212.27 |
| 1971-72 | 18819 | 613210 | 3068.93 | 227.60 |
| 1972-73 | 20754 | 616486 | 3366.49 | 249.67 |
| 1973-74 | 23852 | 638036 | 3738.35 | 277.25 |

*(Cont'd.)*

| Year | Wage Bill | Total No. of Persons Employed | Wage Bill per worker | Index of Wage taking 1950-51=100 |
|------|-----------|-------------------------------|----------------------|----------------------------------|
| 1974-75 | 29842 | 662087 | 4507.26 | 334.28 |
| 1975-76 | 36297 | 685580 | 5294.34 | 392.65 |
| 1976-77 | 37750 | 703535 | 5265.76 | 390.53 |
| 1977-78 | 39270 | 731676 | 5367.13 | 398.05 |
| 1978-79 | 44844 | 758602 | 5911.04 | 438.41 |
| 1979-80 | 50954 | 811334 | 6280.27 | 465.77 |
| 1980-81 | 59896 | 851582 | 7033.50 | 521.63 |
| 1981-82 | 70213 | 921108 | 7622.67 | 565.33 |
| 1982-83 | 83309 | 935698 | 8903.41 | 660.31 |
| 1983-84 | 97993 | 955167 | 10259.25 | 760.89 |

# APPENDIX II

## Notes on Tables in the Report

**Table 4.1**  Estimates of total Economic Cost and Gross Revenue at Current Prices of IPD.

This table is presented for the period 1950-51 to 1985-86 under the heads of cost of capital services, other costs, total costs and total revenue. The figures for cost of capital services, other costs and total cost are taken from Annual Reports of Department of Posts and Telegraph (1950-51 to 1983-84) and Department of Posts (1984-85 to 1985-86).

The figures for total revenue are collected from the Appropriation Accounts of Department of Posts and Telegraph (1950-51 to 1983-84) and Department of Posts (1984-85 to 1985-86).

**Table 4.2**  Index Number of Wage Rate/Capital Cost/Postal Tariff.

For preparing the wage rate index, data on wages, salaries, allowances, etc., were taken from Annual Reports and Appropriation Accounts of IPD. Base year for the calculations is 1950-51.

The index of postal tariffs was prepared from tariff rate figures supplied to us by IPD. We averaged these figures and constructed an index number with 1950-51 as base.

The index of cost of capital services was computed with figures from Annual Reports and Appropriation Accounts.

**Table 4.3**  Estimates of Economic Cost and Revenue

These estimates are presented under the heads of (i) total economic cost, (ii) total revenue, (iii) post card equivalent of

total revenue, (iv) production efficiency, (v) index of economic efficiency.

The figures in columns (2) and (3) are deflated. The deflator used is general price index with 1950-51 as base.

Post card equivalent of total revenue is calculated by dividing total revenue in column (3) expressed in 1950-51 prices by the 1950-51 price of a post card. Productive efficiency is then defined as

$$\frac{\text{Column (4)}}{\text{Column (2)}}$$

An index of economic efficiency is calculated by constructing an index of productive efficiency with 1950-51 as base.

**Table 4.4**     Estimates of Average Rate of Return and Rate of Depreciation

Estimates of average rate of return are collected from the *Report on Currency and Finance* published by RBI.

Rate of depreciation is calculated by dividing the amount of depreciation by the value of capital stock of IPD.

**Table 5.1**     Estimates of total per unit cost of postal services are prepared from the statement showing the cost, revenue per article and profit/loss on each service, prepared by IPD.

**Table 5.2**     Cross-Subsidy Free Prices.

The source for these computations is the same as the one for Table 5.1.

Per unit total cost of each item has two components: (i) attributable cost and (ii) joint cost.

The following costs are attributable: (a) RMS charges,

(b) printing and stationery charges, and (c) transport charges.

Joint cost components are (a) per day operation charges, (b) per day supervision charges, (c) accommodation, (d) administration, and (e) accounts and audit.

**Table 5.3** Average Revenue on Tariff of Postal Services

The source for this Table is the same as that for Tables 5.1 and 5.2.

**Table 5.4**   Rates of Subsidies for First Class Mail and Registered Newspapers (single) and

**Table 5.5**   Estimates of Mark-Ups Over Cross-Subsidy-Free Prices for some registered mail services.

These Tables are computed on the basis of figures reported in Tables 5.2 and 5.3.

**Table 5.6**   Cross-Subsidisation of Postal Services.

*Method of Computation*

The rate of cross-subsidisation is computed in Tables 5.4 and 5.5 for all the seventeen services, supplied by the IPD for the period 1981-82 to 1985-86. Then each rate is multiplied by its respective traffic figure for each year.

**Table 5.7**   Estimates of Budgetary Deficit of IPD.

IPd estimates are reported from the Appropriation Accounts of Department of Posts and Telegraph for the period 1981-82 to 1983-84 and Department of Posts for the period 1984-85 and 1985-86.

Our cost estimates are different because they include the cost of capital services and treat recoveries from other agencies (e.g., Ministry of Finance) as mere transfers. Hence our economic cost

corresponds to total resource cost: labour, capital and material inputs.

**Table 5.8**　　Unregistered Mail By Users During 1986-87

This Table is taken from the Report on Postal Traffic Survey, IPD, (Efficiency Bureau).

**Table 5.9**　　Percentage Distribution of Various Categories of Registered Post by Users During 1986-87.

This Table is also taken from the Report on Postal Traffic Survey (IPD) (Efficiency Bureau).

**Table 5.10**　　Percentage Distribution of Various Postal Services by Rural and Urban Sectors in India.

Same as that for Tables 5.8 and 5.9.

**Table 5.11**　　Distributional Weights $(b_i)$ to Postal Tariff Demands for the Three Sectors Under Alternative Scenarios.

Same as that for Tables 5.8 and 5.9.

**Table 5.12**　　Distributional Weights $(b_i)$ to Postal Tariff Demands for the Three Sectors Under Alternative Scenarios.

Distributional weights to consumption of postal services by Household, Business and Government are estimated with the assumption that Government regards household demand for postal services as distributionally more important than the business demand.

**Table 5.13**　　Estimates of Distributional Characteristics of Postal Service under Alternative Scenarios.

**Table 5.14**　　Estimates of Second Best Prices for Various Postal Services under Alternative Scenarios during 1985-86.

**Table 6.1**   Block Prices Charged by IPD During 1985-86.

These are taken from Postal Tariff Rate List Series 1854 to 1.1.1987 supplied by the Department of Posts (IPD).

**Tables 6.2**

**and 6.3**        Estimates and Actual Rates Charged According to Various Slabs for Letter Mail Service and Parcel Services, respectively for the year 1985-86.

Estimated as explained in the text.

**Table 6.4**     Estimated and Actual Rate of Commission Charged according to Various Slabs on MOs during the Year 1985-86.

Estimated as explained in the text.

**Table A.1** Traffic Demand.

Traffic demand figures are collected from Annual Report of Department of P and T (for the period 1950-51 to 1983-84) as well as from the Statistical Digest of IPD.

There are several problems with these figures:

(i) For unregistered traffic the figures are highly exaggerated.

(ii) Different statements prepared by IPD give very different estimates of traffic demand for the same year.

We have consistently used the figures in the Annual Reports and Statistical Digests of IPD.

**Table A.2** Estimates of Employment.

The reported figures are taken from the Annual Reports.

An estimate of total number of persons employed is made in the following way. We have (separate) estimates of employment

in IPD and Department of Telegraph for 1984-85. We assume that the ratio of employment in the two departments was the same throughout the period. Hence from the figures for P & T for the period 1950-51 to 1983-84 we obtain estimates of employment within IPD alone.

**Table A.3** Index Number of Wages for P & T.

Figures under the heading of wage level and total number of persons employed are taken from the Annual Reports of Department of P & T (from 1950-51 to 1983-84) and from the Report of IPD for the remaining years.

# REFERENCES

Annual Reports, 1950-51 to 1983-84, Department of Posts and Telegraph, Ministry of Communication, Government of India.

Annual Reports, 1984-85 to 1987-88, Department of Posts, Ministry of Communication, Government of India.

Aumann, R.J and L.S. Shapley (1974), *Values of Non-atomic Games*, Princeton University Press, Princeton, New Jersey.

Billera, L.J. and D.C. Heath (1982), Allocation of Shared Costs: A Set of Axioms Yielding a Unique Procedure, *Mathematics of Operations Research*, pp. 32-39.

Brown, Stephen J. and David S. Sibly (1986) : *The Theory of Public Utility Pricing*, Cambridge University Press, Cambridge.

Faulhaber G.R. (1975), Cross-Subsidisation : Pricing in Public Enterprises, *American Economic Review*, Vol. 165, pp. 966-77.

Feldstein, M.S. (1972), "The Pricing of Public Intermediate Goods", *Journal of Public Economics*, Vol. 1, pp. 45-72.

India, Administrative Reforms Commission (1966), Report on Posts and Telegraphs, 1970, p. 82, Chairman - K. Hanumanthaiya.

India, Administrative Reforms Commission, Working Group on Posts and Telegraph (1968), Chairman - Ram Kishan, Delhi, 1969.

India, Appropriation Accounts, 1950-51 to 1983-84 (Department of Posts and Telegraph), Government of India, New Delhi.

India, Appropriation Accounts, 1984-85 to 1986-87, Department of Posts.

India, Communications (Department of ) Posts and Telegraphs (Board), Memorandum Showing the Proposed Version of Postal and Telegraphs Tariffs, Delhi.

India, Posts and Telegraphs Accounts (Enquiry Committee on -- ) 1931, Chairman--Cowasjee Jehangir.

India, Tariff Enquiry Committee, Department of Posts and Telegraph, Mahavir Tyagi's Report, July, 1968.

International Bureau of the Universal Postal Union, Berne, *General Principles of Rate Fixing*, Study 2/305 of the Consultative Council of Postal Studies (various other reports of the same organisation), 1974.

Jha, Raghbendra and M.N. Murty (1987), "Distributional Equity and Optimal Prices for the Public Sector - The Flexible Co-efficients Case", *Energy Economics*, January, pp. 46-54.

Jorgenson, D.W. and Z. Grilichess (1967), "The Explanation of Productivity Change", *Review of Economic Studies*, 34, 249-83.

Mirman, L.J., Samet D, and Y. Tauman (1983), "Axiomatic Approach to the Allocation of a Fixed Cost through Prices, Bell Journal of Economics Vol. 14(1), pp. 139-151.

Mirman, C.J. and Y. Tauman (1982), "Demand Compatible Equitable Cost Sharing Prices", *Mathematics of Operations Research*, pp. 40-66.

Mukherjee, B.N., "A Note on Early Postal System", *Journal of Asiatic Society* (Bombay) pp. 54-55 1979-80.

Murty, M.N. (1983), "Distributional Equity, Indirect Taxation and Optimal Structure of Prices for Public Sector Commodity",

Working Paper E/106/84, Institute of Economic Growth, Delhi, India.

Murty, M.N. (1987), 'Prices for Public Electricity Supply in India : Efficiency, Distributional Equity and Optimal Structure'', *Economic and Political Weekly*, October 10, pp. 1762-1769.

Samet, D., Y. Tauman and I. Zang (1983), ''An Application of the Aumann-Shapley Prices for Cost Allocation in Transportation Problems, *Mathematics of Operations Research*.

Sams, H.A., *Post Office of India in the Great War*, Bombay, Times Press, 1922.

Statistical Digest, Department of Posts and Telegraph, Ministry of Communications, Government of India, 1976-77 to 1983-84, The Manager, Press, Government of India, Aligarh.

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