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RAILWAY RATES

[THIS article, which was published in the ECONOMIC
JOURNAL, 1912, as the second section of the series announced
as " Contributions to the Theory of Railway Rates," deals
with some leading problems in Railway Economics. The
function of discrimination is investigated on the lines of
Dupuit. There comes up for reconsideration the vexed question
of the relation between through fares lowered by competition
and fares to intermediate localities which are subject to monopoly.
The discrepancy in this matter between expert practice and
abstract theory is explained by the circumstance that the theory
may be too abstract, not taking into account the monopolist's
concern for interests in the distant future. The monopoly
also may be not pure, but mixed with competition or altruistic
motives. A return to the subject is promised; but this is one
of the promises which were swallowed up by the War].

The classical economists rather anathematised than analysed
monopoly.[1] It was reserved for Cournot to cultivate this neg-
lected branch of economics; gathering the first-fruits of the
mathematical method. Cournot and his mathematical successors
have fully discussed what may be called the leading case : that
of a monopolist dealing with a whole class of mutually competi-
tive customers at one and the same price. Some acquaintance
with the laws governing this comparatively simple case is here
presumed. My contributions are directed to a subject less
generally studied,[2] the case in which the monopolist *discriminates*
between different classes of customers. I build upon the founda-
tions laid by Dupuit.[2]

[1] For instance, Adam Smith's dictum, " The price of monopoly is upon every
occasion the highest which can be got " (*Wealth of Nations*, Book I. chap. vii.),
J. S. Mill's dictum, " Monopoly value does not depend on any peculiar principle,
but is a mere variety of the ordinary case of demand and supply " (*Political
Economy*, Book III. chap. ii. § 5), seem wanting in precision.

[2] See his epoch-making papers, *De la mesure de l'utilité des travaux publics* and
De l'influence des péages sur l'utilité in the Annales des Ponts et Chaussées, 1844
and 1849, which will be found among the periodical publications in the library of
the British Museum. Some extracts from Dupuit's papers are given in my article
in the ECONOMIC JOURNAL, September, 1910.

The corner-stone of this building is formed by a conception which Dupuit introduced under the designation " rente des acheteurs " : the money-measure of the benefit accruing to purchasers from obtaining articles which they purchase at a certain price, while they would have been willing to give more for those articles rather than go without them altogether. The sum of money designated by the term in question may, I think, be an object of science as well as the sum designated by the more familiar term *price*. The monetary equivalent of total utility may be as objective as the monetary equivalent of final utility. It should be observed, too, that often the *Rente des Acheteurs* with which we are here concerned does not consist only of *Consumers' Surplus* in the phrase adopted by the second founder of the theory, but also of a certain *Producers' Surplus* which consists of money, and does not require, like Consumers' Surplus for the most part, to be evaluated by an unusual or hypothetical transaction. Thus, if a railway lowers the rate for carriage of coal to a residential and manufacturing town (dependent on that railway for its supply of coal), not only will there be a gain of Consumers' Surplus to those who use coal for domestic purposes, but also the manufacturers becoming able to extend their use of coal in various directions will presumably secure a greater surplus of money profit. I propose to subsume the two kinds of advantage which may accrue to the purchasers of monopolised services under the title " Customers' Benefit."

The theory which I attempt to construct is based mainly on the first principle of pure economics, the prevalence of self-interest. In the words of Professor Cohn, comparing the different motives by which railway managers are actuated, " by far the weightiest are assuredly the egoistic motives." [1] In the words of another high authority,[2] " the constant effort of every railway company [is] to secure the volume of traffic and to maintain the fares that will jointly yield maximum net profit." " The main purpose of the railway manager is to secure present or prospective profit for the stockholders." [3] But while reasoning from this premiss, I do not forget that a concrete railway company is far from being a perfect monopoly; and I will point

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[1] " Weitaus die wichtigsten sind allerdings die egoistischen." *Englische Eisenbahnen*, vol. ii. p. 398, and context adducing evidence that " das Eigennutz " is the predominant motive.

[2] Johnson and Huebner, *Railway Traffic and Rates*, p. 227. The words relate to passenger traffic, but may safely be generalised. Compare the context, p. 216. A qualification of this assumption, made by the distinguished writers, will be noticed in the sequel. [3] *Op. cit.*, p. 228.

out how the deductions from the abstract principle require to be modified by other considerations.

(1) *Discrimination due to differences in demand.*—The most characteristic case of discrimination resulting from monopoly occurs when different charges are made for like commodities solely on account of differences in value to the purchaser, and quite irrespectively of differences in cost to the producer. Examples of this case too familiar to require citation occur throughout the wide fields of railway practice [1] designated by the terms Classification and Local Discrimination.

To explore the consequences to the customers of such discrimination, let us at first suppose that no very great difference of rates—no " wrench in commercial conditions " in the phrase of an experienced railway manager [2]—is caused by the introduction of the discrimination. Let us further provisionally assume that the company's interest in the two kinds of traffic—say through traffic and local traffic—is not very unequal. We have then the typical case which I have discussed at length in a former paper.[3] It is there shown that the perfectly self-interested monopolist tends to exploit the customers in such wise that their last state will be worse than their state prior to discrimination. But, as it is further shown—by an extension of a theorem pointed out by Dupuit and applied by M. Colson—the monopolist has not much interest in pushing his exploitation up to and beyond the limit at which discrimination begins to be detrimental to the customers as a whole. For a small consideration the monopolist can probably be induced to adopt a set of prices such that the customers as a whole—as well as the monopolist himself—may be gainers through discrimination.[4] If he does not insist on extracting the uttermost farthing, discrimination will result in an increase of Customers' Benefit.[5]

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[1] As shown by all intelligent writers on the economics of transportation, with particular lucidity by Hadley and Acworth.

[2] E. P. Ripley in the context of a passage quoted in the sequel.

[3] *Applications of Probabilities to Economics*, ζ, II. 407.

[4] The instances of discrimination alleged by Schipfer in his interesting study on the passenger service of Prussian railways (*Volkwirtschaftliche Studien*, Berlin; Heft 209) as detrimental to the public—for instance, between " return " and ordinary fares—are hardly relevant here, so far as the allegation rests on the difference in the value of money to different classes of the community. This is a consideration not taken into account here.

[5] This last proposition is a new corollary, which the mathematical reader will have no difficulty in deducing from the theory given in the paper of 1910; upon the assumption not only that the coefficients a, β, γ, etc., pertaining to the demand curves (*loc. cit.*, p. 459, note), are small, but also that the monopolist takes no account of amounts (of profit) less than what correspond to the squares of those

As we leave the limiting case in which the receipts prior to
discrimination are nearly equal and the discrepancy in prices
produced by discrimination is inconsiderable, the probability in
favour of the conclusions enounced becomes weaker.[1] The lamp
of Probability is dimmest when the inequality between the
original demands is considerable, but not immense. Penetrating
this obscure central region we emerge into daylight[2] as we
approach a new limit characterised by the extreme inequality of
the receipts prior to discrimination. One class has now so small
a demand, in the absence of discrimination, that the alteration
of its price does not sensibly affect the other class constituting the
bulk of the customers (prior to discrimination). There are two
varieties of this extreme case; the rate fixed for the exceptional
class may be either raised or lowered. An example of the first
variety would occur if millionaires were treated as *corvéable à
discrétion*, in Mr. Acworth's phrase. But probably in the man-
agement of railway traffic this variety is much rarer than the
converse one in which rates are lowered for outlying classes.
This category includes the cases in which judicious managers
" create traffic "[3]—" excursion business, handled at reduced
fares," in contrast to " the regular business at standard fares,"[4]
" extra traffic that will not move without special conditions."[5]
Here we may place walking and cycling tickets, week-end, and
" long-date week-end " tickets,[6] special terms offered to pas-
sengers on the occasions of exhibitions, football matches, etc.;
with like discrimination in favour of producers. Now in all such
cases there is a pure gain of Customers' Benefit; since by hypo-
thesis the position of the bulk of the customers is unaltered, while

small magnitudes. The corollary, it may be observed, is true independently of
the form of the demand-function, since in the expansion of those functions the
terms involving higher powers than the second may be neglected.

[1] *Loc. cit.*

[2] Theoretically the light does not return until we have crossed the new limit
into an outlying region occupied by customers who have *no* demand at the original
(undiscriminated) price. But practically it may be often assumed that the very
small demand of a special class will not have a sensible effect on the rates fixed
with regard to the demand of the majority.

[3] See the lively directions for creating traffic quoted by Johnson and Huebner,
Railway Traffic and Rates, Vol. II. p. 197.

[4] *Loc. cit.*, p. 221.　　　　　[5] *Loc. cit.*, p. 189.

[6] Many such instances are given by H. Marriott, *The Fixing of Rates and Fares*,
chap. vi. Perhaps some of the instances are not quite at (or beyond) the limit
under consideration. Thus, the demand for week-end journeys might well be so
great and of such a nature that, if special week-end fares were to be abolished
and a uniform fare adopted, that undiscriminated charge would be—practically,
as well as theoretically—lower than the present standard fare.

the remainder are enabled to purchase a commodity of which the price was previously preventive.

(2) *Discrimination due to differences in cost.*—An equally simple and perhaps more familiar case arises when two classes of customers [1] between whom it is proposed to discriminate have the same demand for a commodity which it costs more to supply to one than to the other. For instance, the two classes may be the residents in two localities, whose dispositions with respect to local journeys are identical; but the operating expenses [2] may be greater—say on account of the steepness of the gradients—in one place than the other. The reader will rightly presume, though probably for the wrong reason,[3] that when the price of the two services is not constrained to be uniform, the price of the service which it costs more to supply will (theoretically) be higher. But preconceptions will be of little avail to answer the question whether under the circumstances the customers as a whole will be benefited by the discrimination. The Ricardian doctrinaire will presume that prices proportional to costs of production form the best possible arrangement. The undisciplined Socialist may presume that equal charges for classes whose wants are identical are productive of maximum satisfaction. But both these contrary presumptions are incorrect. The first thesis is only approximately true; the second is false.[4]

(3) *Discrimination due to differences in both demand and cost.*—Now let us compound the two preceding simple cases. For instance, the discrimination between first- and third-class passengers' fares (in England) is, I suppose, based partly on the different requirements of the passengers, and partly on difference in the cost of equipment. In this case the same line of cleavage separates the classes which are discriminated in respect of demand and in respect of cost.[5] More generally, it may be conceived that the two classes differing in one of those respects, for instance, the residents in the two localities for which the cost of carriage

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[1] It may be well to repeat here the advertisement which I gave at the outset of the cognate paper in the Economic Journal for 1910 :—" I shall for convenience of enunciation confine my statements to the variety in which only two species are discriminated; but the propositions thus enunciated are readily adapted to any finite number of species."

[2] The *general* expenses are not relevant to the present theory.

[3] On the strength of Ricardian premisses inappropriate to the present inquiry which relates to pure monopoly. The true reason is to be found in Cournot's theory concerning the effect of a rise in cost of production on the price of a monopolised commodity.

[4] For proof of these and following statements see the paper on the Application of Probabilities, Section VI., ζ, below, p. 387, *et seq.*   [5] *Loc. cit.*

was different, have a uniform demand only on an average; each class capable of being broken up into species, such as travellers by fast and by slow trains. We may then employ first one of the above propositions, then the other, to obtain conclusions analogous to those which have been enounced.

It remains to notice the modifications of the simple propositions which arise when we introduce *correlation* [1] both of demand and cost. For instance, the demand on the part of passengers for first-class and that for third-class accommodation are *rival*. The demands for the carriage of the passengers themselves and for the carriage of their luggage (where, as in Prussia, a separate charge is made for luggage) are presumably *complementary*. In the case of special tickets for " parties " [2] we have an instance of *complementary demand*, so far as the desire of each for the trip is heightened by the pleasure of company; and of *joint cost* so far as the largeness of the party enables the economies of production on a large scale to be realised.[3] But it will not be necessary to examine in detail the variety of cases which are constituted by these complications. The subject is particularly open to the remark which Mill quotes from Montesquieu : " Il ne faut pas tellement épuiser une chose qu'on ne laisse rien à faire au lecteur." The reader is invited to ascertain for himself, with the aid of the notes in the former paper,[4] that the propositions above proved for the simpler cases of demand and supply may be extended to cases complicated by Joint Demand and Cost; the probability becoming more *a priori* and of less practical service as the complications increase. The mathematical reader will have no difficulty in making these generalisations if he bears in mind the essential characteristics of our theory, namely, (1) that monopoly profit is at a maximum [5] (before and after discrimination), and accordingly that the data must be such as to fulfil the usual criteria of a maximum; (2) that the coefficients which determine the extent of the discrimination are, at least, initially small; [6]

[1] The term is defined and divided, S, II. 72, 73.

[2] For instances of such arrangements, see the passages of Johnson and Huebner's *Railway Traffic and Rates*, referred to above, p. 175.

[3] See, as to the relation of Joint Cost and Increasing Returns, passages referred to in the Index.

[4] See ζ, p. 423, *et seq.* The treatment of Correlated Cost is exemplified below, p. 184, *note. Cp.* S, II.

[5] In accordance with the fundamental premiss postulated above, p. 173.

[6] Relatively small (such as the coefficients a, β, etc., employed in the note to p. 174, above); partly in accordance with the practice of railway managers (alluded to below, p. 190), but principally in virtue of a method of reasoning introduced by Cournot and largely applicable in mathematical economics; as to which see Index s.v. *Differentials and Finite Differences.*

(3) that the usual postulates of *a priori* probabilities [1] are granted; in particular, it is assumed that if two quantities P and Q take on from time to time different values (ranging through tracts of the same order of magnitude), such that P is always positive, Q as often positive as negative, then (under the circumstances characterising the class of problems with which we are dealing) the sum $P + Q$ is probably positive.

With reference to the complex cases, it may be well perhaps to explain what is implied in my use of the evasive term Joint Cost. When it is said in the present context that two discriminated commodities have a joint cost, it is meant that when the production of one is increased by an amount such as that which results from the discrimination contemplated,[2] then the increased production of the other commodity becomes less costly. It is true that most of our examples seem to imply Joint Cost on a different scale. Thus, the two parts of the same railway which were instanced in our second subsection would, no doubt, have a joint cost in virtue of the initial expenses of the railway. But we might equally have supposed two distinct railways, owned by the same company, similar as to the requisites of customers, differing only in that the cost of haulage is greater on one of them than in the other. So with respect to our first problem we might suppose two separate lines (owned by the same company) on one of which lime destined for agricultural purposes, on the other lime destined for architectural purposes is hauled, at different rates, though the cost (per ton) of haulage is the same.

It thus appears that the distinction drawn by Professor Taussig [3] between the discrimination resulting from Joint Cost

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[1] [As to *a priori* Probabilities, see passages referred to in Index.] In the case specified in the text it is assumed that the frequency with which P and Q assume different values in the long run (between certain limits) is approximately uniform, in accordance with common experience as to the behaviour of statistical quantities (the sort of assumption approved by Karl Pearson, *Grammar of Science*, p. 146, 2nd edition).

The argument in the text may be illustrated by the following transaction :— Two digits are taken from mathematical tables at random, or from the expansion of such a constant as π. I (1) give you a number of shillings equal to the *first* digit, and (2), according as the *first* digit is odd or even, either I give you or you give me a number of shillings equal to the *second* digit. In the long run, formed by a series of such trials, you would stand to gain. The proposition remains true when the ranges of the two elements are different; for instance, one of the two component digits being excluded from the values 8 and 9. But the proposition is of course less useful when the order of the constantly positive element is small compared with the element of inconstant sign.

[2] As to the propriety of specifying the magnitude of the " dose " considered with reference to Joint Cost, and generally Laws of Return, see C, above, p. 65, *et passim*.

[3] *Quarterly Journal of Economics* (1891); reprinted in Ripley's *Railway Problems* (p. 140, *et seq.*).

and that which results from Monopoly, however important in
general, is not particularly relevant to the benefit accruing to
customers which we have in view. This sort of benefit may be
obtained from discrimination without Joint Cost in a regime of
Monopoly, and with Joint Cost in a regime either of Monopoly
or of Competition. Our withers are unwrung by the observation
that " people constantly confuse the principle of joint cost with
monopoly. To charge what the traffic will bear under the
former principle is for the public interest, to charge what it will
bear under the latter principle is against the public interest." [1]
The public interest which most writers outside the school of the
Ponts et Chaussées connect with joint cost and discrimination of
price is the circumstance that but for such discrimination the
production is apt to be unprofitable and therefore impossible.[2]
But the public interest which I here, after Dupuit, emphasise,
is one quite distinct from that familiar advantage. It is some-
times, indeed, superadded thereto, but it often exists independ-
ently. It consists in minimising through discrimination that
loss (*perte sèche* in M. Colson's phrase) of customers' benefit which
is apt to result from unitary price. Doubtless competitive joint-
cost is more in the public interest than monopolistic joint-cost,
other things being the same. But other things are likely not
to be the same, since monopoly is more favourable to discrimina-
tion.[3]

(4) *Changes in demand.*—Having now considered the in-
fluence of demand and cost as determining discrimination, let us
go on to consider changes in those factors.[4] The question arises
how will a change in the demand for one of the commodities
discriminated affect the result of discrimination. The change
may be supposed, with sufficient generality, to occur *after* the
introduction of discrimination. The commodities which we have
hitherto considered may be likened to two horses of different
mettle at first yoked together and constrained to go at one and
the same rate ; afterwards unyoked and free to go each at its own
pace. The question now arises, if, after the separation, one of
the steeds be either spurred or reined, what will be the effect on

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[1] Taussig, *Principles of Economics*, Vol. II. p. 495.   *Cp.* our subsection 7, below.

[2] As in the " oyster-case " which Principal Hadley has made classic ; referred
to above, C, p. 93.

[3] As to the possibility of monopoly being better for the customer than com-
petition, see D, p. 101, *et seq.*, and ζ, p. 406 *seq.*

[4] The relation between the following two subsections and the preceding three
may be illustrated by the relation between § 2 and § 5 of Mill's chapter on *Inter-
national Values*, dealing respectively with the level of values resulting from
the opening of trade, and the change in the level resulting from a variation of the
data.

the rate of the other ? The metaphor suggests the true answer, namely, *nil*, in the absence of special relations, whether of rivalry or sympathy. Thus, if a Company has been free to adopt the rates that are most profitable at different distances (say, arbitrarily tapering rates), then should a fall in the demand for through traffic occur, through the construction of a competitive line passing through a distant point, that circumstance *per se* will not theoretically affect the fares for shorter distances. They had already been fixed at the amounts supposed to be most profitable; to alter them on account of some loss occurring elsewhere would mean but an additional loss of profit.

This deduction from abstract theory is at variance with the judgment of experts.

Thus, the experienced Albert Fink testifies that a hard-and-fast tariff (preventing discrimination) " would have the effect that they would have to increase their charges upon such portions of the road as they could control themselves." (Report of the Hepburn Commission, Vol. I. p. 68.)

So in the classical pages of C. F. Adams we read :—

" At one point " rates became almost literally nominal; residents " at other points would be charged every penny that they could be made to pay without being drawn off the railroad and back to the highway." (*Railroads*, 1878, p. 123.)

The high authority of Professor W. Z. Ripley may be quoted in favour of the prevalent doctrine :—

" In the constant pressure for reduced rates in order to widen markets, it is not unnatural that the intermediate points, less competitive probably, should be made to contribute an undue share to the fixed sum of joint costs." (*Political Science Quarterly*, Vol. XX.; 1906; *Railway Problems*, p. 489.)

And, again, Professor Ripley speaks of " the danger of local rates . . . being actually enhanced, or at least prevented from reduction because of an unduly low level of competitive rates at more distant points." (*Quarterly Journal of Economics*, 1909, p. 481.)

To the same effect the acute H. Turner Newcomb :—

" To these stations the relation of the railway is that of a monopoly, and from them the latter can and will . . . recoup all losses that may be sustained." (*Railway Economics*, p. 47.)

" Competition at terminal points impels most railways to charge relatively high rates at intermediate points, the traffic of which cannot be directed to other lines." (*Op. cit.*)

How strongly this doctrine of recoupment recommends itself

to enlightened common-sense appears from its continual recurrence in the reports and decisions of the Inter-State Commerce Commission. For example :—

" The greater the departure from the direct line, the greater would commonly be the necessity for lower rates on through traffic, and the greater the liability to have the charges on the local traffic increased to make the carriage of through traffic possible." (Quoted from the Decisions of the Inter-State Commerce Commission, Vol. I., by Hugo Meyer, *Regulation of Railway Rates*, p. 355.)

Through rates " must not be so low as to burden other business with part of the cost." (*Inter-State* Commerce Commission, Third Annual Report, p. 126.)

" If the rate is too low upon one article, in the end other articles pay too high a rate." (Quoted by Ripley, *Railway Problems*, p. 466.)

And who pays for this loss [occasioned by a roundabout service to competitive points] ? " Ultimately the intermediate points." (*I.C.C. Annual Report*, Vol. XI., p. 45.)

A similar contradiction between abstract theory and expert judgment may be noticed with respect to the practice of giving free passes to passengers. Theoretically, if from a homogeneous [1] body of customers some are selected to pay for their journeys by some service to the general interests of the company, that variation of the terms for certain passengers does not *primâ facie* affect the rate for the other passengers; what was before the rate affording maximum profit still fulfils that condition.[2] But this theory is not in accordance with common opinion. Thus, the Cullom Commission complain (*inter alia*) :—

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[1] If, as it is sometimes objected, the favoured persons belong to the wealthier classes (and so have a higher effective demand for passenger service)—" men of wealth and prominence who rode at the expense of others less able to pay " (*I.C.C. Annual Report*, Vol. III. p. 11)—then the discrimination would tend to *lower* the fares of the other passengers (by the theory of our subsection 1).

To continue our equine metaphor, we have (1) in the case of homogeneous demand a horse of like mettle with others running abreast of them at the same pace without any constraining yoke. The removal of such a one to be employed elsewhere does not tend to alter the general pace. But (2) if the steed removed is one of higher mettle, which ran at the same rate as others only through constraint, the removal of such a one tends to *lower* the general rate.

[2] One of the few writers whom I have found on my side in this matter is Marshall Kirkman, who enounces what I consider the (provisionally) true doctrine in his *Basis of Railway Rates*, p. 38 :—" Making of a low rate never has the effect to raise another rate. Each is independent." But I do not claim the alliance of a writer who holds that the charges " for railway service are governed by the same laws that fix the prices of other necessaries "—" fish or flour " (p. 26), " what we may term God's natural laws."

" That the cost of the passenger service is largely increased by this abuse " [the granting of passes].   (P. 801, quoted by the Elkins Commission.)

So A. B. Stickney :—

" To charge one person two prices for the sake of carrying another free " [seemed outrageous].   (*Railway Problems*, ch. viii.)

So the Inter-State Commerce Commission :—

" Favoured persons have been furnished free transportation at the expense of the general public by higher general charges to reimburse for gratuitous carriage."   (Annual Report, III. p. 12.)

These antinomies between abstract reasoning and common opinion appear to be due principally, but perhaps not altogether, to the admitted inadequacy of the premiss stated at the outset, and so far employed without correction, the prevalence of perfect and perfectly self-interested monopoly.[1]

It remains under this head to consider the special cases in which there is a *correlation*, a sympathy, or rivalry,[2] either in respect of production or demand, between the commodities for one of which the demand is changed.   Thus, a fall in the demand for through traffic (owing to competition at a distant point), not met by a lowering of through rates, might be followed by a shrinkage of the through traffic, with a loss of the economies attending production on a large scale that would involve a rise of the fares for shorter distances.   To exemplify correlation of demand (between the commodities for one of which the demand is altered), suppose that in a country where a separate charge is made for passengers' luggage the demand for travel increases (without any decrease in the amount of luggage required on each journey) ; then the demand for the carriage of luggage would be increased, and therefore presumably the charge for carrying luggage might be raised.

The last conclusion requires some qualification, for it is one of the paradoxes of Monopoly as contrasted with Competition that a rise in demand, even under monopoly without discrimination, as shown in another paper,[3] is not necessarily attended with a rise in price.   It is thus not exactly true to say with Ricardo that " commodities which are monopolised rise in price in proportion to the eagerness of the buyers to purchase them." [4]

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[1] *Cp.* subsections 6, 7, and 8 below.

[2] The cases illustrated above, p. 177.

[3] Above, p. 144.

[4] *Principles*, ch. xxx.

This paradox has not any important, or rather not any *recherché*, analogy under the head of cost.[1]

(5) *Changes in cost.*—The antithesis between theory and common opinion recurs when we consider the case in which the cost of transportation is changed for one of the discriminated services. In the absence of correlations there is no reason why the rate for the other service should be altered. Thus, if Government should compel railways to carry particular classes—say soldiers or workmen—at unprofitable rates, yet, supposing that the railway was previously free to fix discriminating rates at its discretion, the other classes of customers need not suffer. Because the Government smites the Railway on one cheek, is that any reason why the Railway should smite itself on the other cheek by altering fares arranged to yield maximum profit? But such is not the received opinion, which is thus well expressed by Mr. Pratt :

" If workmen are to be regarded as a privileged class who must be carried to and from their occupations at fares or under conditions which do not pay a railway company, then it is obvious that the difference must be made up either by other classes of travellers, or by the general body of the traders." (*Railways and their Rates*, p. 41.)

So far supposing that there is no correlation between the discriminated services. Now let there be such a relation; and first, let there be a rivalry of demand as for first-class and third-class passenger service. In such a case, as I have shown at length in other papers,[2] a rise in the cost of one service may not only not cause a rise, but may cause a fall in the charge for the other service. The proposition is principally important as giving a shock to the obstinate convictions of the half-taught, who persist in transferring to a regime of pure monopoly the lessons which they learnt in their youth when competition held, in the books at least, undivided sway.

A similar interest attaches to a corresponding case of correlations between costs. For instance, suppose that goods and passenger services are so related, on a crowded line, that if the one is increased the other becomes more costly. Let the cost of the passenger service be increased by any cause not directly affecting the goods traffic. The Ricardian will rightly presume

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[1] The analogue is the truism that an increase in the *total* cost of producing each amount of a commodity [Cournot's $\phi(x)$ as distinguished from his $\phi'(x)$] is not necessarily attended with a rise of price in a regime of pure monopoly.

[2] Above, E, p. 132; F, p. 149.

that the charge for passenger service will tend to rise. But he is likely to have a wrong opinion on the question whether the customers of the railway as a whole may be benefited by the change. By a parity of reasoning with that employed in the case of correlated demand, it may be shown that the increase in the cost of one service may quite possibly be attended with an increase of Customers' Benefit—more beneficial to the shippers and consumers of the goods than it is detrimental to the passengers. The proposition has some affinity to Dr. Marshall's celebrated paradox as to the conditions of maximum satisfaction.[1] Both theories conduce to the same purpose, to awaken old-fashioned dogmatists from their optimistic slumbers. But the analogy is not close, as appears from the observation that inelasticity of demand for the commodity of which the cost is raised is *not* a condition favourable to the effect here considered.[2]

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[1] *Principles of Economics*, Book V. ch. xii.

[2] The general truth may conveniently be conveyed by way of a particular example. In a notation similar to that employed in an earlier paper (above, E, p. 132) let p_1, p_2 be the prices of the two commodities referred respectively to the prices at the point of equilibrium; let $x\,y$ be the corresponding, similarly measured, amounts of commodity. Let the laws of demand (not now correlated) be expressed by the equations :

$$p_1 = \tfrac{3}{8} + x - \tfrac{2}{3}x^2; \quad p_2 = \tfrac{31}{34} - \tfrac{3}{4}y + \tfrac{8}{24}y^2.$$

Let the (now correlated) cost of producing the quantities x and y, say K

$$= C + \tfrac{1}{4}x + \tfrac{1}{4}xy + \tfrac{1}{4}y$$

(where C is a coefficient representing general expenses, which, with reference to the present operations, may be treated as constant). The values of x and y for which the profit of monopoly $(xp_1 + yp_2 - K)$ is a maximum are then as they ought to be, each *unity*.

Now let the (total) cost of production be increased by an expense proportioned to the amount produced of one commodity, say the additional expense τx, where τ is small. By the method explained in a former paper it will be found that the resulting increments of x and y are approximately,

$$\Delta x = -\tfrac{12}{14}\tau,$$
$$\Delta y = +\tfrac{6}{7}\tau.$$

The corresponding increment of Customers' Benefit is

$$- \Delta p_1(x + \tfrac{1}{2}\Delta x) - \Delta p_2(y + \tfrac{1}{2}\Delta y)$$

$$= - \Delta x \frac{dp_1}{dx}(x + \tfrac{1}{2}\Delta x) - \Delta y\frac{dp_2}{dy}(y + \tfrac{1}{2}\Delta y)$$

$$= - \Delta x(1 - \tfrac{1}{3})(1 + \tfrac{1}{2}\Delta x) + \Delta y(\tfrac{3}{4} - \tfrac{5}{12})(1 + \tfrac{1}{2}\Delta y)$$

Substituting for Δx and Δy the values above found and neglecting quantities of the second order, we have for the increment of Customers' Benefit ·5τ, that is, a *positive* quantity. [A smaller (positive) value was before inaccurately given.]

More generally put for the increment of Customers' Benefit (approximately)

$$- (x\Delta p_1 + y\Delta p_2);$$

where $\Delta p_1 = \dfrac{dp_1}{dx}\Delta x$, and $\Delta p_2 = \dfrac{dp_2}{dy}\Delta y$ (there being no correlation of demand).

By reasoning of parity with that before employed (E, p. 131)

$$\Delta x = \tau\frac{d^2V}{dy^2}\Big/ D^2; \quad \Delta y = \tau\frac{d^2V}{dxdy}\Big/ D^2;$$

where V as before is the monopolist gain, D^2 is necessarily positive, $\dfrac{d^2V}{dxy} = -\dfrac{d^2K}{dxdy}$

(6) *Future interests.*—" So far we have supposed the owner
of a monopoly to fix the price of his commodity with exclusive
reference to the immediate net revenue which he can derive from
it." I use Dr. Marshall's words [1] to mark the transition to
cases in which the monopolist may alter his price " with a view
to the future development of his business." The development
of his own business by developing the business of his customers,
at a sacrifice of present to future profit, is more readily practised
by the monopolist than by the entrepreneur in a regime of com-
petition, as the monopolist has an assurance that the fruits of
his sacrifice will not be snatched by a competitor. With this
view intelligent railway managers often fix rates lower than those
which would afford maximum profit in the present. To encourage
future traffic " a railroad operating in a new territory may for a
time offer to carry freights at rates which barely cover expenses." [2]
They may even " haul materials at a loss." [3] Coal, hay, grain,
" are sometimes carried at less than the total expenses." [4] Freight
is sometimes carried at a loss to get some other freight that will
pay more.[5] The consilience between the interest of the monopolist
and his customers, which was before seen to be approximate,
seems now to be complete. There is presented an optimistic
view of *dynamical* discrimination comparable to Bishop Butler's
doctrine that rational self-love and universal benevolence are
nearly coincident in this life and completely when account is
taken of the future.

It is true, indeed, that in the words of an able writer, " traders'
and railways' interests are in the long run coincident." [6] But
the traders of whom this is true are supposed to continue cus-
tomers of the railways during the long run.[7] But the railways
prevent many traders from having a long run. In the words of
the Hepburn Commission, " in a speculative attempt to increase

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where K is the total cost of production. In order that the increment to
Customers' Benefit may be positive, $-x\frac{dp_1}{dx}\frac{d^2V}{dy^2} - y\frac{dp_2}{dy}\frac{d^2V}{dxdy} > 0$.

Whence $\left(\text{since } \frac{dp_1}{dx} \text{ and } \frac{dp_2}{dy} \text{ are both negative}\right) \frac{d^2V}{dxdy}$ must be positive. That
is, the production must be complementary (joint). *Both* prices cannot fall; since
$\frac{dp_1}{dx} < 0, \frac{dp_1}{dy} = 0, \Delta x < 0.$

[1] *Principles*, sixth ed., p. 486.
[2] Johnson and Huebner, *Railway Traffic and Rates*, Vol. II. p. 317.
[3] *Op. cit.*, p. 366.   [4] *Op. cit.*
[5] Hepburn Commission, p. 2894.   [6] ECONOMIC JOURNAL, Vol. XIX. p. 477.
[7] The inadequacy of this supposition is strikingly illustrated by Frank Norris's
story *Octopus*. But the exploitation of Dyke and other customers of the grasping
Railway involved an element of fraud not here contemplated—typical of common
cheats rather than common carriers.

business they favour one shipper at the expense of another." [1]
A witness admits to having " acted as a fostering mother " to one
customer but not so to another—" a small concern." [2] " A
railroad has the life and death of the manufacturer in his hands,"
as Professor Ripley has said; [3] and in the United States it has
exercised that power unscrupulously, has ruined some in order to
build up others. The American railway manager has fostered
or frozen-out manufacturers, has brought on or kept back cities
at his arbitrary discretion, like the ruthless agent of transporta-
tion in the nether world who, discriminating between passengers
across the Styx,

> " Nunc hos, nunc accipit illos,
> Ast alios longe submotos arcet." [4]

It is tenable, indeed, that even in Monopoly, as certainly in
Competition, *laissez faire* is less detrimental than at first sight
appears. Thus, perhaps, Professor Hugo Meyer is right when
he affirms that if railway managers had had a free hand to estab-
lish " basing points " in Australia, they would have brought about
that very decentralisation which has been vainly aimed at by
governmental regulation.[5] Perhaps he has rightly described some
evils attending unrestrained discrimination as but " growing
pains."

Postponing the difficult questions just suggested, I have to
add here one dark trait to the picture of dynamical discrimina-
tion. The immunity from vicarious suffering which was claimed
on statical grounds [6] is not equally tenable dynamically. Static-
ally, it may be unthinkable that because through traffic has
become less profitable, therefore the profit of local traffic should
be diminished by an alteration of rates. But dynamically, if
the loss of immediate profit has disturbed the balance of present
and future advantage, it is quite conceivable that local customers
who were before spared for future development should now be
sacrificed to present exigencies.

(7) *Action of competition.*—Several corrections of our provi-
sional conclusions are required by the incompleteness of our first
principle—the prevalence of perfect and perfectly self-interested
monopoly. Firstly, Monopoly is seldom perfect. In spite of agree-

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[1] Report, p. 64.   [2] *Loc. cit.*, p. 62.
[3] Report of the Industrial Commission, Vol. XIX.
[4] " Quo discrimine," on what principle of discrimination, was the natural
inquiry of an intelligent visitor; and the answer left him pondering and pitying
the victims of discrimination under their hard, not to say unjust, fate (sortem
iniquam).—*Aeneid*, Book VI.
[5] *Regulation of Railway Rates*, p. 301.   [6] Above, p. 180.

ments and consolidations,[1] railways are apt to compete for the
carriage of goods and persons, whether by the offer of lower rates
or higher accommodation. Then there is the so-called " competi-
tion of markets," [2] when the customers of different railways
compete against each other in one and the same market. Each
railway in order to preserve and increase its custom must
moderate its charges for carriage to the common market; just
as an intelligent trade union will not demand a rise of wages so
great as to make the competition of the employers in a foreign
market impossible. I must leave it to railway experts to evaluate
the extent to which these kinds of competition are effective. My
analysis resembles Mr. Asquith's Coal Bill in not having any
figures inserted. It is safe to say with Professor Johnson, " The
railways are only partial monopolies."

As some kinds of competition prevent railways from exploit-
ing their customers, so another kind of competition tends to
prevent railways from being exploited by Governments or cus-
tomers acting in combination.[3] This is the competition between
different industries for the funds of investors. In virtue of this
competition the profits of railways (and like industries [4]) tend to
be on a level with all the industries that are run by Companies.
This is certainly an appropriate conception; but to what extent
it excludes the conception of monopoly I do not feel competent to
determine. Professor Taussig has assumed, provisionally at least,
and for the sake of argument, that " a railroad's business is carried
on under the circumstances of free competition." [5] Mr. Harry
Turner Newcomb may be mentioned as having expressed the
conception with peculiar clearness.[6] It must be admitted that a
railway company is analogous to, or rather identical with, a
capitalist seeking the most profitable investment. But it is to be
remembered that the equation of profits which is deduced from
this Ricardian principle is true only over " long periods." But
there is reason to think that in concerns of such magnitude as
railways the relatively " short period " is absolutely long. It is

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[1] The degree of unification prevailing between American railways is well shown
in the fifth chapter of Emory Johnson's *American Railway Transportation*.

[2] Johnson, *op. cit.*, p. 65. W. Z. Ripley, " Local Discrimination," *Quarterly
Journal of Economics*, Vol. XXIII. p. 489 *et passim*.

[3] There is latterly much complaint that manufacturers, combined in the form
of " trusts," impose hard terms on carriers.

[4] It is hoped that the reader of these pages will throughout retain in his
memory what was stated at the outset (ECONOMIC JOURNAL, Vol. XXI. p. 346) that
" railways " are here used as typical of the larger class of industries which have
been described as " public works."

[5] *Quarterly Journal of Economics*, 1891, reprinted in Ripley's *Railway Problems*
(p. 146).　　　　　[6] *Railway Economics*, pp. 75, 78 *et passim*.

safe to say with Mr. Maurice Clark, " In the case of railroads, whatever may be the ultimate tendencies, there is undoubtedly over long periods a wide divorcing, not only of unit price from unit cost, but also of total return from total cost." [1] During the continuance of that divorce the theory of monopoly which has been propounded is applicable.

To the extent to which the Ricardian conception of normal profits in the long run is appropriate, no exception can be taken to dicta above cited [2] purporting that a loss by a rate at one point tends to be recouped by a rise in rates at other points. This is, indeed, Ricardo's central doctrine that capitalists finding profits below the natural level back out of an industry in such wise that, supply being contracted, prices rise and the diminished numbers in the business thereby obtain adequate profits. How far this theory is from the facts of the railway business *judicent peritiores*. It may be remarked that the doctrine of recoupment comes with more grace from an author like Mr. Pratt,[3] who demands independence for the railways, than from those who demand that railways should be regulated, as being monopolies, with respect to actions which presuppose competition.[4]

The qualification of monopoly by competition is, as we have seen, not an unmixed advantage. Not only are certain benefits of discrimination likely to be impaired, but also certain immunities from the pressure * of raised cost. But these benefits may

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[1] *Standards of Reasonableness.*   [2] Above, p. 180, *et seq.*   [3] *Loc. cit.*

[4] The dicta of the Inter-State Commerce Commission in this matter of recoupment are not entirely, I think, defensible upon the grounds explained in Subsection 6, above.

* The immunities here ascribed to monopoly are of two kinds. Firstly, when the raised cost which we may designate as a tax is very small, it is probable that the monopolist will not raise the price at all, the gain thereby obtainable not compensating for the trouble to himself and the disturbance to his market which the readjustment of price would occasion (*cp*. S. II. 350 and ECONOMIC JOURNAL, 1922, p. 439). Secondly, if he does raise the price to the point of maximum advantage, the rise will probably be less than what it would be in a regime of competition. For let the equation connecting x the amount demanded with p the price be $x = F(p)$. Then if a tax of τ per unit of commodity is imposed, we have for Δp the consequent rise of price

$$\Delta p \frac{d^2}{dp^2} pF(p) = \tau F'(p)$$

$$\Delta p = \tau\, F'(p)/(2F'(p)) + F''(p)$$

$$= \tau\, \tfrac{1}{2} \frac{1}{1 + \tfrac{1}{2} F''(p)/F'(p)}.$$

In our ignorance of the sign of $F''(p)$, whether the demand-curve is concave or convex (while we know that $F'(p)$ is always negative), we are justified in assuming that Δp hovers about $\tfrac{1}{2}\tau$. It is therefore probably less than τ, what it would have been in the regime of competition. Of course Δp *may* be greater than τ, as Cournot has pointed out.

well be insignificant in comparison with the advantage attending
the limitation of the monopolist's power to exploit his customers.
The reader may be assisted in apprehending the nature of the
limitation and the extent of the advantage by a reference to
another paper.[1] The conceptions there introduced seem appro-
priate to the position of one who enjoys a monopolistic power
of discrimination, but is deterred from using it unreservedly by
the prospect of competition. He may be regarded as aiming at
his own maximum profit *subject to the condition*, that his cus-
tomers obtain a certain amount of benefit, namely, as much as,
or perhaps a little more than, his competitors may offer. From
this point of view we may discern more clearly than is usual the
transition from the bad sense of the phrase " charging what the
traffic will bear," to the good sense, sometimes awkwardly
enough described as " not charging what the traffic will not bear."
The entrepreneur in both cases discriminates prices and adjusts all
manner of complicated variables to the end of securing maximum
profit; but the maximum is in the one case absolute, and in the
other case subject to a condition which the variables must fulfil.

To secure this beneficial result a small leaven of competition
will suffice; for a reason that has been already explained, and
that will be referred to again in connection with the following
second limitation of the abstract theory.

(7) *Altruistic motives.*—The *second* modification of the
originally assumed self-interested monopoly relates to the
adjective. " Here and there better motives than egoism rule,"
as Professor Cohn witnesses in the context of the passage which
we cited as affirming the prevalence of self-interest.[2] So Pro-
fessors Johnson and Huebner, after defining the " main pur-
pose " of railway managers to be that which we have so far
assumed, added :—

" It would be as unjust as inaccurate to say that philanthropical
and social motives are not also influential." [3]

More explicitly they observe :—

" The railway official . . . may no longer, nor does he, con-
sider himself merely as the officer of a private business corporation.
He realises that he holds a dual position as the servant of a
corporation and as the manager of a public service." [4]

To the same effect the vigorous railway-president, E. P.
Ripley, who certainly has not been influenced by any bias in
favour of governmental regulation :—

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[1] ζ, II. 407, *et seq.* As to the position of the partial monopolist, *cp.* S, II. 97.
[2] Above, p. 173.   [3] In the context of the passage quoted above, p. 173.
[4] *Op. cit.* p. 76.

" It is needful . . . that railway managers shall see and frankly concede that they are quasi-public servants, owing a different and a higher duty to the public than almost any other business men." [1]

When asked, in the course of his examination by the Inter-State Commerce Commission, whether he would increase a discriminating rate to any extent, provided it were profitable, say by 200 per cent., he replied :—

" The advance would be too great of itself. It would be too great a shock to my sense of propriety—a shock to my sense of justice." [2]

Doubtless in the case of companies as of individuals, it is difficult to disentangle altruistic from egoistic motives. It is sufficiently accurate to say, with the wise Albert Fink :—

" Enlightened self-interest " [dictates the exercise of power] " reasonably and in a spirit of liberality." [3]

There is also to be noticed the regard for public opinion which comes to much the same practically as regard for public welfare. Among many symptoms may be mentioned the importance attached by railway men to the proportion between profits and capitalisation. Theoretically, a Railway Company is concerned to maximise the absolute amount of profits in the present (and future) without reference to the amount of capital invested in the past. Theoretically there is nothing paradoxical about President E. P. Ripley's trenchant dictum that the making of freight " has not, never did have, never ought to have any relation to the capitalisation of railroads." [4] But the opinion of the public, and, accordingly, the practice of the railways, is different.[5]

So far as altruistic motives act the doctrine of recoupment above noticed is less open to criticism. If a railway from motives of liberality has refrained from charging all that some parts of the traffic will bear, it is intelligible that when straitened at other points the Management should retract its liberality. As Mr. Pratt says, " when a railway company gets an inadequate return from one department, it is much less likely to make generous concessions in another." [6]

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[1] " The Railroads and the People," *Atlantic Monthly*, Jan. 1911.

[2] *Report*, 3500, p. 351.

[3] Hepburn Commission, Vol. V. *Exhibits*, p. 87.

[4] Quoted with disapproval by the Inter-State Commerce Commission Report, 3500, p. 349.

[5] On this controversial topic Johnson and Huebner express themselves with their usual moderation.

[6] See the context of the passage cited above.

The altruistic motive need not be strong in order to be effective. An " exiguum clinamen " [1] from the direction of egoistic purpose may result in a considerable benefit to the customers. For by the theory of maxima a small decrement of profit from its maximum is apt to be attended with relatively large changes in variables connected therewith, in particular Customers' Benefit.[2]

Other corrections besides the two main ones that have now been indicated are required to adapt the rigid outline of abstract theory to human life. But these may be deferred.

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[1] *Lucretius*, Book II.   [2] *See* ζ, p. 407 *et seq.*, and Index, s.v. *Maximum.*