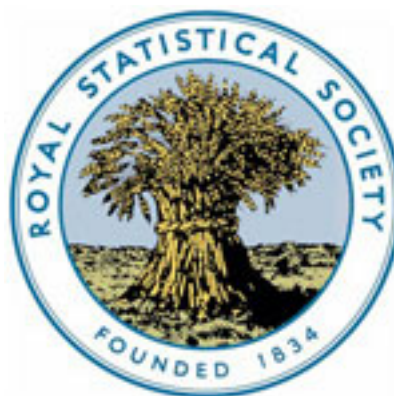The Effect of Trade Fluctuations Upon Profits
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THE EFFECT OF TRADE FLUCTUATIONS UPON PROFITS.
By J. C. STAMP, C.B.E., D.Sc.

[Read before the Royal Statistical Society, May 14, 1918,
the President, Sir BERNARD MALLET, K.C.B., in the Chair.]

CONTENTS :

1. IN his *Science et Hypothèse*, M. Henri Poincaré remarks that it is " far better to predict without certainty than never to have " predicted at all. We should never disdain to verify when " opportunity presents itself. But every experiment is long and " difficult, and the labourers are few, the number of facts which we " require to predict is enormous, and besides this mass the number " of direct verifications that we can make will never be more than a " negligible quantity. Of this little that we can directly attain we " must choose the best."

Some years ago there presented itself to me the practical problem of estimating from any available indications what the current

amount of profits—that is, the profits of any particular time through which we might be passing—would prove to be, compared with previous years. This had to be done when no considerable body of completed and published accounts could be used. I soon found that while there was much literature on economic cycles and crises, on the correlation between different measures of trade prosperity and vital or social statistics, there was nothing which connected the trade movements with their trade *results*, and no indication as to their relative degrees of profitability. With all the recent mass of writing on trade cycles,[1] and the skilful production of " business barometers," there is little to show us, from the most accurately adjusted barometer and skilled reading of its movements, what precisely is the " change " in the weather " that may be expected to follow or accompany its indications. The reason is not far to seek. While we have various partial measures of trade changes, continuously and regularly kept, it is difficult to get any aggregation of profit, made up on a sufficiently uniform plan, to correspond thereto. If we select a given group of businesses, of which we know the profits, it is almost impossible to get uniform details of their total trade ; moreover, the group is probably too small for us to be confident that individual idiosyncrasies will have cancelled each other, and it is not easy to keep a complete series for a sufficient number of years to secure that the cycles of trade shall be fully represented. In short, there are very formidable difficulties in the way of making a proper comparison between profits and trade statistics.

In our pre-war experience when monthly statistics of foreign trade were quoted, or the bankers' clearing-house figures were referred to, all kinds of inferences were drawn for and against the political features of the day. If the " returns " were up by 10 per cent. on the previous year, it was held to be something for jubilation, if they were down, perhaps the tariff controversy took on a new twist. But we do not do increased trade for its own sake—we do it because we hope for increased profits. And there was always the assumption that the up and down movement of trade connoted a related degree of altered " profit " prosperity. (There was the further ethical or teleological assumption, I suppose, that if we all made more profits, then we were all so much happier and better off.) But in many of our minds, as we looked at the figures, there were

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[1] Among others Juglar, *Des Crises Commerciales ;* Professor Aftalion, *Les Crises périodiques de surproduction ;* Jones, *Economic Crises ;* H. L. Moore's *Economic Cycles,* and notably D. H. Robertson's *Study of Industrial Fluctuations* (P. S. King and Son), 1915, which is invaluable on the phases of the subject with which it deals.

misgivings and unsettled questions : what would the increase be like if the natural growth of population were taken into account, and how far was it a *real* increase in output of commodities, as distinct from an increase due to higher " prices " for the old quantity of goods ?   If a given measure of trade has risen, say from 100*l.* to 120*l.*, and we rejoice in a rise of 20 per cent., it may be either that 120 units have been sold instead of 100, at a regular price of 1*l.*, or that 100 units have been sold at a price of 1*l.* 4*s.* each instead of 1*l.*, or the result may be a combination of both changed quantity and changed price ; it may even be that one factor has actually *diminished*, but that its effect is more than offset by the increase in the other. What is the actual or probable change in profit that accompanies such a change of 20 per cent., according to the cause of the change ?   Will a like change accompany a second, or third ensuing rise of 20 per cent. ?   Will the relations found to exist for increases hold also for decreases, or what difference may we expect ?   These are all questions to which we should like answers, and they suggest many more.   For trade in general it may be said that our notions about the relative influence of quantity and price upon profits are very theoretical and abstract, and I have proposed to direct myself to some preliminary investigation of the actualities so far as the United Kingdom is concerned.   I have found business men quite ready to answer these questions, but their views are so special or local in point of time and place, and so frequently cancel each other out, that they are almost useless as a basis of general statements.   " Practical " business men will generalise and theorise with a fearlessness and freedom from restraint that any " abstract " professor might envy, but would certainly not imitate.   More particularly is it impossible to obtain from them a clear idea of *net* effects to the whole community as distinct from particular results in single industries.

2. In my earlier efforts I was mainly concerned to find which set of industrial statistics moved most closely in relation with the profits represented by the assessments to Income Tax under Schedule D, both as to actual correlation and as to the degree or percentage of variation year by year.   For this purpose I took the official records of those assessments from the 'seventies, and patched up some awkward breaks or faults in the series, due to changes in taxation law and conditions, sufficiently well to get broad results.   The necessity for thoroughly probing those figures before I could feel comfortable in using them in such problems was one of the things that led me to spend three or four years in the work of exploring, bridging, and preparing for the statistician the chief series of statistics relating to Income Tax, &c., the results of which were

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published under the title " *British Incomes and Property.*"[1]   I shall perhaps be pardoned, therefore, if I take the stages reached in that book for granted, and if I make numerous references thereto in the interests of brevity and, in effect, treat it as part of this paper.   I have no reason whatever to complain of my critics, who have, indeed, been sufficiently generous, but from several widely separated quarters the note was touched, that I might well have advanced my work to its more complete application in current problems—which was really a criticism that I had written one book instead of four !   However, I now offer this sketch as a contribution to such a task.

Broadly speaking, the first result that I reached was on the following lines.   Setting out the Schedule D assessments upon profits, which as a whole for any given year represent the average of the profits of the three preceding years, the percentage increase or decrease of each year's assessments compared with those of the preceding year was ascertained from 1879.   The statistics of railway tonnage, railway receipts, bankers' clearing house, and foreign trade, were then each arranged in triennial averages to correspond, and the annual percentage change for each series was ascertained.   Thus the Schedule D assessments for 1900–01 amounted to 466·19 million £, and for 1901–02 to 487·73 million £, or an increase of 4·62 per cent. The average of the imports for 1897–98–99 was 468·82 million £, and the average for 1898–99–1900 was 492·83 million £—an increase of 5·12 per cent.   Similarly special exports (exports of products of the United Kingdom) showed 5·43 per cent., total foreign trade 5·34 per cent., railway tonnage 4·33 per cent., railway receipts 3·79 per cent., and bank clearings 5·93 per cent.   If, therefore, a forecast of the increase in Schedule D assessments had been made, based on these different series of statistics as indicative of the course of profits, it would have been erroneous to the following extent :—

On imports	....	....	....	·5 per cent. too high.	
On special exports		....	....	·81	,,	,,
On total foreign trade	....	....	·72	,,	,,
On railway tonnage	....	....	·29	,,	low
On railway receipts	....	....	·83	,,	,,
On bank clearings		....	....	1·31	,,	high.

Computing this " error " for each of the thirty years, it was found to average as follows (without regard to its plus or minus character) :—

	Per cent.			Per cent.
Imports	2·37	Railway tonnage	1·81
Special exports	3·40	Railway receipts	2·35
Total foreign trade	2·59	Bank clearings	2·41

[1] *British Incomes and Property : the Application of Official Statistics to Economic Problems*, 534 pp., P. S. King and Son, Ltd., 1916.   Referred to hereafter in the text as " *British Incomes.*"

In the case of the railway tonnage, the error over the last twelve years only was ·8 per cent. The most accurate measure for the whole period was found to be the mean of the figures for railway tonnage and bank clearings, which gave an average error of 1·7 per cent.
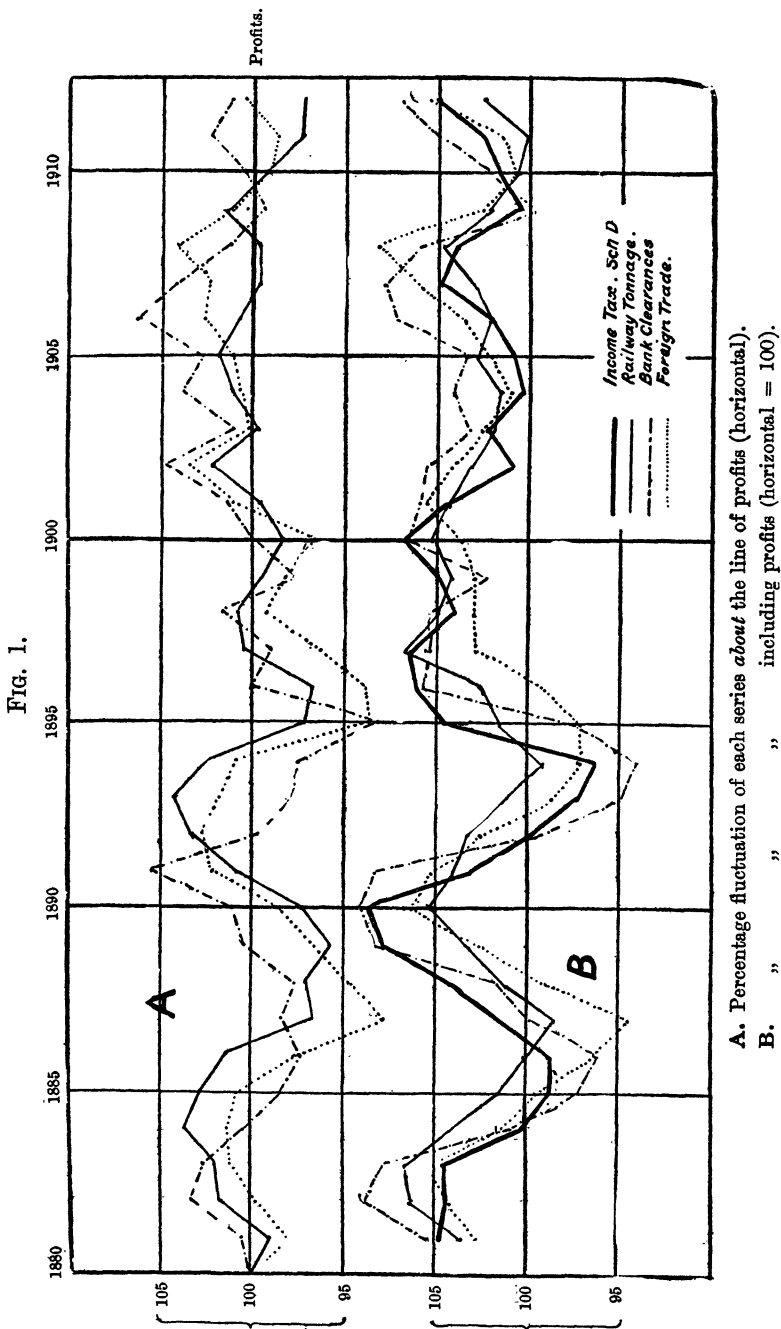
Fig. 1 (B) shows the deviations of four of the series from a straight line, which represents 100 per cent. (or an unchanged figure annually) so that any increase on a preceding year is shown above the line. " A " gives the same set of figures, except that the series fluctuates about the line of increase of profits as though it had been uniform.

I worked out certain co-efficients of correlation to which I will refer later on, but did not then pursue the matter further. I have, however, recently applied to the problems involved a wider range of statistical method and analysis in order to see whether answers can be obtained to any of the unsettled questions to which I have referred. Space will not permit of more than a selection from the various tests I have used, and present economies altogether preclude the repetition of long series of relevant statistics or correlation tables, interesting though they may be. If the statistics are available elsewhere they are not repeated here. I have, for similar reasons, almost entirely abstained from comments on the theory of fluctuations and from assigning reasons for the results obtained.

As there will probably be twelve persons interested in the problems generally, for every one person to whom statistical and technical terminology bears any significance, I shall devote the greater part of my space to the statement of results in broad general terms and percentage expressions. There will be but a plain statement of the statistical constants, coefficients, etc., the full bearing of which will probably be sufficiently obvious to those to whom they carry meaning, without extended comment. In view of the different preferences that statisticians have in this field of their activities, I have endeavoured to take as many points of view as possible, in order to satisfy each line of thought, and also so that it may be seen whether similar results emerge from various tests.

3. It is obvious that the question of the methods employed to test relationship is very important. I have not troubled to correlate the annual items in each series, because the high co-efficients that result include the spurious correlation from the common increase due to the common cause (*e.g.*, growth in population).

Correlation of deviations from the moving average.—This recognised method has been used in most cases, but, of course, when the series of years is not a long one, it is wasteful of material at both ends,

FIG. 1.

A. Percentage fluctuation of each series *about* the line of profits (horizontal).
B.   ,,   ,,   including profits (horizontal = 100).

Income Tax. Sch D
Railway Tonnage.
Bank Clearances.
Foreign Trade.

Profits.

and limits the value of the co-efficient because of the small number of items.

Correlation of variate differences.—Recent developments in this method have raised high expectations as to its value in this class of investigation.[1] It has just been subjected to a very close scrutiny in a masterly paper by Professor Warren Persons, " On the Variate " Difference Correlation Method and Curve-Fitting,"[2] and he has clearly shown that it contains certain inherent defects. He concludes as follows : " The method involves the assumption that the " taking of multiple differences leads to series of random variates. " In practice for short series this assumption is not fulfilled. Co- " efficients for higher differences of short series tend to alternate " in sign and to conceal rather than to reveal the nature of the " correlation between the series being tested." I have employed the method freely, but am bound to say that I have seen nothing to indicate that it is an improvement upon the other methods.

Correlation of deviations from the linear secular trend.—It is usually found that a linear trend can properly be " fitted " to these series of statistics. This trend, fitted by the method of least squares, gives an excellent point from which to measure deviations, and in my judgment is superior to the moving average in almost all respects. Professor Persons comes to the conclusion that these correlation co-efficients, together with the co-efficient for first differences, " constitute a reliable basis for judgment." He considers that " co-efficients of correlation between second differences may give " information concerning minor oscillations as distinct from secular " trend and major cycles." Even for this purpose the use of higher " than second differences appears to be unreliable, especially so for " short series." He has further demonstrated that co-efficients between second differences are identical with those between deviations from three-year progressive averages. So far as I know this is the first application that has been made of the method to this class of statistics in this country.

In a few cases, where one series has a cyclical or pseudo-cyclical fluctuation, and the other (such as price level) has no such periodical wave, I have used a method of my own, viz., the correlation between the first differences of one series, after eliminating the linear secular trend, with the first differences of the other. I have also made a sparing use of the multiple correlation formula. It will be seen, therefore, that I have attempted to apply the simpler methods of statistical analysis to very intractable material in order to register a few facts

[1] *Biometrika*, April, 1914 ; November, 1914.
[2] *Quarterly Publications of the American Statistical Association*, June, 1917.

in a region hitherto occupied by unexamined assumptions and generalities.

There is no doubt that the application of these methods to statistics of this character is difficult and not without a fair amount of risk. There are some, indeed, who would deny that they have any valid application at all, on the ground that the human volitional element enters so largely into the questions of rise and fall in trade activity and into profit making, that the phenomena under investigation are quite unlike those which vary on a physical or biological basis. But my answer to this is that if the statistics relate to businesses as a whole and not merely to small groups of selected cases, we are simply postulating the normal measure of hedonic impulse, the normal psychological reaction to the prospect of rising or falling prices, existing in a given nation at a given epoch, just as if they were physical constants, the larger effects of which are not subjective at all, but quantitative and quite susceptible of broad statistical treatment. Moreover, we are not trying so much to establish causal relation, as to find, amid a mass of difficult and confusing facts, evidence of the existence and extent of concomitant variation. If we found that x units of change in profits has, in fact, accompanied y units of change in prices or z units of change in quantities, and we then proceed to *expect* that relation to hold good in the future, we could state our " law " only as a purely empirical one, like Pareto's formula for the distribution of incomes. Of course it is quite possible to formulate the conditions under which almost any combination of such related functions may be found, and even to find the businesses which exhibit those conditions. Business A may inevitably show a decrease in the rate of profits upon an increase of output, while business B shows the reverse—indeed, one and the same business working at different pressures in comparison with its normal or natural output may successively be working under conditions of increasing, constant or decreasing returns. When times are slack and the machines are half used, overhead charges are distributed over a small output, and every additional unit of product gives a more than proportional rate of profit; while, at the other extreme, when the business is pressed beyond its true capacity, the cost of making room for additional plant, the higher rates for overtime, the breakdown of effective supervision and the costs arising from general congestion, may make the extra profit gained per unit less and less to the point where the profit per unit vanishes. What we ask is, Where does British business as a *whole* stand, in regard to the connection between profits and fluctuating trade ?

4. The inherent difficulties of the subject are made worse by the complexities of statistics of " profits." I have shown (*British Incomes*, Chap. VI.) that the income tax test secures homogeneity and constancy—a uniformity both in space and time. But unfortunately the assessments are mostly expressed as successive three-year or five-year averages. We have then two courses possible : (1) to resolve those averages into the actual profits of separate years, or (2) to throw all the other series that are to be compared with the profits series into a like set of successive averages. Now the first course is, I believe, mathematically impossible unless we can get a clear start with one definite year, when it becomes theoretically quite easy, for, apart from the annual trend, the difference between the two successive triennial averages is the difference between the first and the fourth year divided by three. But that single clear year is unattainable. I. have, however, devised a means for getting a close approximation to a part of the true series, and I will refer to it later. For the moment let it be assumed that the second is the only available course. Throwing all the figures into three-year averages, and then treating those results as unrelated successive items in an historical series, means that the sharp edges of comparison are rubbed off at the very beginning, and that some unknown statistical perils may lurk beneath all our tests. Nevertheless, we must make the best and most of it and proceed. I have shown that on an evenly falling or rising curve the Schedule D assessments for a year, say 1908/9 (April 6, 1908, to April 5, 1909), would approximate to the actual profits of the year to June, 1907 (*British Incomes*, p. 178), so that if we were sure these conditions of uniform change existed our series might be taken to be an ordinary historical series of which each item was slightly prior in actual time to the label it bore. But the assumption is unwarranted. Further difficulties in regard to the material under investigation will be referred to in the appropriate place.

5. *Coal Mining.*

For simplicity in introducing the several methods, the profits of business as a whole will not be considered until after those of the coal mining industry.

Owing to a happy accident of legal classification in the earliest Income Tax systems, we have always had the statistics of assessment on mines shown separately. The complete and corrected series is only to be found in *British Incomes* (p. 220) and it is used here. The basis of assessment is the average of the five years preceding the year of assessment, and the figures include the assess-

ment on the profits of *all* mines in the United Kingdom, and not merely coal mines. For the purpose of watching *fluctuations*, I am satisfied that the series does not differ materially from what the coal mines alone would show, for (*a*) " other mines " form so very small a proportion of the whole, that the profits would have to fluctuate in a widely different way from coal mining profits seriously to affect the total figures as an index to coal only, and, moreover, we have (*b*) an occasional glimpse of the profits of " other mines " as a separate class (*British Incomes*, p. 223) and find that the proportion to the whole is practically constant. We have the annual output of coal given for fifty years, the " receipts " also for a similar period, with one complete break in the series, and the " price per ton " on a uniform basis unbroken for thirty years, all from the Home Office Reports.

FIG. 2.—*Coal profits* 1871-1913 (*five-year averages*).
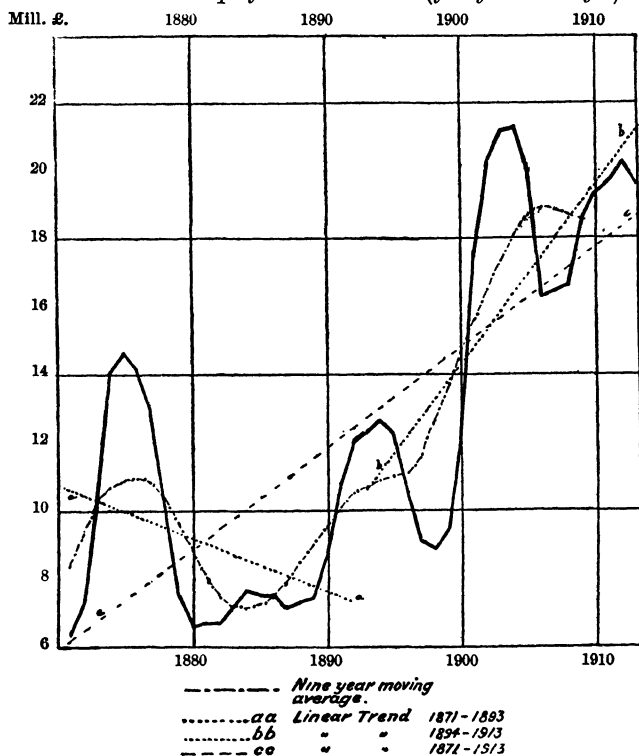
Throwing these series into five-year averages, a comparison may be instituted. The course of profits is shown in Fig. 2, together with the nine years moving average, and the linear secular trend. The following are some statistical results:—

Deviations about the moving average. Tonnage (x) and Profits (y)

$\sigma_x = 2\cdot29$ (millions of tons) $\left.\right\}$ for thirty-nine years.
$\sigma_y = 2\cdot187$ (millions of £)...

$r = \cdot63 \pm \cdot06$

(or, divided into periods) ·56 for first twenty-three year period,
·68 for second sixteen year period.

But if profits are lagged forward a year, we get

$$r = \cdot4$$

or   ·68 on the first twenty-three years,
and   ·22 on the second thirteen years.

Why should putting the 1870 profits against the 1871 tonnage and so on continuously, give such a markedly superior co-efficient ?

A lag in the opposite direction showing that changes in output did not make their presence felt in changes in profits instantly would have been comprehensible, but what possible connection could there be between the profits of one year and the trade activities of the next following year ?

A search for the cause of this peculiarity soon resulted in a complete and convincing explanation—a not uninteresting example of Mill's " Method of Residues." It consists in a certain statutory provision for special relief in Income Tax assessments when there is a sequence of diminishing profits, known as the " 133rd Section " which I was fully aware of, but had not hitherto considered in its statistical connections. It has the effect of partly advancing the profits a year, *i.e.*, the assessments recorded for 1873 would approximate actually to those for 1874, and those for 1874 to 1875 and so on. As the point is rather technical I have explained it in detail at the end of this paper (Appendix) together with other technical points relating to the assessment of mining profits. Suffice it to say that its discovery led to the solution of several difficulties in other directions that previously were given up as hopeless. We are justified in regarding the co-efficient here as ·68 *throughout* the thirty-nine years, because it is necessary to take the lag forward in the major part of the first twenty-three years (during which the xy series is wholly positive) but not at all in the subsequent period.

Variate differences.—Tonnage and Profits.

First differences (lagging profits during first twenty-three years)
$r = \cdot52 \pm \cdot07$.

Second differences (not materially different with the lag)
$r = \cdot42 \pm \cdot08$.

Prices and profits (1887 to 1913).

First differences : $\sigma_x = 4\cdot7d$, $\sigma_y = 1\cdot67$ million £, $r = \cdot84 \pm \cdot038$.
Second differences : $\sigma_x = 3\cdot9d$, $\sigma_y = 1\cdot54$ million £, $r = \cdot81 \pm \cdot039$.

Deviations from the linear secular trend.

Trend of profits :   1871 to 1891, *aa* in Fig. 2. $y = 10\text{·}58 - 1\text{·}58t$.
(Origin at 1871.)

1893 to 1913, *bb* in Fig. 2. $y = 10\text{·}62 + 5\text{·}3t$.
(Origin at 1893.)

Whole period :   1871 to 1913, *cc* in Fig. 2. $y = 6\text{·}3 + 3\text{·}07t$.
(Origin at 1871.)

Trend of prices :   1893 to 1913 (in pence). $y = 83\text{·}8 + 1\text{·}06t$.
(Origin at 1893.)

Coefficient for *deviations*, 1893 to 1913 :—

Profits : $\sigma_1 = 2\text{·}806$ (million £).
Prices : $\sigma_2 = \text{·}71$ (pence).
$r = \text{·}89 \pm \text{·}03$.

The ratio of variation (approx.) : ·4.   (The term is used for the ratio borne by one set of deviations—expressed as percentages of the items of the series—to the other set, viz., the deviations in the profits series, the latter being treated as unity.)

General conclusions from the foregoing results.

When the annual tonnage output of coal is thrown into the form of a series of five-year averages, the series is a steadily rising one, and the separate items vary from a " trend " of the items by only a small deviation.   The annual average *prices* of coal (which are known accurately only from 1882) fluctuate much more than tonnage.   The assessments upon profits (already actually in five-year averages of annual profits) have deviated from their trend *much* more violently than the tonnage statistics, and considerably more than prices—approximately two and a half times as much in fact.

Apart from the *degree* of deviation, the *correspondence* of deviation in the case of tonnage compared with profits is close—profits have generally increased more than the average where tonnage has increased more than the average, and decreased similarly.   But the effect is of course mixed up with increases and decreases in price. In the comparison of price-changes with profit-changes the correspondence is found by all tests to be very close indeed.

I can well understand, however, that people will ordinarily be reluctant to accept results based wholly upon a comparison of fluctuating results which are thrown into *averages*, and thus necessarily robbed of their sharpness and clearness.   It may be thought that the comparison of the results of the years themselves would lead to a substantially different conclusion, and considerable attention has accordingly been devoted to the problem of " unravelling " the averages in the assessments of profits.   There is no method of ascer-

taining the *actual* aggregate profits for any given year which enter into those averages. But if by observation of a collection of results (such as those given in the *Economist* quarterly articles) one can get a large unbiassed group of actual instances of colliery profits for a sequence of five years, one is in a position to ascertain the approximate assessment for the next ensuing financial year, on that group as a whole.

For example, let it be assumed we know the *actual* annual profits of a large group of collieries for the five years 1902 to 1906, then we are in a position to give the assessment for 1907–08 on the group :—

				£	
1902	....	....	....	6,000,000	⎫
1903	....	....	....	5,000,000	⎬ Average 7,000,000*l.* for
1904	....	....	....	7,000,000	⎪ 1907–08 tax year.
1905	....	....	....	8,000,000	⎪
1906	....	....	....	9,000,000	⎭

If the actual aggregate assessment is 21,000,000*l.*, we may assume the aggregate profits of each of the years 1902–06 to be in the same proportion to those in the group, *i.e.*, 18,000,000*l.* for 1902 and so on.

Over a period of years I have made a number of such observations, and so by applying this method where possible I have a set of figures —in some years several different values for one year, closely approximating, and in other years no results. Where there are gaps, the later five-year averages may be unravelled backwards with the aid of the above values, the earlier averages unravelled forwards, and where the two results meet, they must of course agree. In the result I go back to 1888 or two years earlier than my earliest actual sample figure (which is as far as I care to go without the risk of a fair margin of error by the process of " unravelling " alone) and can confidently assert that the series cannot be far removed from the truth. For it satisfies very severe tests :—

(1) It fits all the sample results.

(2) It fits the recorded series of assessments throughout.

(3) It answers to the " 133rd section " test, where that applies.

For comparative purposes, the series is reduced to an index number (100 = average of 1896 to 1905) and the other colliery statistics for single years are similarly tabulated (Table I). This makes the lines in Fig. 3 quite comparable. In that graphical presentation, the secular linear trends are also given, and the equations for the trends are:

Profits : $y = 71 \cdot 80 + 3 \cdot 35t$.
Tonnage : $y = 76 \cdot 38 + 2 \cdot 14t$.
Prices : $y = 87 \cdot 9 + 1 \cdot 2t$.
Receipts : $y = 64 \cdot 3 + 3 \cdot 4t$.
(All origins at 1889.)

TABLE I.—*Coal statistics.*

Year.	Quantity. Million tons.	Values. Million £.	Price in pence.	Profits. Million £.	Index numbers: 100 = average of 1896 to 1905.							
					Quantity.	Difference.	Receipts.	Difference.	Price.	Difference.	Profits.	Difference.
1888	169·9	43·0	61	7·1*	77·5	…	51	…	67	…	47*	…
1889	176·9	56·2	76	12·4*	81	3·5	67	16	83·5	16·5	82*	35
1890	181·6	75·0	99	16·6	83	2	89·5	22·5	109	25·5	110	28
1891	185·5	74·1	96	14·4	85	2	88·5	−1	105·5	−3·5	96	−14
1892	181·8	66·0	87	11·0	83	−2	79	−9·5	95·5	−10	73	−23
1893	164·3	55·8	81·5	9·1	75	−8	67	−12	89·5	−6	60·5	−12·5
1894	188·3	63·7	79·5	10·4	86	11	75	8	87·5	−2	69	8·5
1895	189·7	57·2	72·5	7·6	87	1	68	−7	80	−7·5	50·5	−18·5
1896	195·4	57·2	70	7·7	89	2	68	0	77	−3	51	·5
1897	202·1	59·7	71	8·9	92	3	71·5	+3·5	78	+1	59	8
1898	202·1	64·2	76	12·4	92	0	76·5	5	83·5	5·5	82·5	23·5
1899	220·1	83·5	91	22·9	100·5	8·5	100	23·5	100	16·5	152	69·5
1900	225·2	121·7	130	35·6	103	2·5	145	45	143	43	236	84·0
1901	219·0	102·5	112	25·2	100	−3	122	−23	123	−20	167	−69
1902	227·1	93·5	99	16·9	104	4	112	−10	109	−14	112	−55
1903	230·3	88·2	92	14·4	105	1	105·5	−6·5	101	−8	96	−16
1904	232·4	83·9	86·5	12·8	106	1	100	−5·5	95	−6	85	−11
1905	236·1	82·0	83	13·0	108	2	98	−2	91	−4	86·5	1·5
1906	251·1	91·5	87·5	16·6	115	7	109·5	11·5	96	5	110	23·5
1907	267·8	120·5	108	26·4	122	7	143·5	34	118·5	22·5	175	65
1908	261·5	116·6	107	24·5	119·5	−2·5	139	−4·5	117·5	−1	163	−12
1909	263·8	106·3	97	16·1	120·5	1	127	−12	106·5	−11	107	−56
1910	264·4	108·4	98·5	17·2	120·7	0	129·5	2·5	108	1·5	114	7
1911	271·9	110·8	98	16·6	124	3·3	131·5	2	107·5	−0·5	110	−4
1912	260·4	117·9	109	22·9	119	−5	141	9·5	120	12·5	152	42
1913	287·4	145·5	121·5	30·4	131	12	174	33	133·5	13·5	202	50
1914	265·7	132·6	120	23·2	121·5	−9·5	158·5	−15·5	132	−1·5	154	−48
1915	253·2	157·8	149·5	29·6	115·5	−6	189	+30·5	164	32	196·5	42·5

* Or less.

FIG. 3.—*Coal mining*, 1888–1915.
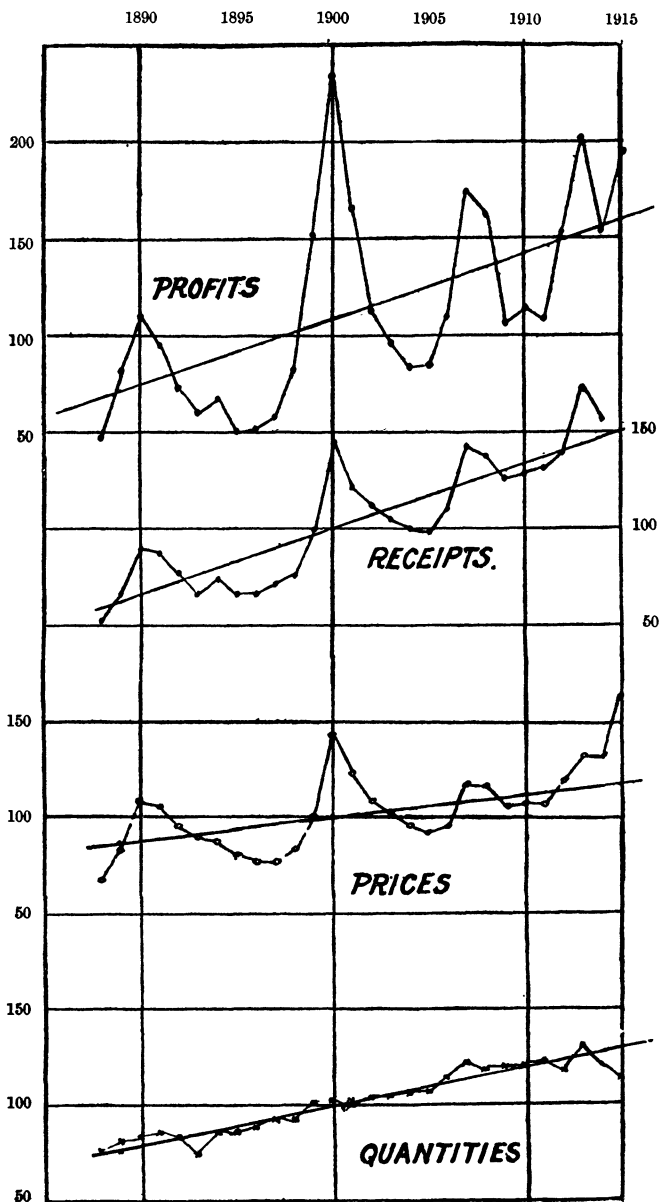
The statistical constants are :—

$$\text{Profits}: \quad \sigma = 40\cdot73.$$
$$\text{Tonnage}: \quad \sigma = 3\cdot67.$$
$$\text{Prices}: \quad \sigma = 14\cdot55.$$
$$\text{Receipts}: \quad \sigma = 16\cdot48.$$

Profits and tonnage : $r = \cdot50 \pm \cdot1$.

Profits and prices : $r = \cdot89 \pm \cdot026$.

Profits and receipts : $r = \cdot92 \pm \cdot02$.

In the case of profits and prices the coefficient of variation is approximately ·38. It will be observed that these coefficients agree closely with those obtained from the five-year averages (linear trend), viz. : ·89 ± ·03 for profits and prices, with variation ·4, and would lend support to the view that the former series would be authentic for a single-year series.

In order that the results may be intelligible to the non-statistical reader, let me endeavour, by studying Table I, to express them in general terms.

As the resultant effect of two forces, sometimes moving together, sometimes against each other, are shown, we have a series of rough equations. Analysis of the details gives the following results :—

(a) Looking first at the years in which there is a negligible change in *quantity*, the whole change in profits may be taken to be due to change in price, and from this it appears that for a change in price represented by one point, profits change three and a third points. This result is on the whole the most satisfactory with the years taken together, but from it one judges that if the quantity changes by one point, the profits will change by rather more than unity. It does not appear possible that the profit-change per unit of quantity change can be *greater* than 1·5.

(b) Taking the years in which there were *increases* in profits (compared with year preceding) and dividing them into two groups : (1) small changes (less than 30 points) ; and (2) large changes (more than 30 points), and using 1·5 as the common factor to eliminate the effect of the quantity change, we find that the group (1) gives a profit-change of 2·5 per unit of price change, and the large-change group (2) gives 2·7 ; or 2·57 for all increases.

(c) Taking in the same way the years when there were *decreases* in profits, it is found that the smaller changes give 3·7, and the larger 4·1 ; or 3·8 for all decreases.

(d) From this it would appear that a rise in prices has had rather less effect in raising profits than a fall in prices has had in diminishing profits, and also that where the rise or fall has been large, the change in profits has tended to be greater in proportion than it was for a small rise or fall.

(*e*) Where a year of rising profit is followed by another rise (or a year of fall is followed by another fall) the succeeding year tends to show a diminished factor, *i.e.*, the effect of the price change in altering profits is not so great. (There are ten such sequences in which this result holds good against two where it does not.) Doubtless the rapidity with which wages follow prices is instrumental in bringing about this result.

(*f*) Looking at the case theoretically and knowing what a large part of the price of coal is made up of wages, it would appear probable that an additional *output* of one per cent. would entail additional expenses of nearly one per cent., and that there could only be a fractional saving in on-costs, so that the net profit could increase only by a fraction over one per cent. This being so we may take it that the profit change per unit of price change is actually about three times (*see* Appendix I). The above result is quite intelligible so far as it relates to the effect of a quantity change, but theoretical reasoning alone could hardly yield the conclusion as to the effect of the price change.

Attention must, however, be directed to one feature that runs throughout all the foregoing treatment of colliery profits. The profits include *royalties*, and, in this industry, royalties do not to any extent vary with the price, so that the amount charged is practically constant with the output. It amounts to about 6,000,000*l.* (*British Incomes*, p. 223), or about one-third of the whole profit. If we are thinking of " colliery profits " as those profits pertaining to the industry rather than to the ownership of the coal, then the fluctuation due to price must be regarded as greater than that given above. It is reckoned above on a base of 100, of which the colliery proprietor, who bears the fluctuation, keeps from 65 to 70 only, and upon this base, the fluctuation of three becomes $4\frac{1}{3}$ to $4\frac{1}{2}$ per cent. The broad fact, therefore, emerges that price has been fully *four* times as powerful as output in causing fluctuations in the profits.

It is possible to get substantial corroboration of these results from an entirely independent source, unconnected with taxation. A Parliamentary Return (No. 197 of 1903) on " Wages and Profits " in Coal Mining " gives for the years 1886 to 1902, the average price, the computed wages, the computed receipts at the average price, and the balance, or gross profit before charging royalties and other expenses. This is reproduced graphically in Fig. 4 (with a deduction for royalties), each series being reduced to an index (100= the mean). The average deviation of the values is 18 points, of wages 15 points, and of *gross* profits (after charging royalties) 45

FIG. 4.—*Coal mining,* 1886–1902.


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- - - - - - -    Profits (after charging wages and royalties only).
...................    Wages.
——————    Price.
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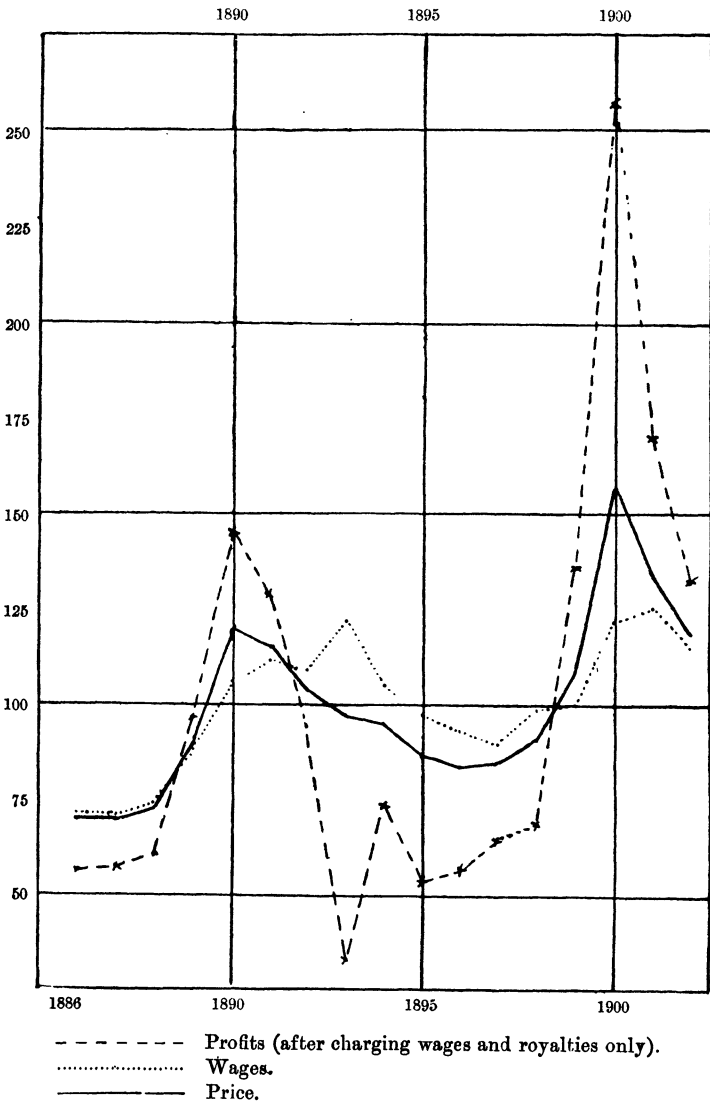
points.   Thus the average deviation of the *gross* profit is two-and-
a-half times that of price, and obviously the deviation in net profit
would be considerably greater.

When we come to consider the " prosperity " in the colliery
industry as part of the prosperity of the country as a whole, important

qualifications have to be made. In so far as it arises from increased output it may be symptomatic of increased trade generally, for coal is of course used in many industries. But in so far as it arises through increased price, it may be a positive bane to other industries using coal if they are not in a position to pass on the increase in price to their customers. We may look briefly at the profits of railways.

6. *Railways.*

The profits of railways are assessed to Income Tax on a single-year basis (*i.e.*, for 1914-15 on the 1913 profit) and the figures have for years been published separately. Strictly speaking in the case of railways there is no variations in " price," save for periodical revisions of rates, and the gross receipts (given in the Statistical abstract) correspond to what we should call in other industries the " output," or work done. There is no significant correlation between the profits and the " output," they are practically independent in their fluctuations.

(*Linear trend* fluctuations 1880-1912, $r = \cdot29 \pm \cdot10$, or for the period from 1889, $r = \cdot12 \pm \cdot11$.)

Are there then any factors to which railway profits are related ? On a comparison of the *price of coal* each year with railway profits for the same year, or more particularly for the following year, I find the series is closely correlated, in an opposite direction, *i.e.*, if the price of coal is markedly increased, then the railway profits are clearly less in the following year. The negative correlation is high and significant. This may be clearly seen in Fig. 5, where the fluctuations of each series about its own trend, on a comparable basis, are shown.

Linear trend.—Years 1892 to 1912, with a lag of one year, $r = -\cdot65 \pm \cdot08$. The deviation of railway profits from the trend is about one *quarter* of the opposite deviation of coal prices.

First differences, deducting the amount of the trend, annually,
$$r = \cdot50 \pm \cdot09.$$

7. *Profits of gasworks.*

In a similar way, we may examine the facts relating to the profits of gasworks, for these have been separately classified in the Income Tax tables. Two recent Parliamentary Papers (311 and 312 of 1915) give details for the years 1882 to 1913 of the quantity of gas sold, and consumed, and also the receipts, from which I have computed the average price of gas in each year. Fig. 5 shows the chief results

2 s 2

FIG. 5.
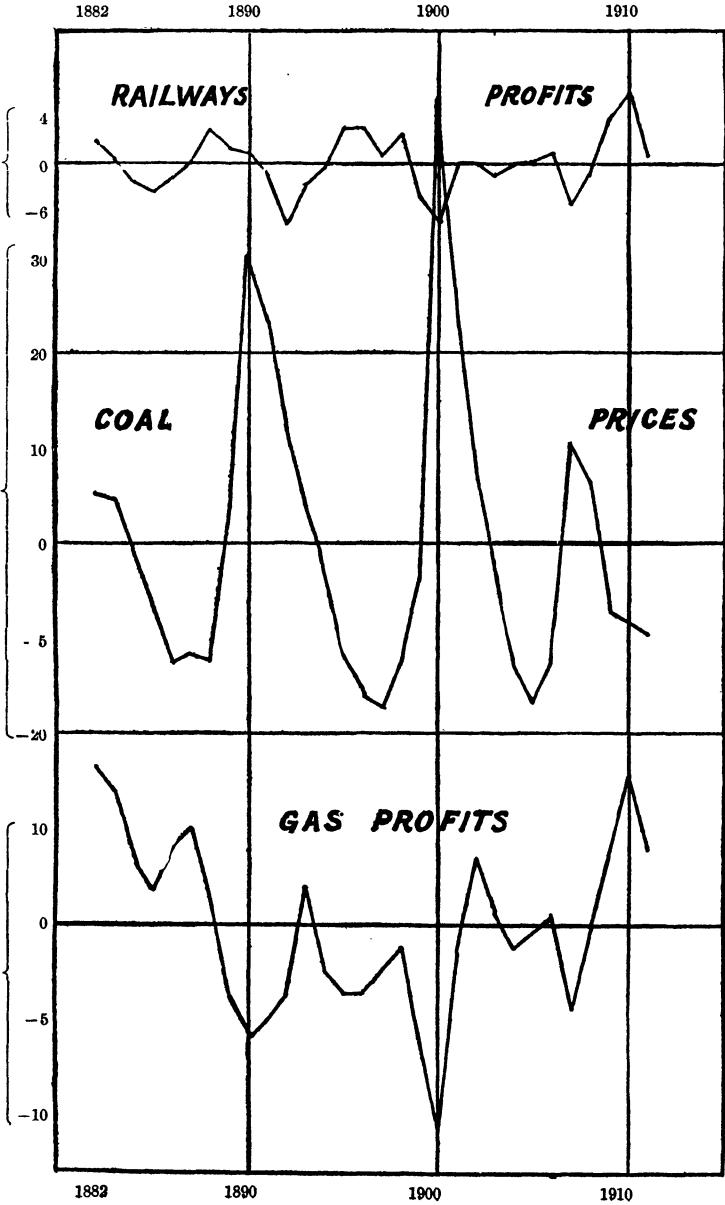
graphically. There is practically no trend in the price ($y = £ \cdot 190$ $- £ \cdot 0005t$) so that the ordinary deviations have been taken.

Correlation: Prices with profits $r = \cdot 22 \pm \cdot 11$

Output with profits $r = \cdot 48 \pm \cdot 09$

The first differences in gas profits (minus the annual trend). $y = £503$ million $+ 16t$) are correlated with coal prices :—

Gas profits with coal prices $r = -61 \pm \cdot 07$, and the average deviation of profits compared with coal prices is as $1 : 1\cdot55$.

8. *Merchants' profits.*

In considering what increased or decreased trade returns may mean for the commercial and industrial community as a whole, we must. pay regard not merely to cases like the foregoing where increased profits in one trade are partly offset by decreased profits in another, as the direct result of the same cause, but also to the large body of trade or professional business which is done at fixed prices or on a fixed margin and in which fluctuations in profit are related entirely to fluctuations in quantity. In a merchant's business the prices may fluctuate widely, but the margin between buying and selling price remains fairly constant. Fig. 6 shows an actual case, where the buying price of a raw textile in an Eastern market and the selling price in London are given for each month for seven years to 1914, and the correlation coefficient for the eighty-four items is $\cdot 97$. It

FIG. 6.—*Merchants' buying and selling prices,* 1907 *to* 1913.

$r = \cdot 97.$
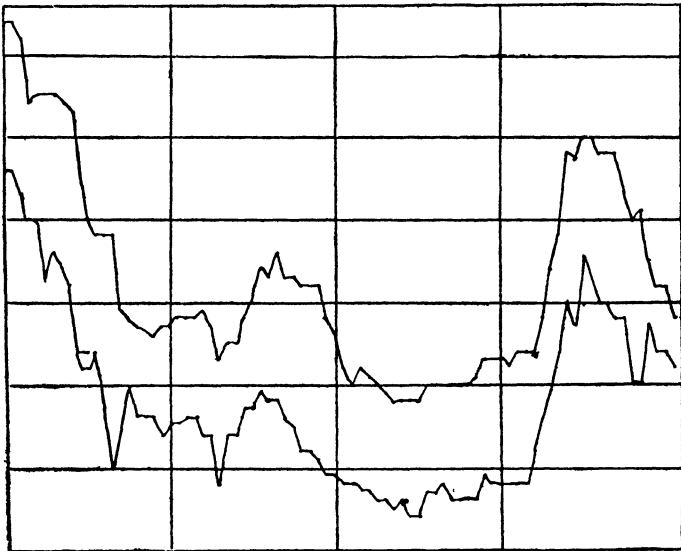
is clear that fluctuations in total profits must be the result of fluctuations in the amount of sales only, and there is a *prima facie* presumption that sales will be largest when prices are lowest.

9. *General profits : data and examination.*

In my first attempt to ascertain the relative values of the several series of trade statistics, I took the *percentage* deviation of each year's assessment from a trend ascertained by taking the average of the preceding seven years' assessments. The banking and other figures were thrown into corresponding triennial averages, and these were then reckoned as deviations from a similar seven-item trend. The modified coefficients were as follows :—

				r (1887—1910).	V.
Profits and	railway receipts	....	....	$\cdot 931 \pm \cdot 018$	$\cdot 90$
,,	railway tonnage	....	....	$\cdot 965 \pm \cdot 009$	$1 \cdot 09$
,,	bank clearings	....	....	$\cdot 852 \pm \cdot 037$	$1 \cdot 11$
,,	special exports	....	....	$\cdot 594 \pm \cdot 088$	$\cdot 69$
,,	imports	....	....	$\cdot 698 \pm \cdot 069$	$\cdot 50$
,,	total foreign trade	....	....	$\cdot 693 \pm \cdot 071$	$\cdot 57$

The ratios of variation in the last column were the mean of the percentages which the successive deviations of the trade series bore to the deviations in profits, treating the latter as unity.

Of course, these are not true coefficients. Each particular item being measured from a trend wholly *preceding* it, the deviations are nearly all positive, and the result obtained contains not merely variations about a trend but the correlations of the trend itself, and therefore has a large spurious element, due to the position of the items in point of time. But this was the way that for practical purposes I had to look at the relationship, and so I was desirous of placing the different series *in order of merit*, so to speak, from that point of view.

The actual correlation coefficient for profits and railway tonnage, measured about the mid-point of this moving average is $\cdot 60$, which will serve as a guide to the corresponding value of the remainder. In this case if the fluctuation of profits about the mean is represented by unity, the tonnage fluctuation is $\cdot 67$, *i.e.*, changes in quantity average only two-thirds of the changes in profits. I took the seven years' average partly because I then thought the cycle was becoming shorter.

On approaching the matter later, I was concerned with variation only and not with trend, and with questions of business profits as such, and not with total assessments under Schedule D. The

Schedule D figures contain a variety of unlike " ingredients " and so I confined myself to the section which is actually based on the three years' average, and described on the official reports as " Businesses " not otherwise detailed," or the series given in the older reports as " trades and professions." These will represent the fluctuations of profits as well as any figures that can be obtained, though even in that series is contained a considerable constant deadweight of small cases which hardly move with any fluctuations in trade. It is true that the profits for different businesses are made up to different dates, in the calendar year, but, on the *average*, the year of account does not deviate materially from the calendar year (*British Incomes*, p. 177).

The secular *trend* may be said to take up all increase due to growth in population ; but it also covers all *gradual* change of habit, *e.g.*, the growth in the " cheque " habit will make the trend of the bank clearances steeper than it otherwise would be and continuous bank amalgamations would have the reverse effect ; competition in other methods of transport would make the railway tonnage upward trend less steep ; improvement in income tax administration would quicken the rise in the trend of profits. But the chief dangers to be guarded against are sudden " faults " in the figures, such as changes in tax-law might occasion (and these have been carefully corrected) or such as a number of simultaneous bank amalgamations. A single serious break does not however wholly mar the comparison of fluctuation, and the only real danger is some periodic or erratic repeated change which does not come out evenly in the trend.

There was a change in the method of making up railway tonnage statistics in 1903 (according to the *Statistical Abstract*) which does not seem, however, from any tests that I have been able to apply, to have been of great magnitude, and it has been ignored. The bankers' clearances statistics have no warnings as to any special changes in method, but an interesting point arising in research may perhaps be recorded. After working upon these figures for some years it gradually became forced upon my attention that the year 1896 had most unaccountable peculiarities and steadily refused to take its " natural " place in various correlation workings. I have no particular knowledge of banking history, but I inferred that there must have been an epidemic of bank amalgamations (which, of course, have the effect of reducing the number of cheques passing through the Clearing House) and on searching the matter out in contemporary literature the inference was verified to the full.[1]

[1] *Bankers' Magazine*, 1896 and 1897, various articles on the numerous amalgamations.
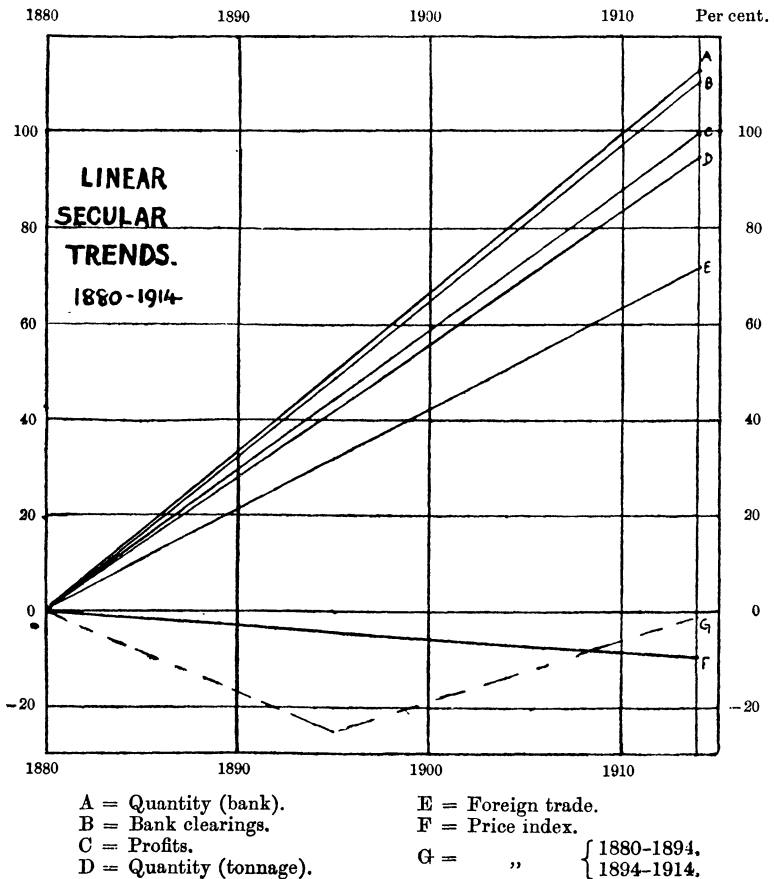
In addition to these two series, I have taken " total foreign " trade," and have not thought it worth while to make the computations for the other series referred to above. But I have been very anxious to make a comparison of fluctuations in price, and fluctuations in quantities. For prices, it was unwise to trust wholly to one index number, in view of the comprehensive interests under examination, and so three series were taken, the Sauerbeck *Statist*, the *Economist*, and the Board of Trade indexes, each as equated to 100 at 1900 in Mr. Joseph Kitchin's tables, and the mean value for each year was adopted. These were then thrown into three-year averages like the other figures for profits.

To exhibit the fluctuations in " quantity " or output, only the railway tonnage statistics exist as a comprehensive indication. Minerals are, of course, an important feature in trade, but it seemed too much to say that variations in the quantities carried must necessarily be a measure of variations in trade as a whole. Minerals have, however, a commanding influence in those tonnage statistics. So another independent measure of changes in trade volumes at a constant price was sought. Foreign trade was not very suitable, but it seemed that if the bank clearances could be freed from the influence of changing prices, they would afford a reliable test of the quantity of business done. I experimented along these lines, and put the various results to crucial tests. I divided each year's " clear-" ances " by the triple price index referred to above, but found the effect was very violent. The reasons are obvious. A large proportion of the clearances represent transactions almost uninfluenced by price fluctuation, *e.g.*, rents, mortgage and debenture interest, preference dividends and customary or regular payments of all kinds, including payments for professional services, capital payments and repayments of debt. Accordingly *one half* was finally taken as subject to the price change, and the clearance figures were modified to that extent.

It is necessary to refer briefly to the character of the " profits " which have been under examination for that term covers many different ideas for different purposes. Being made up on strict statutory lines for taxation purposes, these figures for profits represent a higher degree of uniformity than could possibly be obtained on commercial lines. From the commercial standpoint they may be said to include all business profit, before payment of interest on loans borrowed on fixed terms (but after payment of " short " interest) and of debenture interest except so far as such interest is payable out of the annual value of real property. Generally the profits include the remuneration for management in private concerns,

but not in public concerns, but do not include the rental return
on real property.   Bad debts are allowed for, but the figures taken
here (unless otherwise defined) are profits before any allowance is
made for " wear and tear " of plant.   The fluctuations shown must
be increased by about one-seventh to get the fluctuation of net
profit after allowing for such depreciation.   From the point of
view of economic definition, the " profit " here adopted is far wider
than that elusive residuum of analysis which is usually allowed
to claim the title.   Not only does it include some elements of econo-
mic rent, but it covers also pure interest, and special interest, risk-
taking (whether borne by the separate businesses, or taken up as
a separate *class* of business) and some remuneration for management,
and entrepreneur's profits.

FIG. 7.

A = Quantity (bank).

B = Bank clearings.

C = Profits.

D = Quantity (tonnage).

E = Foreign trade.

F = Price index.

G =   ,,   { 1880–1894.
                       { 1894–1914.

The linear secular trend of the different series is shown in Fig. 7. The percentage fluctuations about the trends may be compared in Fig. 8. It may perhaps be said that the long downward drag or depression to 1894 was so different in character from the subsequent recovery following the expansion in gold production that there were *two*

FIG. 8.
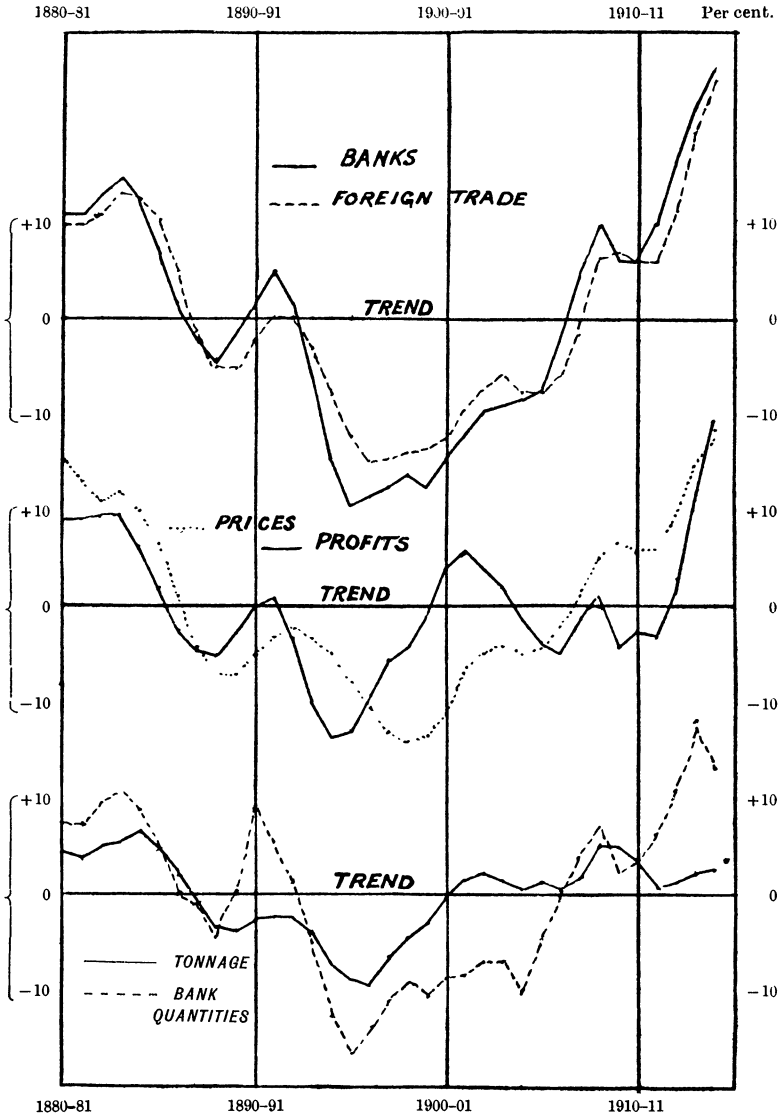
trends, and not one.   As many think that these trends were dominated
by price tendencies, and not by population changes, or other radical
differences in business life, I was anxious not to " beg the question,"
and I have accordingly, after doing some work on the double trend,
thought it best to present the figures as one series for thirty-five years.
But in Fig. 7 the two trends of price are shown, for it seems a little
difficult for us to realise that the whole trend is a downward one to
1913, when prices had not reached the old levels of the 'seventies.
It is indisputable that trade quickened remarkably after the rise
in price began.   I have undertaken not to theorise, but we all
know the *disproportionate* effect which the rise has upon business
psychology, in the direction of stimulus to enterprise, and of engen-
dering a *feeling* of prosperity.   I am far from asserting that it is
entirely an evanescent result and that it leaves no solid gains.   A
shrewd observer of the business " economic man "[1] has recently
well said that it is a matter of experience that the rise " does leave
" behind a general residuum of benefit, even after the temporary
" inflation which accompanies it has subsided."

In a classic essay on "the Energies of Men "[2] William James,
referring to the stored-up reserves of energy and power that are
not ordinarily called upon, deals with the psychology of their conquest
and exploitation.   Men are the victims of habit neurosis.   Improve-
ment and progress when they occur are due either to " some unusual
stimulus filling with emotional excitement " or to some " unusual
" idea of necessity inducing them to make an extra effort of will.
" Excitement, ideas, and efforts, in a word, are what carry us over
" the dam. . . .   Most of us may learn to push the barrier
" farther off, and to live in perfect comfort on much higher levels of
" power."   War necessities at the present time are a conspicuous
example of such a stimulus putting industry on to new planes of
possibility, and the psychological aspect of rising prices has in the
past had this influence on business.   But when measured by objec-
tive tests it is difficult to prove that the increase in profit is propor-
tionately *greater* than the increase in price, *ceteris paribus.*

Table II shows in summary form the various coefficients.   In
the case of the moving average, the low coefficient for price-level
is probably accounted for by the fact that prices have a secular
trend, but no cyclical variation.

[1] G. B. Dibblee, *The Laws of Supply and Demand.*
[2] *Memories and Studies,* 1912.

<div align="center">TABLE II.</div>

Correlation of profits and	Coefficients.			
	Deviation from linear trend.	Variate difference.		Deviation from nine year moving average.
		First.	Second.	
Railway tonnage	·68 ± ·08	·60 ± ·07	·38 ± ·10	·59 ± ·08
Bank " quantities "	·68 ± ·06	·35 ± ·10	·42 ± ·10	·79 ± ·05
Bank clearings	·67 ± ·08	·70 ± ·05	·65 ± ·07	·78 ± ·05
Foreign trade	·60 ± ·07	·62 ± ·07	·50 ± ·09	·49 ± ·07
Price level	·68 ± ·08	·48 ± ·08	·36 ± ·10	·31 ± ·11

Table III shows the linear secular trend for each series, and these results are given graphically in Fig. 7 where the rise from 1880, in 34 years, is shown as an aggregate percentage. Table III also gives various measures of the degree of fluctuation in each series, the deviation in profits standing as 1 in each case. It will be seen that the mean deviation and standard deviation for the same items give closely similar results, but there is some difference in the proportions according to whether the trend or the moving average is taken. These results are not so much contradictory as complementary, for they express different aspects of the case.

<div align="center">TABLE III.</div>

	Trend. Annual rise as a percentage of the mean of the series.	Relative size of average deviation from		Relative size of standard deviation (as a fraction of the mean of the series).		First differences. Relative size of	
		Trend.	Moving average	Trend.	Moving average	Average.	Standard deviation
Profits	2·85	1·00	1·00	1·00	1·00	1·0	1·0
Railway tonnage	2·72	·65	·58	·60	·57	·71	·51
Bank " quantities "	3·23	1·38	1·00	1·27	1·12	·97	·81
Bank clearings	3·18	1·91	1·15	1·76	1·18	1·18	1·13
Foreign trade	2·05	1·63	·97	1·50	·93	·89	·92
Price level	— ·27	1·42	·79	1·28	·76	·55	·73

All of the foregoing paragraphs relate to partially smoothed curves, owing to the adoption of triennial averages. These have some virtue in subduing minor disturbances, and differences due to the dates of accounts, &c., so that the more stable short date tendencies may emerge, but they also have obvious drawbacks. As in the case of colliery profits I have endeavoured to supplement

them by annual results, obtained over a wide area.   I have obtained, in the course of business an experience of these figures that enables me to weight them accurately to represent the importance of each industry in the whole.   Back to 1903, numerous duplicate and triplicate samples give a firm basis for my statement, but prior to that year I have information that I care to put forward as reliable for only five " pairs " of years.   The percentage changes in each year's profits compared with the previous year are set out in column 2 of Table IV.   The third column shows the change in the quantity or output, which is the mean of the railway tonnage and the series referred to as " bank quantities."   The fourth column gives the change in price level, on the triple index already referred to, and the percentage change of the two factors is *added* together in the last column.

TABLE IV.

Years.	Annual percentage changes.			
	Profits.	Quantity.	Price.	Quantity and price changes *added* together.
Five isolated years prior to 1903	+ ·4 +14·5 + 3·7 + 8· +10	+ 5·75 +13 + 3 + 4 +10	− 5·5 − 2·5 + ·25 + 2 + 4	+ ·25 +10·5 + 3·25 + 6 +14
Total	+36·6	+35·75	− 1·75	34
1903 to 1904	+ 3·4	+ 2·25	+ 1·75	+ 4
1904 to 1905	+14·4	+ 8·75	+ 2	+10·75
1905 to 1906	+13·3	+ 3·25	+ 6	+ 9·25
1906 to 1907	+ 4·6	+ 2	+ 2·50	+ 4·●
1907 to 1908	−12·4	− 3·75	− 7	−10·75
1908 to 1909	+ 8·4	+ 6·75	+ 1	+ 7·75
1909 to 1910	+ 8·2	+ 3·50	+ 6	+ 9·5
1910 to 1911	+ 6·3	Nil	+ 8	+ 8
1911 to 1912	+10·5	+ 3	+ 5·5	+ 8·5
1912 to 1913	+ 6·6	+ 2·25	+ ·25	+ 2·50
1913 to 1914	−12·8	−11·0	Nil	−11·0
Total change 1903–1914	100·9	46·50	40	86·50
Total, all years	137·5	82·25	38·25	120·50

It will be observed that, except at the beginning, price and quantity have moved in the same direction.   If each element accounted for a unit per unit change in profits, the total change in profits would be 120·5 points against an actual change of 137·5

points, and speaking generally the annual changes in column 5 are of the same order and comparable with the changes in column 2. But where percentage changes in quantity and price act together, the effect on the percentage of profit cannot be confined to the sum of their separate effects ; there is also the price change upon the additional output.   For example :—

Goods costing 100*l.* are sold for 120*l.* = 20*l.* profit.

On an increase in price of 50 per cent. : goods costing 150*l.* are sold for 180*l.* = 30*l.* profit, or an increase of 50 per cent. also in profit.

But if output has also gone up 50 per cent., we have goods costing 225*l.*, sold for 270*l.* = profit 45*l.*, or an increase of 125 per cent., which exceeds the sum of two increases of 50 per cent., by 50 per cent. upon 50 per cent. The actual effect of the combined percentages for the years 1903–14 in cols. 3 and 4 is therefore not 85·5 only (on the unit per unit change hypothesis) but a further 40 per cent. of 46·5, or 18·6, making 104·1 in all, against the actual aggregate change of 100·9 points in col. 2. (In discussing the similar table for coal statistics this feature was taken into account, but not specifically referred to.) The profits in col. 2 are perhaps more " mobile " than the whole profits dealt with in Table II, which carry a deadweight of small non-fluctuating cases, but this is counterbalanced by the fact that if depreciation of·plant were deducted from profits the percentage changes would be about one-seventh more. These are broad results worth studying in detail, but in all the circumstances it would be a mistake to expect them to answer to the finer statistical tests of uniformity and consistency.

10. *General profits : conclusions.*

The following findings may I think be fairly stated, in general terms, from the foregoing examination and from the materials upon which it is based :—

1. Speaking for the results of trade as a whole, the statistics of the Bankers' Clearing House and of the railway receipts (or tonnage) have afforded a reliable test as to the *direction* of the movements in profits, and the movement of foreign trade is also a fair but less important criterion.

2. The fluctuation in profits has generally been rather less in *magnitude or range* than the fluctuation in statistics of " turnover," such as banking or foreign trade statistics, which reflect both quantities and prices, and it may be taken roughly at two-thirds to three-fourths of such short period changes in trade returns.

3. The influence of a change in price level on profits *as a whole* is far less than is frequently supposed by those who base their views upon observations of the striking effect of price changes in particular industries.

In times of rising prices, increases in profits have been made over and above the amount that would arise upon the increased output that such prices induce, but the additional profit is not usually much greater in proportion than the rise in price, if the period taken is not less than a year. There is no evidence as to the effect of such changes measured over shorter periods than a year.

Although the increased quantities evoked by increased prices have followed quickly enough to keep profits within such limits the check has not been permanent, and continually renewed stimulus by the raising of the price level has resulted in increases of profits much greater than could have followed the ordinary increases in output (due to increasing population) at a constant price level. Similarly the drop in prices from 1880 to 1895 kept profits down considerably below what would have resulted from the *actual* output at a constant price level, and in itself was instrumental in depressing that output.

4. The " turnover " of foreign trade has become a *relatively* less important part of the whole trade of the country during the last thirty years.

5. The annual trend of increase in trade freed from all fluctuation has to a great extent been made up of the larger output of existing businesses increasing continually in size, and to a relatively smaller extent of the output added by new businesses.

11. *Cotton spinning profits.*

The material furnished by the income tax records of profits has now all been utilized, and if it is desired to pursue the subject further, we must resort to statistical material of a partial or sample character, which does not cover the results of an entire industry for the United Kingdom. The periodical figures in the *Economist* have been in existence for a few years only, and it would be premature to put forward my own collection of data, which, though wide in range, does not cover a long enough period at present to be satisfactory. As an example, however, of what may be attempted along these lines, we may refer to the well-known series of figures for cotton spinners' profits from 1882 which Mr. Kidger, of Oldham, continues annually.[1] The profits and losses for a hundred mills

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[1] Referred to in detail in the *Economist.*   *Vide* also D. H. Robertson, *A Study in industrial fluctuations.*

are given, as the profits of one huge mill. It is probable that the constitution of the sample now is very different from what it was 20 years ago, but at the same time that it is kept as little changed as circumstances will allow and that the *difference* from one year to the next is negligible. In such a case the method of differences may be tried. If the tendency of the change in the constitution is to get a larger number of spindles into the sample, there may also be a secular trend, and from the figures it appears that this is not unlikely.

The average annual profit of all the mills taken together is 218,000*l.*, the highest profit being 1,321,150*l.* in 1907 and the worst year 1910, when the aggregate loss was 368,000*l.*, and generally speaking the range of fluctuation is very wide. The following coefficients for *first differences* may be recorded :—

Profits and purchase price of raw cotton   ... − ·07
  ,,   sale price of yarn   ...   . + ·17
  ,,   difference between purchase and sale
         price   ...   . ·46 ± ·09
  ,,   *value* of raw cotton imported   ... ·35 ±1·06
  ,,   quantity imported   ...   . ·41

(or a coefficient for the last 14 years of ·60 and a negligible coefficient for the earlier period). For the whole period the correlation between profits and the quantity imported, after taking out the trend from the latter (on the assumption that the additional mills not in the sample have taken the increasing quantity in the trend) the coefficient is ·41 ± ·10.[1]

First differences, coefficient for purchase and sale price is ·86 ± ·03.

The broad conclusions are therefore :—

(1) There is very little regular relationship between the profits of cotton spinning and either the purchase price of raw cotton or the sale price of yarn, but the changes in the *difference* between the two prices is more indicative of changes in the amount of profits. Of late years the quantity of raw cotton imported has been some criterion of the prosperity of the trade. The purchase price of raw cotton and the sale price of yarn are very closely related indeed.

(2) The fluctuations in the profits of spinning are very violent. The deviation of the price from the trend of prices is 14·4 per cent. on the average price, but the deviation of profits from the average profit is 154 per cent. or nearly eleven times as great ! (Standard deviation taken.) Reckoned by another method also, it is ten times

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[1] The coefficient of correlation between profits and the sale price after taking out the trend or secular tendency to increase in the latter (*y* pence = 11·75 + ·23*t*) is + ·03.

as great (average deviation).   It may fairly be said that fluctuations in profits are ten times as great as fluctuations in prices.

12. *Profits and prices in war time.*

While there can be little doubt as to the utility of obtaining more exact knowledge than has generally been available on these subjects so far as normal times are concerned, it cannot be expected that similar conditions will obtain during war time.   It is hazardous to attempt even the roughest examination of present relationships, and indeed most of the essential data are lacking.   We have not even a broad idea as to the *quantity* or output of trade in general, nor is it easy to form estimates of aggregate profits.   Professor Plehn has chided me gently for being unwilling to go beyond available evidence, and suggests that there is an obligation to impart any " educated guess."   An estimate as to the progress of total profits during the war, which will, I think, satisfy the tests of weighted samples, and the aggregates of income tax profits and excess profits duty (as stated in parliamentary replies and official reports) is given below, together with the average of the monthly *Economist* index number of prices :—

|			Pre-war (1912 and 1913).	1914.	1915.	1916.	1917.
Profits	....	....	100	110	125	175	180
Prices	....	....	100	98	122	159	201

But, of course, these figures are put forward with great reserve. The most that can be said, I think, is that business profits *in the aggregate* (including the part paid away as excess profits duty) have risen to an extent rather less than the rise in prices.

13. *Real value of average profits.*

I referred at the beginning of this Paper to the fact that our instinct and individual experience have generally assured us that an increase in " profit " results from an increase in " turnover," and that on examining the facts, dissociated from psychology feelings and theories, we could perhaps see whether, and to what extent, we might be deceived.   I also mentioned our tacit assumption that increases and decreases in profit, when verified, must mean increases and decreases respectively in our *real* prosperity, a state of being genuinely " better " or " worse off."   To what extent is this assumption true, for the community as a whole, apart from the

effect upon individuals ?   For short period fluctuations one feels
bound to believe that it must be true, but in regard to " progress "
over a long period the results of an experiment I have just made
have surprised me.   I do not think there is much scope for error
in the details, so they are set out accordingly, and I will refrain
from theorizing to account for the conclusions which may be
drawn.   In *British Incomes* (p. 319), Table G 4 gives what is the
main work of that book, the " Taxable income " in a true comparative
series substituted for the official tables (hitherto generally used for
comparative purposes but not properly adapted for such use).   These
were arrived at after minute detailed labour upon the effect of every
statutory change in the basis of assessment or administrative change
in statistics, and by numerous checks must certainly be correct
within a very small margin of error, which has been duly shown.
For the present purpose I have selected the column giving the
" taxable income " on the statutory conditions which obtained after
1894 (*viz.*, an exemption limit of 160*l.* and an allowance for repairs
under Schedule A).   In Chapter XIII I gave an exhaustive examina-
tion of all the estimates that had been made as to the *number* of
taxpayers, and by a new method which is totally unrelated to
the computations of income above referred to, I arrived at an estimate
for certain specified years, *viz.*, 1860, 1874, 1881, 1894, and 1909
(p. 448) and 1913 (p. 449), and gave the upper and lower limits of
that estimate, which I believe is far more soundly based than the
work of Baxter, Levi, Mallock and others.   I have taken the upper
limit for my present purpose though the lower limit gives similar
results in effect.   These data are set out respectively in col. 2 and
col. 3 of Table V.   The total taxable income in each year was then
divided by the number of taxpayers, to get the average individual
income as assessed.   It will, of course, be within general knowledge
that for most of this period the income tax was a highly impersonal
tax, a tax on sources of income, and there was hardly any internal
administrative evidence as to the number of taxpayers ; for the
individual " total incomes " of taxpayers, now so important a
feature, were hardly ever required to be known for taxation purposes.
The result shows some wide variations (col. 4 of the table), and would
indicate that although the average has been steadily mounting during
the last twenty years it is actually not greater than it was fifty
years ago, and far below its level forty years ago.   There is a general
belief that " colossal " incomes have increased under modern capital-
ism, out of proportion to the increase in the population, but it is also
pretty certain that the numbers of persons enjoying an income of
modest dimensions (200*l.* to 250*l.*) has vastly increased.   These

effects combined would serve to account for the fact that the *average* income of *all the persons with incomes over* 160*l.* has not greatly increased, but the number of persons with such incomes has increased in a much greater ratio than the population, *viz.*, 320 per cent. against 59 per cent. I am, however, concerned rather with the fluctuating fortunes of this " average " taxpayer than with his position in the whole population. When he gets his nominal income, what is its real value, or purchasing power ? I have divided the average by the Sauerbeck-*Statist* index number (wholesale for the three years immediately preceding) and also by Mr. G. H. Woods' retail index number (continued by the Board of Trade retail index number) for the actual year itself, and taken the mean of the results, in order to get figures which shall be as firmly based as possible and free from the accidents of individual methods or series. (Each index number has been taken on the series in Mr. Joseph Kitchin's charts as equated to 100 at the year 1900.) The " real value " of the average assessed income is given in col. 5 of Table V, and it will be seen that its course has been much freer from wide fluctuation than the nominal average and the maximum range of 200*l.* has been lowered to 100*l.* It would appear that the widespread depression in trade that had followed the decline in price levels after 1872, had by 1881 affected the average profit to a greater adverse extent than was made good to the *spender* in the reduced prices themselves, but that by 1894 business had become more settled at the lower levels of prices (before the 1896 turning point in gold production began the new upward trend) and the spender had the full benefit of the cheapness of commodities. Since then, as a spender of income he has lost the apparent advantage that he has obtained as a maker of income. But a further stage is necessary. Those who have studied Chapter VIII of *British Incomes* will, I think, have no doubt that between 1860 and 1909 there was an improvement in income tax administration which would amount to *at least* 10 per cent. in its effect upon the amount assessed ; and I have therefore corrected the figures in col. 5 of Table V, by showing in col. 6, what the figure would have been in each year at the present level of administrative efficiency and *statutory powers*, by giving an increase of 10 per cent. fifty years ago, and diminishing the addition by ·2 per cent. per annum. The results are, I think, notable, and are shown graphically in Fig. 9, where the dotted line *c* represents the real value of the true average assessable income in each year observed. Apart from the depression in 1881 and the appreciation in 1894 the line is almost level, and with regard to the latter I would only remark that the income tax law has throughout been such that the

2 T 2

Fig. 9.
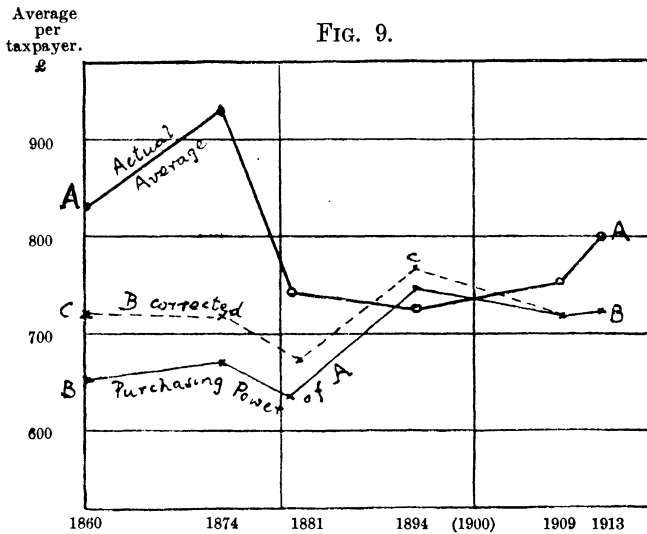
fluctuations in the agricultural interests (farming) are hardly re-presented at all, and if the true income of farmers had been given its effect upon the general average, the depression in that industry in 1894 was so great that it would have reduced the prominence of that average for that period. I will refrain from any attempt at this stage to account for these interesting results.

TABLE V.

1. Year.	2. Taxable income (millions).	3. Number of taxpayers (incomes over £160) (thousands).	4. Average taxable income per taxpayer. Col 2 ÷ Col. 3.	5. Purchasing power of average income. Col. 4 ÷ index number of prices.	6. Purchasing power of *real* taxable income. Col. 5 corrected for improvement in income tax adminis-tration.
	£		£	£	£
1860–61	232·9	280·4	830	656	721
1874–75	440·3	473·8	927	670	718
1881–82	468·7	632·2	741	635	672
1894–95	551·4	761·7	723	746	769
1909–10	831·0	1100	755	719	719
1913–14	951·0	1190	799	723	723

14. I should like to conclude by saying that I am very conscious of the shortcomings of this study, pursued, as it has been, in the odd moments of scant leisure. I can only urge that it is difficult new ground which others have been reluctant to traverse. Jean Henri

Fabre's processionary caterpillars went round for days in an endless circle because no one of them had the wit to break it, or was capable of new impulse. It may well be that a statistician who is so familiar with his " tools " that their use necessitates no attention on his part can free his energies from their manipulation for the invention of new methods to meet new needs at each moment of his task I can perhaps plead that in this instance the material is so peculiar in its grain and temper that having had a long and close acquaintance with its vagaries of structure I may in some respects make good my failings in other directions. But perhaps there is required a higher quality even than knowledge or mental agility, to discern the truth in such a sphere. As Bergson says : " Il y a des choses que " l'intelligence seule est capable de chercher mais que, par elle-même, " elle ne trouvera jamais. Ces choses l'instinct seul les trouverait ; " mais il ne les cherchera jamais."[1]

APPENDIX.

The 133*rd Section.*—Relief under this Section for many years down to 1907 was given on the following lines :—

				£	
1902	....	....	....	7,000	
1903	....	....	....	2,000	
1904	....	....	....	7,000	
				3/16,000	
				5,333	Assessment for 1905–06.

If actual profits of 1905 were 3,000*l.* a new average was taken:—

				£	
1903	....	....	....	2,000	
1904	....	....	....	7,000	
1905	....	....	... .	3,000	
				3/12,000	
				4,000	Assessment for 1906–07 and substituted assessment for 1905–06 also.

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[1] *L' Évolution créatrice,* p. 164.

But if the profits of 1905 had been 5,000*l.*, the average would have been :—

				£
1903	....	....	....	2,000
1904	....	....	....	7,000
1905	....	....	....	5,000
				3/14,000
				4,666

And as the profits of the year of assessment 1905-06 were *greater* than this average, the 1905–06 assessment was reduced to 5,000*l.* only. (The same test applied to colliery profits, although the average for assessment was five years.)

Where the average is an average loss, the effect in depressing the aggregate assessments is no greater than if the average were *nil.* Moreover, the dead rents and royalties of the year would be assessed, although the profits might be nil. In these ways, the effect of bad times is not fully reflected in the Income Tax statistics, and the actual fluctuations from the highest to the lowest point of aggregate profits is wider than the figures would indicate. This feature is of importance in highly fluctuating industries.

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DISCUSSION ON DR. STAMP'S PAPER.

PROFESSOR EDGEWORTH, in proposing a vote of thanks to the author of the Paper, said that the Paper seemed to him to fulfil quite ideally the conditions of a Paper proper to their Society. The subject matter of the Paper consisted of statistics in the older sense of the term, observations relating to *States*, or, rather more generally, human society. To data of this kind Dr. Stamp had applied the latest refinements of technical method. In doing so he had shown a due sense of the limitations to which such methods were subject. He, the speaker, thought that Dr. Stamp would agree with him in thinking that the mathematical theory of Probabilities was not applicable to sociological statistics with the same perfection as to some branches of physics and biology. He agreed with Dr. Stamp that the difference was not to be explained simply by the prevalence of human volition in the former class of phenomena. The fact that the fundamental assumption of Probabilities, that an event will occur in random fashion about as often in one way as another, was perhaps more intelligible when a certain play of free-will was admitted than upon the now fashionable hypothesis of complete determinism. Dr. Stamp had made the best of existing methods by trying all that might be applicable to his problem. He had unfortunately not recorded the results of one method which he tried— " multiple correlation." It would have been interesting to present the relation between profits and output clear of the influence of

prices. But he was prepared to hear that the data, though good enough for the purpose of determining correlation of the simplest sort, proved unsuitable for more elaborate calculations. A foundation on which two stories might be built might not be solid enough to support an edifice of the type prevalent in New York. Dr. Stamp was also to be commended for having translated his technical reasoning into ordinary language. He thus secured the attention of that important class whom he designated as " the non-statistical reader," or, as he, the speaker, would prefer to say, the non-mathematical statistician. There was ever in such a class a natural and not altogether unhealthy suspicion of any technical method, any *organon* which seemed intended to supersede the use of common sense. It was Locke, or some one who wrote, like Locke, against the Aristotelian syllogism, who protested that the Almighty had not dealt so very sparingly with the noblest of his creatures as to make them only bipeds, leaving it to Aristotle to make them rational. A similar prejudice on the part of common sense against correlation and other mathematical instruments is to be apprehended. But Dr. Stamp's paraphrase of his mathematical conclusions dissipated this prejudice by showing that his technical methods come not to supersede but to complete common sense. For instance, ordinary observation and Ricardian reasoning would lead us to expect that in a merchant's business, while prices might have fluctuated widely, the margin between buying and selling prices would remain pretty constant. But this presumption acquired a new certainty and precision when, comparing the buying price of a raw textile in an Eastern market and its selling price in London for each month over seven years, Dr. Stamp obtained from the eighty-four pairs of observations the correlation coefficient ·97. A similar corroboration of ordinary economic reasoning was afforded by the (negative) correlation between the price of coal and both the profits of railways and the profits of gasworks. It would be noticed that many of these examples were of great economic interest. This remark also applies to statements not specially involving the method of correlation; in particular the important conclusions as to the improved distribution of income shown by a proportionate increase in the number of taxpayers with incomes over 160*l.* (without any corresponding increase in the average taxable income). Here, as throughout, they had the advantage of Dr. Stamp's minute acquaintance with the subject matter ; an indispensable condition without which not only the more refined statistical methods but even the seeming inferences from simple arithmetic could not be trusted. The economic interest of the Paper to which he had just now referred was further exemplified by one of the main topics, the relation between price and output. Dr. Stamp seemed to afford some corroboration of the argument frequently employed by the bimetallists of last century, that the fall of price leads to discouragement of business and diminution of output. But the full consideration of the subject belongs to economics ; the subtlety of the entrepreneur's mentality exceeds even the subtlety of mathematical statistics.

Mr. P. D. LEAKE, in seconding the vote of thanks, said how much they must all feel indebted to a statistician who started out to explore difficult new ground which others have been reluctant to traverse. It often happened that the first results of pioneer work of this kind might at first appear to be somewhat disappointing and inadequate to the hard work necessarily devoted to the matter. Dr. Stamp had been doing work of this kind and they were greatly indebted to him. It made the work of others coming after him a great deal easier and enabled them better to judge what to use and what to reject. He had a strong feeling, which was perhaps in the nature of an instinct, that real profits were represented only by a real increase in commodities available for consumption, use, and enjoyment. In dealing with statistics based on values, they were dealing with a very dangerous and difficult element, although, of course, the violent fluctuations to which values were subject might occur simultaneously in both trade statistics and profits. We are now in the midst of an example of violent fluctuations arising out of the vast increases in values or prices resulting from war conditions. The consequent apparent increases in profit would scarcely be claimed to be increases in real profit or welfare, being due, in fact, principally to scarcity in comparison with demand and the consequent inflation in values. Dr. Stamp had referred to our tacit assumption that increases and decreases in profit, when verified, must mean increases and decreases respectively in our real prosperity, a state of being generally " better " or " worse off." He was going to suggest, however, that when, as a nation, we were, by efficient work, increasing our real profits to a greater extent than the natural growth of population, the resulting surplus profit represented by the real increase per head in commodities available for consumption, use, and enjoyment would probably, to a large extent, be consumed as a result of the adoption of a higher standard of luxury and comfort in living. If this were true, a nation might be increasingly prosperous and earning increasing real profits without showing much evidence of largely increasing its permanent wealth, the increase being represented perhaps chiefly by better houses and by increases in factories and plant and in foreign investments. Apart from Government property and Government debts (British and foreign) owing to individuals, which, before the war, probably represented together about 18 per cent. of our national capital, our national capital was invested as to about 60 per cent. of the whole in what he would call the assets of industry or production, such as railways, ships, mills, agricultural land, mines and so on, about two-thirds being situated in this country and about one-third abroad, and as to the remaining 22 per cent. in what might be called the assets of leisure or consumption such as dwelling houses with the furniture therein and the lands upon which these stood. The real profits of the nation could be largely increased without the need of any very great increase in invested capital of this kind and the natural human instinct would be to consume a large part of those increased profits by a higher standard of living. There were many interesting points in the Paper which required and

would well repay a great deal of reflection and careful study. It occurred to him there was one disturbing element in comparing the profits represented by the assessments to income tax with trade fluctuations and it was this, that there were well marked periods of public speculation in such adventures and enterprises as mines and patented inventions which often resulted in considerable and sustained losses of working capital on the part of the public. Those continuous losses of working capital would not come into the average which was used for computing profits for income tax purposes. He thought that was an element which did not run evenly over a series of years but was confined to periods or groups of years. The periods could probably be fairly well located by reference to the current literature of past years. They could all call to mind past times when there had been wild speculations of one kind and another, and he thought that in an investigation such as that undertaken by Dr. Stamp the matter should not be lost sight of. He had the greatest pleasure in thanking Dr. Stamp for his very valuable Paper.

Mr. EDGAR CRAMMOND said he wished to associate himself with what had been said in the way of thanking Dr. Stamp for his extremely interesting and stimulating Paper. It appeared to him that Dr. Stamp had opened up a very wide field of thought, and that his Paper would be of immense use to those who were interested in questions of national income and national production. He would like to ask Dr. Stamp whether he had considered the question of the relationship between profits and production. He had given them a very interesting estimate of the increase of profits since 1913. It would be of very great value to them all at this particular time to have an estimate of the increase of the national income. Profits were of course of very great importance ; but he thought at the moment they wanted to know very much to what extent the national income had increased since 1913. His own impression was that it had increased to a very great extent, as much, perhaps, as 60 per cent. That would not be in the same proportion as the increase of profits as estimated by Dr. Stamp, which was 80 per cent. Had he any reason to assign a ratio between increase of profits and increase of production ? It also seemed to him that all their official papers, such as the returns of assessment to income tax, foreign trade returns, and returns under the Census of Production Act, required co-ordination. There was an intimate relationship between all those questions ; and he thought the forms should all be brought under the review of some statistical department with a view to their co-ordination, so that one could see to what extent production, foreign trade, income tax returns and profits reacted upon one another. He hoped Dr. Stamp would pursue the subject and perhaps indicate at some future time the lines upon which they might standardise, if they could do so, the various Government returns. He thought the War had shown them that the nation was like a business house without a statistical department. He hoped that the public would

recognise the vast importance of having the fullest statistical returns, and he thought Dr. Stamp had done a great deal to help them in that direction.

Mr. PERCY WALLIS asked whether Dr. Stamp, in preparing the Paper, had examined the problem from the reverse position, the effect of profit fluctuations upon trade. Speaking as a business man he hoped to avoid being classed as the " practical " " theorist " free from " restraint," mentioned in the early part of the Paper. He had investigated the problem from this reverse standpoint and found a very close relationship between the rise of profit and the increase of trade. The method adopted was based on the average value output per person employed in the coal mines of the countries in Europe and America. These output figures showed a very similar movement to the one shown in the chart (fig. 4) of price movement. They had no complete returns with regard to wages in English coal mines but they had for France ; on examination they would find that the wages rose very much slower than the prices on the upward movement, leaving a larger margin for possible profits, and the quantity of trade always increased during these periods. By this method it was possible to very accurately forecast years in advance the increase or decrease in trade. In measuring trade fluctuation, he had always taken the number unemployed as the best indication of the volume of trade. If the percentage of unemployment was high, the amount of trade was small ; if the percentage of unemployment was low, the amount of trade was large. Taking those with consideration, he found, the price seemed invariably to have moved first and made profits larger, the larger profits made the trade increase.

Mr. G. B. DIBBLEE asked Dr. Stamp if he could tell them quite briefly what he referred to at the very end in the corrected " C " line of the last table, the improvements in statutory powers exercised by the Inland Revenue which they benefited by at present, and which were 10 per cent. some forty-five years ago, as it would be interesting to know.

Mr. W. TETLEY STEPHENSON said he had spent most of his time in the railway industry, and had been particularly interested in consequence in the figures that Dr. Stamp had put forward in connection with the railway experience. He had compared the movements in railway profits with the movements in the prices of coal. He thought he would have found, if he had made use of iron along with coal, that he would have got an even closer relationship to the movements in railway profits. The iron industry was obviously very closely affected by coal prices, and iron in its various forms was enormously used by the railway industry. Then of course one was without Dr. Stamp's raw materials ; and the railway tonnage figures as available in this country were figures which Dr. Stamp had taken from the Board of Trade Railway Returns or from railway reports, and were figures which meant very different things at different times.

That Dr. Stamp had had to use them, such as they were, might tend to make an error which over short periods was not important, but over long periods might be substantial. For instance, he showed that the railway tonnage over some period came to ·29 per cent. too low as a guide to Schedule D assessments. During that period there had been quite a number of railway amalgamations. Railway statistics were in as bad a state almost, or were up to 1913, as the statistics of any industry in this country. Each railway counted each ton of goods it carried as a ton, regardless of the fact of how many times it had been counted by other railway companies. If two railways amalgamated, as the Chatham and Dover and the South Eastern did, then the whole exchange of traffic between them immediately became a single ton for each ton of goods, instead of being 2 tons for each ton of actual goods. Taking years in which changes of that sort took place, or such a year as 1898, when the Great Central extension to London was opened and all the traffic from the old Sheffield and Lincolnshire line coming to the south ceased to be transferred to other railways, as the Great Central naturally put every ton of its traffic that it could over its new line, the effect on the counting of tonnage twice over was substantial. It was only for 1913 that the actual figures of the real railway tonnage were available, and all the time there was that effect taking place. Even in 1913 the true tonnage as compared with the individual line tonnage was very nearly a matter of 2 to 1, so it would be appreciated how much greater the error was when the railways were more divided up, and it would not be at all surprising if, could corrections be made on that account, the error in the railway tonnage figure was very much less than the comparatively small error that Dr. Stamp had noted. He knew at the present time that paper, printing and so on made it impossible ; but he hoped that at some time Dr. Stamp would give them the opportunity of seeing the big mass of raw material which must have formed the foundation of his exceedingly interesting Paper.

The CHAIRMAN, in putting the vote of thanks to the meeting, said that as one who used a great many years ago to take an interest in Inland Revenue statistics, he wished to say how interested he was in Dr. Stamp's work. It seemed to him that what he had done would make the statistics of income derived from income tax data, which one hoped would one day appear, of very much greater value and importance than they had hitherto been.

Dr. STAMP, in reply, said he thanked them for the expressions they had been good enough to make. Professor Edgeworth had referred to the fact that although a passing reference had been made to multiple correlation, it had not as a matter of fact been brought into the Paper. There were a great many tests which he had used from time to time but had excluded from the Paper for considerations of space ; but perhaps in this case he had another consideration, for he had never seen the theory of multiple correlation applied to this class of statistics, and thought there might be latent perils in

it. He had applied it with different results, so far as he could, to verify the conclusions in the Paper. Then Professor Edgeworth had referred to the curious " forward lag," to use an Irishism. The question of that " lag " in profits would be seen to be for the most part a question of income tax law. He had been puzzled for some time, because he could not understand why the " lag " of profits for a year should give a high correlation in the coal industry, until the " 133rd Section," known to many officials there, occurred to him. That accounted fully for the phenomenon. What happened was, that when they had a long series of falling prices, they kept advancing their profits a year beyond the date they really looked like. A correction was made, and a sort of relief was given (which was explained in the Appendix) which had the effect of advancing some of the profits in the aggregated three years' average in this particular case, as compared with the five years' average ; and in order to get the true comparison with the figures appearing in the statistics, it was necessary to take account of that, though not as to the whole of it, because much of it was given effect to after the statistics were made up. He had, however, no doubt from the practice in the seventies that there was a very considerable effect on profits. Professor Edgeworth had referred to the question of the effect upon incentive of the 8o per cent. excess profits tax, and the question of the amount of profits a man was able to retain. There were many of them fully alive to the effect upon incentive at the present time of the very high rate. In the case of a man who had not great incentive to exert himself beyond a particular point of fatigue or responsibility, there was a great tendency for a high duty to take away that incentive and reduce total output. Mr. Crammond had referred to the question of the effect of profits upon production. In so far as output was a measure of production, he had dealt with it as far as he could in the Paper. The question of the relationship between the two was rather a different question from the question to which he had been directing his attention. Although he had often referred to " prices " as having an effect upon profits, at the beginning of the Paper he was careful to say they were not trying to trace causal relationship so much as concomitant variation. He was content to say that the two things varied together without saying which was doing the " shoving." They might reverse it, and say that the high profits a man made this year would be causal in regard to a big output next year, because he will be stimulated to secure more. One of the general conclusions about profits was, that the stimulus of high profits conduced to additional output enough to pull down those profits in the course of a year, unless the stimulus was revived by a new increase in price. Then Mr. Crammond had referred to the interesting question of the national income. It would require a separate Paper to consider the national income now as compared with 1913. One would first of all have to decide on two very broad questions : whether the change from unpaid work that was done by wives and mothers in the homes before the war, and which was never entered in the national income but which was now to some extent replaced,

to actual money paid work, was a true change in the national income, and whether there should not be some sort of valuation of the pre-war services performed. Some of those services were now not performed or only partly performed. That question as to whether married women's labour before the war should enter into the computation of national income, became now very acute in relation to the question of the change of their labour. Then there was also the question of the 5 or 6 million men who were taken away from the ordinary competitive wage market which they were in before the war when their income was included in the national income, but who were now being only paid what was a conventional figure. Who was to say that the proper figure to be applied to those soldiers was the actual 1s. or 1s. 6d. which they might receive ? Is that the economic equivalent, if it is not in competition with industry but under duress of patriotism or conscription ? There was such an extraordinary difficulty attached to a comparison between those two things. It was rather doubtful whether the two things could be really compared —what the national income was before the war and since. Mr. Percy Wallis referred to the very interesting question of the influence of price on production. That was rather outside his subject, but it was dealt with to some extent by Mr. Robertson in his study of industrial fluctuation. He was content to say that profits had risen from a certain output or a certain price, without insisting on any correlation, which might extend from the profits a man makes one year to those he might make in the next year. Mr. Dibblee had referred to the " C " line in the last graph and to the question of statutory improvements. There had been statutory improvements from time to time. There had been improved methods, penalties, and provisions dealing with various points in accounts and so on, but that was not the really important feature. The whole orientation of income tax had changed. The income tax administration was something for which local officials or commissioners were strictly responsible ; and there was a government official placed in each locality to see that they did their work and to get a reasonable amount of uniformity. In the early sixties, one had only to read the annual reports of the Commissioners of the Inland Revenue at that time to see how aloof they stood from the actual administration, and how little responsibility they were ready to take for evasion and fraud. Their own officials had very limited powers in securing true results, and therefore it was not for them to be responsible. But from that time, and particularly in the campaign of efficiency which took place in the early sixties, there had been a gradual change in the spirit of the thing, and most people now looked upon the Government official as the true mainspring of the machine, and the local Commissioners as a sort of watch-dog to see that he did not lead the taxpayer astray. The effect of higher rates of income tax and the permanence of the tax had been that it has become continually and progressively better in its administration. That was what he really referred to in the Paper, and it was stated *in extenso* in his book on *British Incomes.* By improvement

in administration rather than in statutory points it had been brought about. Mr. Stephenson, whom he respected as probably one of our greatest authorities on the subject of railways, had spoken to them in a very interesting way on railway figures. He (Dr. Stamp) was fully alive to the danger of railway amalgamations and so on ; but he would point out that in so far as railway amalgamations were in any way constant, then the secular trend method got rid of the difficulties. In so far as they were not constant but occurred at isolated intervals in a particular year, then the method of differences corrected them, because a wrong difference would result for a particular year ; but it was only one difference out of 30 or 35 and could not affect the coefficient very seriously, and then only adversely. If they corrected that error and there was a tendency for the coefficient to be a high one, the probabilities were that the true coefficient would be rather higher than lower than the one shown. So that by combination of the two methods one could avoid the two classes of danger. He had felt a little distrustful of using the quantity of minerals and goods which were carried over the railways as a test of the quantity of trade, and that was why he had introduced a term into the Paper in a part which he had not actually read called " Bank Quantities." Explaining it briefly, he had rather imagined the Banker's Clearing House figures, if they could eliminate the question of change of price, were some indication of the output of business ; so he had taken out a triple index number of the wholesale and retail lines, and divided the Bank Clearing House figures by the price index in order to get the bank quantities. The effect was extremely violent ; and, on reflection, he came to the conclusion that it was wrong to alter the whole of the bank clearance figures, because so large a part of the bank clearances related to transactions over which price had little influence, such as the payments of debenture and mortgage interest and regular rents, and all sorts of customary payments not influenced by prices. Eventually, he had divided half the bank clearances by the price as being that portion of the bank clearances that would fluctuate with price, and add it on to the other half, and that was the figure which had been dealt with and correlated in the Paper. He would like to have heard the leading authority on the subject of Banker's Clearing House figures, Mr. Holland-Martin, on the possibility of his having gone astray on them, but he was prepared to take his silence as a favourable indication. His feeling about the whole subject was that it was a difficult one, but that it was worth attempting to get some assistance to economic truth from statistical aids, and he merely felt about it that there were so many mathematicians in their Society who could have done better work than he had done that he merely might have spoilt a very good dish of cream by clumsy skimming.

The following Candidates were elected Fellows of the Society :—

Dr. Francesco Giannini.
George Philip.
Alfred Smith.

Francis O. Andrews Speed.
Frank P. R. Tibbles.