



I Discovered the Phillips Curve: "A Statistical Relation between Unemployment and Price Changes"

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Lost and Found

I Discovered the Phillips Curve

Irving Fisher

Yale University

EDITORIAL NOTE.—It is not generally known that the first statistical investigation of the relationship between inflation and the unemployment rate was performed not by A. W. Phillips in 1958 but by Irving Fisher in 1926. The editors are pleased to celebrate the forty-seventh anniversary of Fisher's seminal discovery by reprinting it in its entirety (by permission of the *International Labour Review*). They are grateful to Professor Jacob Mincer of Columbia University, who accidentally discovered it on a recent archaeological expedition. (The article was independently discovered by A. Donner and J. F. McCallum, who cited it in their "The Phillips Curve: An Historical Note," *Economica* [August 1972], pp. 322–23.)

A Statistical Relation between Unemployment and Price Changes

Professor Irving Fisher

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The possible relation between changes in the price level and changes in the volume of employment, much discussed by economists at the present time, has already been debated in the pages of the Review. In the present article Professor Fisher, one of the foremost authorities on monetary problems and for years a protagonist of stabilisation, removes the question from the sphere of controversy to that of exact statistical research. He has found a remarkably high correlation between the rate of price changes and employment, and he describes the methods by which he has achieved this result. The data used refer exclusively to the United States, and further research would be required before the conclusions could be applied directly to other countries. Nevertheless, this objective statistical confirmation of a relation long asserted to exist is a highly important step in advance.

From *International Labour Review* 13, no. 6 (June 1926): 785–92.

In a matter as intensely human as the employment problem it seems a far cry from money and banking to an explanation of why working men are thrown out of jobs. And yet, in the significant period 1915–1925, analysis shows a Pearsonian correlation as high as 90 per cent, between the rate of change in the value of the dollar and unemployment in the United States.

The fact that deflation causes unemployment has been well recognised for many years in isolated instances, such as the great deflation of 1921 in America or the corresponding post-war deflation in Great Britain, Czechoslovakia, or Norway. It has likewise been recognised that inflation carries with it a great stimulation to trade and an increase in employment (or decrease in unemployment). And yet, strange as it may seem, when applied to the so-called “business cycle”, these relationships have been almost wholly overlooked. When, for instance, Mr. Hoover had his committee of experts study unemployment and make a report to him three years ago, almost every other factor that might influence employment was given careful consideration, but references to inflation and deflation were almost wholly absent¹.

It would also seem that many economists and statisticians ascribe a sort of fatalistic nature to the so-called business cycle. At any rate, when studying this ebb and flow of the tides of business and industry, they seem to forget to give any serious consideration to inflation and deflation. In consequence we have the anomaly that, while it is a commonplace that long-continued or sharp inflation or deflation will be reflected in the figures of employment or unemployment, nevertheless, when it comes to the alternation of what is called (or miscalled) “the business cycle”—booms and depressions in trade, times of full employment and great unemployment, occurring in rapid succession—the relation of these phenomena to money and banking is largely forgotten.

Having been interested for many years in all the effects of changes in the purchasing power of the dollar—in other words, in changes in the general level of prices—I have long studied the effects of those changes on employment, as revealed by statistics. During the last three years in particular I have had at least one computer in my office almost constantly at work on this problem, and have made reports of progress at various meetings of the American Statistical Association. Last June a final report was made, on the effect of changes in the purchasing power of the dollar on the so-called business cycle².

What is here presented is largely based on that report, but has special reference to unemployment. In that report a correlation was found even

¹ *Business Cycles and Unemployment*. New York, McGraw-Hill Book Co., 1923. XL + 405 pp. Cf. pp. 270–271: “Proposals to Stabilise the Dollar”.

² Irving FISHER: “Our Unstable Dollar and the So-called Business Cycle”, in *Journal of the American Statistical Association*, June 1925, pp. 179–202.

higher than the 90 per cent for employment reported here, namely, 94.1 per cent. That is, by correlating the volume of trade³ with the *changes* in the price level, not with the price level itself, and assuming a certain “distributed lag” between the two, we obtain this high correlation of 94.1 per cent. (+ 941). This correlation is so high as largely to explain the major fluctuations of the so-called business cycle without reference to any of the conventional explanations.

This high correlation reinforces my extreme scepticism about the necessary existence, in any important practical sense, of “the business cycle”, though I realise that there must be present many diverse influences affecting the ups and downs of business. Or rather I believe that there are always many cycles, more or less blended, but that they are so intertwined that the “business cycle”, or net resultant behaviour of business, as we see it in the statistics of trade, is largely a reflection not of those numerous and conflicting cyclical movements so much as of the course of our unstable dollar.

The correlation for unemployment, while not quite as high as for trade, is sufficiently high to enable us to say that for the period considered—between 1915 and the present—changes in the purchasing power of the dollar may very largely explain changes in employment. The principle underlying this relationship is, of course, familiar. It is that when the dollar is losing value, or in other words when the price level is rising, a business man finds his receipts rising as fast, on the average, as this general rise of prices, but not his expenses, because his expenses consist, to a large extent, of things which are contractually fixed, such as interest on bonds; or rent, which may be fixed for five, ten, or ninety-nine years; or salaries, which are often fixed for several years; or wages, which are fixed sometimes either by contract or custom, for at least a number of months. For this and other reasons, the rise in expenses is slower than the rise in receipts when inflation is in progress and the price level is rising or the dollar falling. The business man, therefore, finds that his profits increase. In fact, during such periods of rapid inflation, when profits increase because prices for receipts rise faster than expenses, we nickname the profit-taker the “profiteer”. Employment is then stimulated—for a time at least.

The ultimate effects of a long-continued inflation are doubtless bad all round, and even during the period when it does help to provide jobs for the labouring man it raises the cost of living against him.

On the other hand, when prices are falling, expenses likewise lag behind and reduce profits, for exactly the same reason turned about. Consequently, during periods of falling prices profits are reduced, bankruptcies are increased, concerns shut down entirely or in part, and men are thrown out of work.

Therefore, what we find in our statistics is exactly what we would expect,

³ According to the indexes worked out by the Harvard Committee on Economic Research.

namely that unemployment is correlated with the purchasing power of the dollar.

A word may be said here as to the technique of the statistical analysis used and to explain why this close correspondence between unemployment and changes in the purchasing power of money has been so often overlooked. The primary reason is, I believe, the failure to perceive the immense difference as regards influence on business between the price level and changes in the price level, between high and low prices on the one hand and the rise and fall of prices on the other.

It is not a high price level that makes for full employment or a low price level that makes for unemployment. Whether a price level is high or low has, in the long run, nothing whatever to do with employment. We might have a price level one hundred times as high as we have today; and yet, as long as it remained at that height without rising or falling for a period of years, there would be no reason to expect, as a consequence, any especially full employment.

Again, we might have a price level ten times as low as our present price level, and yet, if it remained there, it would not tend to create depression of trade or unemployment. But if we sink from one level to another, then, during the time of falling, we do produce depression of trade and unemployment. Reversely, if we rise from one level to another, then during the period of rising we do for a time produce more employment.

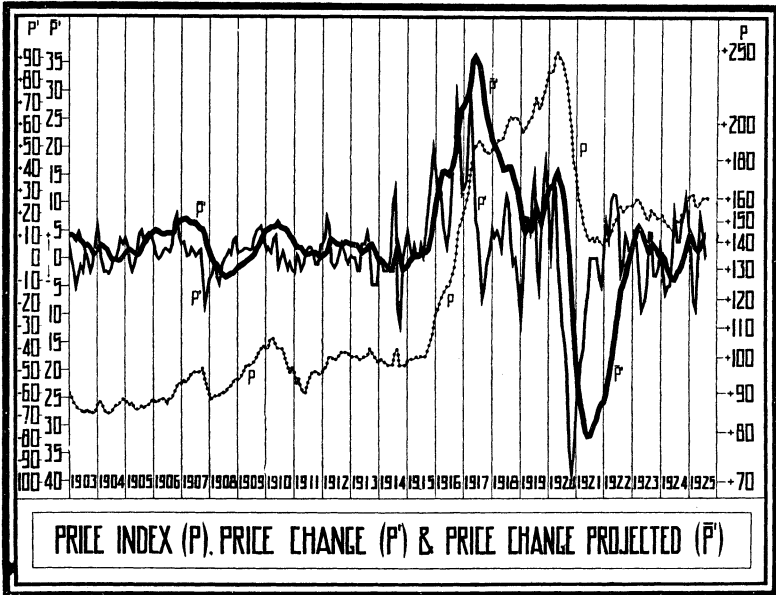
In running an automobile we know that it takes no more petrol on a high plateau than on the lowlands, but that it does take much more petrol when we are going uphill; and, on the other hand, takes less when we are going downhill. It is the going uphill or downhill of the price level on which we should fix attention. We need to picture not merely the price itself, but its rates of change.

In Chart I we see at the bottom a curve P , tracing the price level in the United States between 1903 and 1925. It oscillates somewhat, but rises gradually to 1916 and then suddenly, as a consequence of the war inflation, goes up, at first very rapidly, reaching its peak in May 1920, from which point it falls back about halfway to January 1922. From that time it oscillates somewhat, but not as violently as before.

If now we try to correlate this curve with a curve for employment or unemployment, we find very little relationship. But if we take the rate of change of this curve and plot it, we find a very close relationship. Let us look at the curve called P' , which oscillates very rapidly. This P' indicates the rate of change of the lower curve P . That is, while P represents the price level itself, P' represents its "first derivative", or rate of change.

This relationship between P' and P is in essence very simple. When P is running horizontally, whether it is high or low, P' is zero, because there is no rise or fall. When P is running uphill, P' is high. When P is going downhill, P' is below zero.

Now we find that P' is more intimately associated with employment than



is \bar{P}' . But some further analysis is required to exhibit that relationship clearly. This is done by means of a third curve \bar{P}' , derived from the second. \bar{P}' is a sort of moving average of P' , projected forward. But it is better and clearer to think of \bar{P}' as a certain composite of P' , on the hypothesis that the effect is distributed. In other words, P' is considered as having its effect on employment, not all at once, but after a certain lag. If this lag were a fixed lag we would merely need to shove the curve P' bodily ahead by a certain number of months. This is the usual statistical technique in connecting one curve with another by a lag.

But it stands to reason that correlating with a fixed lag is an extremely inadequate method; for if, at any one time, inflation is going on rapidly, as shown by the rapid ascent of the P curve (or the high peak of the P' curve), the effect on employment will not certainly wait for seven months and then suddenly explode, or be felt all at once, and after that not be felt at all. Instead, its effect will be distributed. It is on this consideration of the actual facts of economic action that I have introduced the idea of a distributed lag. The law of distribution of the lag is somewhat analogous to the typical law of errors, expressed by the corresponding frequency curve. Having tried various types of frequency or probability curves, I have found that one approximating to a simplified "geometrical" probability curve (a curve which, if plotted on logarithmic paper, is a "normal" probability curve) seems best suited to show the effect of P' on unemployment or employment.

The details are fully explained in the paper already referred to. There the distribution of the effect is somewhat as follows: for any particular

spurt P' in prices, about three per cent. of the effect will be felt in a month; six per cent. in the second month; seven per cent. in the third, fourth and fifth months respectively, after which the effects will gradually taper off⁴. In the case of price changes and unemployment the tapering off is very abrupt instead of gradual.

For any one point of time we can now build up, from the effects of a certain aggregate of previous $P's$ —or spurts of pieces upward or downward—their full effect as felt at that one point of time. So built up, we get the curve \bar{P}' (magnified vertically in order to make it more comparable with the other curves). We have now reached \bar{P}' as derived, in two stages, from the curve P . This \bar{P}' represents the composite effects of the rates of rise and fall of the price level, or the “dance of the dollar”.

We next note in Chart II the relation between this dance of the dollar as shown by the curve \bar{P}' , and the fluctuations in employment as shown by the curve E . The dotted curve E represents employment according to the statistics of the Harvard Committee of Economic Research⁵.

It does not require any correlation coefficient to see that there is a remarkably strong resemblance between the two curves, not only between their major fluctuations but also, one is tempted to believe, between their minor changes, as seen from month to month. We notice, for instance, a clear relationship in the depression of 1908, as also in the boom period of 1917, and in the recession of 1921.

The correlation between \bar{P}' and E for the period 1915–1925 is 90 per cent., as already stated⁶. The question now arises whether this conclusion (i.e. of a strong connection between price changes and unemployment) may not be partly vitiated by the fact that I have adjusted the type of probability curve underlying the lag, selecting it out of various possible types of probability curves as the one which gives the maximum correlation. In order to test this, as will be seen from the article referred to, I have applied the curve type with which the maximum correlation for one period was obtained to other periods for which no such selection was tried; and, *vice versa*, I have tried for the maximum fit for the first period and also

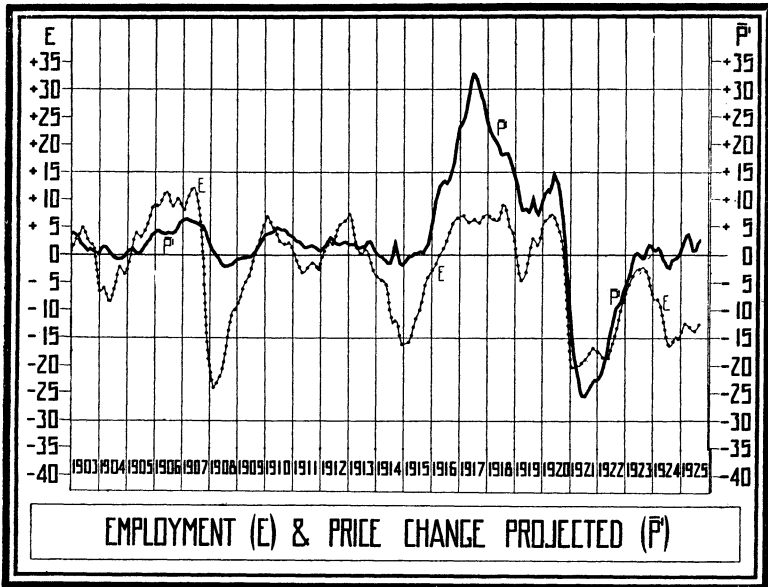
⁴ In the present paper the correlation is based on the simplified method described on p. 198, note 1, of “Our Unstable Dollar and the So-called Business Cycle”. The short time between the outbreak of the war and September 1915 was excluded because, as indicated in the article cited, the influence of the sudden outbreak of the war is irrelevant to this study.

⁵ The Committee obtained its material from various sources, including statistics of both employment and unemployment. These were put together into one index after verifying the strong inverse correlation between them.

⁶ This high correlation can be obtained only by employing the method of “distributed lag”.

The highest correlation between price-change and employment with a fixed lag is only 79 per cent. This is for a lag for four months. A three months' fixed lag reduces it to 62 per cent. On the other hand the use of a properly distributed lag raises the correlation to 90 per cent. These figures are all for the period September 1915–December 1924, during most of which violent price changes were occurring. For periods of less violent price changes the correlation is less.

for the second. It turns out that the lowering of the correlation thereby caused is almost negligible. The calculations were carried back to 1877, the earliest time for which the statistics are available.



We may, therefore, feel certain that changes in the price level do definitely foreshadow or anticipate changes in employment. Of course, this relationship might conceivably not be causal. So far as the statistics are concerned, instead of P' being the cause of E , both might conceivably be caused by some third influence. Or it might be conceived that price-change simply represents a forecast of good or bad business. In fact, I have little doubt that both these views contain elements of truth.

But as the economic analysis already cited certainly indicates a causal relationship between inflation and employment or deflation and unemployment, it seems reasonable to conclude that what the charts show is largely, if not mostly, a genuine and straightforward causal relationship; that the ups and downs of employment are the effects, in large measure, of the rises and falls of prices, due in turn to the inflation and deflation of money and credit.

In short, facts and theory both indicate that in the "dance of the dollar" we have the key, or at any rate a very important key, to the major fluctuations in employment. If this conclusion be sound, we have in our power, as a means of substantially preventing unemployment, the stabilisation of the purchasing power of the dollar, pound, franc, lira, mark, crown, and any other monetary units.