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THE PROBLEM OF VERIFYING THE THEORY OF TECHNOLOGICAL UNEMPLOYMENT

BY ALFRED KÄHLER

I

The Development of the Problem

1. The Situation in Germany

Socialist theory in Germany before the World War was for decades closely bound up with the concept that mechanization of production must permanently increase unemployment. Marx had used this "displacement theory" as the central point of his entire system. It served as the essential basis for the doctrine of the "industrial reserve army," which in turn was basic for Marx's theories of wages, profits and the collapse of capitalism. In the last decades before the war, however, the advocates of this theory found themselves very much on the defensive. It is true that the many theoretical attacks upon the displacement theory were incomplete and could be refuted, but on the other hand it was not possible at that time to verify the theory statistically. Even though unemployment rose in crises, it continued to fall to a minimum again in periods of prosperity. Werner Sombart[1] attempted to reconcile the theory with economic development by asserting that Marx claimed not that unemployment would steadily increase but that average unemployment throughout the cycle would increase. A small amount of unemployment in a period of prosperity need not therefore be any proof of the incorrectness of the displacement theory, if only unemployment increased from crisis to crisis. But even this increase from depression to depression was difficult to demonstrate. More-

[1] Sombart, Werner, review of Wolf, Julius, *Sozialismus und kapitalistische Gesellschaftsordnung* in *Archiv für Soziale Gesetzgebung und Statistik*, vols. 5 and 6 (Berlin 1892).

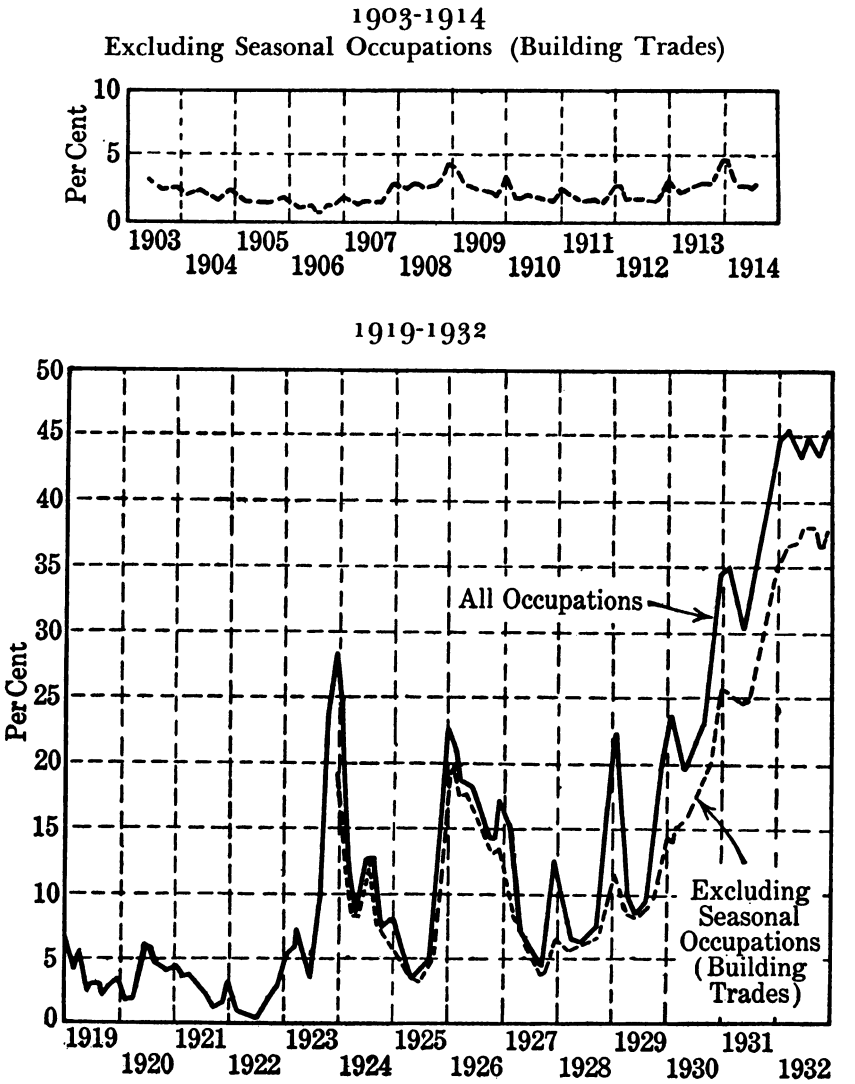
over, since the Marxian displacement and cycle theories were only loosely connected, it was difficult to see how cyclical unemployment might be used as statistical proof of the displacement theory.

Another phenomenon in Germany also worked against the displacement theory. Although mechanization occurred in the main in manufacturing, employment opportunities diminished only in agriculture and increased relatively fast in manufacturing. Franz Oppenheimer[1] then concluded that it was not the machine but the legal relations governing the ownership of land in agriculture which were the real cause of the displacement of labor.

But since in the last prewar decade unemployment was not very large even during crises, the controversy over the displacement theory subsided. The theory certainly was not disproved; nevertheless it was not possible to discover statistical proof of the accuracy and significance of its approach. In the postwar years, on the other hand, almost every country showed an extraordinary amount of unemployment, but for a long time it was explained as a consequence of the war and of the so-called structural changes in world economy. Until 1923 Germany was one of the exceptions to this general situation. Almost to its very close inflation was able to keep unemployment very low or at least within the limits of prewar unemployment. Inflation was followed by a stabilization crisis, which was succeeded after a few months by an expansion of credit and declining unemployment. Germany then entered upon its period of rationalization, in the course of which all economic groups, including the trade unions, advocated most enthusiastically a policy of imitation of the much admired increase in productivity in the United States. The first great cyclical crisis in 1926, which sent unemployment to a level three times as high as the prewar level (see CHART I), failed to disturb the belief in the unqualified advantages of mechanization. Not until the following year did skepticism creep in, when despite an extraordinarily vigorous cyclical recovery, unemployment fell below one million for only

[1] Oppenheimer, Franz, *Das Grundgesetz der Marxschen Gesellschaftslehre* (Jena 1926) p. 56.

CHART I. UNEMPLOYMENT IN GERMANY BY PER CENT OF TRADE UNION MEMBERS (A.D.G.B.)[a]



[a] Figures for 1903-29 from Woytinsky, W., *Der deutsche Arbeitsmarkt* (Berlin 1930); figures for 1930-32 from *Gewerkschafts-Zeitung* (A.D.G.B.), Berlin.

two months and then increased in spite of further expansion in production. In 1928, the year of greatest industrial production,

trade unions already reported an average unemployment of 8.5 per cent among their members while the available statistics on the prewar period showed that between 1903 and 1914 unemployment did not rise above a yearly average of 3 per cent, even in depressions (see CHART I). The iron and machine industries did not reach their production peaks until 1929, a year during which two million were unemployed. This increasing unemployment without actual cyclical collapse slowly changed public opinion concerning the effect of the machine. The science of economics, however, remained silent for a long time, except for Birk's published address,[1] which appeared as early as 1927 and which returned completely to the old prewar displacement theory. Only in the succeeding years, with unemployment of from three to six million, did German economics turn back more and more to the old theory. The situation was similar to that in the crisis year of 1821, when Ricardo in the third edition of his *Principles* asserted for the first time that he had changed his opinion regarding the problem of the machine and that he no longer believed that the introduction of the machine was always an advantage for all classes.

Following the general change in opinion in Germany there appeared an extensive literature on the question of displacement, which, however, was almost exclusively theoretical in nature. Again the argument was advanced that mechanization must under certain circumstances cause an increase in unemployment. On the other hand, hardly anyone tried to cite the existing large unemployment as direct statistical proof of the correctness of the displacement theory. As in the past, this unemployment was considered to be cyclical in character, and therefore to be differentiated from real technological unemployment.

2. The Development of the Problem in America

A similar situation arose in the American literature, although here attention was centered mainly upon the statistical investiga-

[1] Birk, L. V., *Technischer Fortschritt und Überproduktion* (Kieler Vorträge, Jena 1927).

tion of the question of displacement. There were also many studies of individual industries which took the position that workers are displaced by machines and often demonstrated that displaced workers were not reemployed in the same industry. One need only refer, for instance, to the publications of the Department of Labor concerning the amusement industry, agriculture, the tire industry, the electric lamp industry and other industries. But against these monographs favoring the displacement theory, W. I. King[1] could point out that in 1929, at the end of the period of prosperity and apparently also at the end of an extended period of rationalization in the United States, there was only a relatively small amount of unemployment; from this it was concluded that only to a small extent could mechanization be held responsible for the unemployment that arose later. According to King, this unemployment was far more a consequence of the decline in the volume of production during the depression, and "it is absurd to blame technological improvements in methods of production for the evils resulting from our antiquated and unsound monetary system." If the displacement theory, however, is not permitted to draw upon the unemployment which has developed during the crisis, then statistical proof of its correctness still remains impossible, since in the most favorable moment of the last prosperity period there was indeed no substantial unemployment. The question is therefore whether the statistical verification of the displacement theory must limit itself to the period of prosperity or whether in building up its evidence it may also utilize the unemployment which developed during the crisis.

Naturally, the answer to this question cannot be given on a purely statistical basis. We must first consider the arguments which the displacement theory offers for the proposition that the machine causes unemployment. Only then will we know what series might be necessary in order to undertake a statistical verification of the theory and how much of the unemployment might, in the most favorable case, be associated with mechanization.

[1] King, W. I., "The Relative Volume of Technological Unemployment" in *Journal of the American Statistical Association, Proceedings* (1933) pp. 33-39.

II

The Bases of the Theory of Labor Displacement

There are three groups of factors leading to disemployment which singly or in combination determine, according to the labor displacement theory, the development of unemployment. These groups of factors constitute the demand, capital and disproportionality arguments of the displacement theory.

1. The Aggregate Demand Argument

The factors in the first group are the most familiar. Here it is maintained that the machine makes it possible to satisfy a given demand for goods with fewer workers. The intensification of labor results in a reduction of the labor force, which can be avoided only if the market for goods is expanded. The theory of compensatory adjustment assumes that such expansion of markets must occur automatically, since the funds saved on the wage bill must reappear either in the hands of entrepreneurs or, because of price declines, in the hands of consumers. These funds are sufficient to reemploy the displaced workers. The only condition for the validity of this argument is that the existing volume of currency remain unchanged; the latter is indeed not affected directly by the mechanization of production.

It is easy to demonstrate, however, that ordinarily a constant volume of currency is insufficient to permit a complete compensatory adjustment. Let us assume, for example, that, with aggregate physical production and prices remaining unchanged, the funds saved on the wage bill are transformed into property income; that is, are paid out in the form of profit or interest. The displaced workers are then eliminated as purchasers of goods, which are acquired by the recipients of the additional property income. The existing volume of currency is thus completely used. To reemploy the displaced workers the volume of currency must then be increased.

If prices decline the required expansion in currency need not be as large. But even then complete compensatory adjustment without

some addition to the volume of currency would be possible in only a few cases, for technological progress usually involves an increase in interindustrial exchanges (Böhm-Bawerk's *Zwischenumsätze*). The widening spread between the aggregate value of product and the aggregate value "added by manufacture" absorbs a certain amount of currency, so that even with falling prices an expansion in currency is needed, unless of course the price decline proceeds at a more rapid rate than the rise in productivity. The latter condition, however, implies a crisis and may therefore be disregarded for the purposes of this argument. In fact prices cannot always decline as much as the decline in labor cost, because higher productivity is as a rule achieved with the aid of larger capital investment; on account of the resulting increase in interest payments it is impossible to reduce costs and prices by the full amount of the saving in wages. This is commonly overlooked, because a rise in productivity is generally described as an increase in the net product per labor unit and no attention is paid to capital, the second production factor.

It follows therefore that unimpeded reemployment of displaced workers requires an increase in the volume of currency. Only so long as this takes place will there be, on the side of aggregate demand, no obstacles to compensatory adjustments. If the expansion of currency ceases, newly displaced labor cannot be reemployed without more than proportional declines in prices. It may be added further that if the volume of currency is eventually reduced the compensatory adjustments already accomplished would necessarily be undone.

The business cycle has a bearing upon this theory in that during prosperity, when credit is expanding, compensatory adjustments should take place quickly. In depression, on the other hand, deflation increases and prolongs labor displacement.

2. The Capital Argument

The main, and also the oldest, argument in support of the displacement theory is that centering upon capital. In Ricardo's life-

time this was of necessity also the only argument. To begin with, Ricardo like Smith assumed the existence of an unlimited desire to consume. Moreover he subscribed to Say's theory of markets, according to which the supply of one good is regarded as demand for other goods, so that he could not properly evaluate the insufficiency of aggregate demand as an obstacle to the reemployment of displaced labor. Finally, economic theory had not yet become aware of disproportionalities as a cause of major economic disturbances and serious unemployment. Thus the only factor determining the required number of workers was the magnitude of available capital. To this Ricardo added, in the chapter on "Machines" in his *Principles*, that the machine transforms circulating capital into fixed capital, or, in Marxian terminology, variable capital into constant capital; or, to use the approach of Böhm-Bawerk, mechanization intensifies the roundabout character of production. In each case the intention was merely to show that the introduction of machinery increases the amount of capital required per worker and therefore, with a given capital volume, reduces the number of employment opportunities, thus leading to displacement of labor. Compensatory adjustments cannot take place immediately because the accumulation of capital requires considerable time.[1]

The logical soundness of this fundamental argument in support of the labor displacement theory can scarcely be doubted. Its statistical verification is, however, much more difficult. It is necessary to show that labor is disemployed because of the shortage of requisite technical equipment. But according to the studies of the Loeb group[2] and of the Brookings Institution[3] there were available in the United States even in 1929 sizable reserves of physical productive capacity, although unemployment was but slight. How is it

[1] A critical discussion of the theories bearing on this question is to be found in Kähler, Alfred, *Die Theorie der Arbeiterfreisetzung durch die Maschine* (Leipzig 1933).

[2] Loeb, Harold. *The Chart of Plenty* (New York 1925).

[3] Nourse, Edwin G., and associates, *America's Capacity to Produce* (Washington 1934).

possible then to explain disemployment by shortage of capital? Yet, despite this apparent contradiction, the capital argument is significant. For productive capacity must be interpreted to include not plants of every description but only those which are modern enough to be operated under current market conditions. Technological progress continually renders plants obsolete; although they are still in existence they are dead from the economic point of view. Such a definition of economically relevant productive capacity naturally adds to the difficulties of statistical measurement of production reserves, but statistics which do not take account of the feasibility of profitable operation are valueless.

Another question to be mentioned here is that concerning the periodic character of disemployment. This requires an explanation, for the reduction in employment opportunities must be assumed to proceed continuously unless for some reason the increase in productivity is periodic in character. The reason may be, as is often asserted, that the effects of technological progress are bunched at the end of a period of gestation for capital goods, a thesis which will be reconsidered in the statistical part of this article. Lederer[1] argues in this connection that disemployment is delayed during prosperity because inflationary price increases disguise the real unprofitableness of obsolescent plants. With the coming of price declines and intensification of competition, however, obsolete capital is destroyed and disemployment assumes the character of a mass phenomenon, while the newly accumulated capital makes only few employment opportunities because each labor unit requires a fairly large capital equipment.

3. The Disproportionality or Underconsumption Argument

If the two arguments for the displacement theory discussed above hold only with certain modifications which are closely related to the theory of business cycles, the disproportionality argument constitutes by itself virtually an entire theory of cycles. The starting

[1] Lederer, Emil, *Technischer Fortschritt und Arbeitslosigkeit* (Tübingen 1931) pp. 102-3.

point is again the saving on the wage bill with the corresponding reduction in purchasing power. Compensatory adjustments, however, are retarded this time not only by difficulties arising on the side of aggregate demand but also by incongruities between the expenditure-distribution of income and the composition of the output of the productive system. Whereas, according to the demand argument, the problem is merely one in the theory of currency and credit, the disproportionality argument centers attention upon all those doctrines of underconsumption which are closely linked with Rodbertus' name. That this involves questions other than those concerning the volume of currency was shown particularly clearly by Neisser.[1] Disproportionality, it is said, is due to the fact that saving on labor reduces the share of wages in the gross and net product. The weakening of consumer purchasing power thus effected would immediately result in the overstocking of markets if the funds saved from the wage bill did not reappear on the market as additions to property income. A change occurs nevertheless in the composition of demand, since the new income is spent in larger proportions on personal services and residential construction, or is more largely invested in industry and agriculture. The expansion in the demand for personal services and building construction is, however, a factor peculiarly favorable to compensatory adjustment. It permits the immediate reemployment of the displaced workers, creating at least for the time being new employment opportunities without necessitating additions to capital equipment. At the same time this type of compensatory adjustment protects the consumer goods markets from an immediate oversupply of merchandise since the reemployed workers resume their demand for goods. This unstable equilibrium of the economy depends, however, upon the continuation of demand for personal services and continued new investments in building construction and other production activities. And because the process of mechanization does not cease, the share of income going into capital investment

[1] Neisser, Hans, "General Overproduction" in *Journal of Political Economy*, August 1934, p. 433 and p. 465.

must eventually be increased even more. But the new houses require new tenants and the new investments in production a larger effective demand for consumer goods. Since, however, consumer purchasing power is kept low, marketing becomes increasingly difficult. To cope with this problem the distribution apparatus is enlarged, thus requiring more capital funds and larger stocks of merchandise. This expansion of commercial activity is itself an additional compensatory adjustment, though not quite a voluntary one.

Finally there is the development of instalment selling. The feasibility of this device as well as its necessity illustrates the lack of adjustment between production and consumer purchasing power. One invests capital in instalment finance in order in some measure to repurchase with it one's own output, or in order to make available to consumers purchasing power not afforded to them in the form of wages or salaries.

But these paths, too, lead to a dead end. Then the disproportionality between consumption and production makes further investment unprofitable. With investment in building construction and industrial equipment out of the picture, compensatory adjustments are eliminated. This implies a reduction in consumer demand and further diminution of investment opportunities.

Nevertheless there is no absolute oversupply of capital. The lack of adjustment between production and the ability to consume destroys investment opportunities for capital regardless of its magnitude, whether it be large enough to furnish modern equipment for all the workers or only for a small fraction of them. The disproportionality argument is therefore not inconsistent with the argument advanced above as to the time required for the accumulation of new capital in order to provide technical equipment for the displaced workers. The latter is the condition which enables employers to keep the labor share in the net product at a low level, which in its own turn is responsible for the fact that capital funds can be utilized only if investment proceeds on a large scale.

On the other hand, this "overcapitalization" theory is in flat

contradiction to Hayek's theory of crises.[1] According to Hayek production of goods of the higher order must cease because at the end of a period of prosperity there sets in a shortage of consumer goods. This reasoning flows logically from Böhm-Bawerk's theory of capital and from the opinion widely held among business cycle students that a crisis is immediately caused by the scarcity of capital. But the statistics of crises, particularly of the last one, are in all too flagrant opposition to this view.

The aggregate demand argument, discussed first, may once more be brought in at this point. If the volume of credit and with it of purchasing power is not expanded *pari passu* with the mechanization of production the overstocking of consumer goods markets will set in even more quickly.

III

The Statistics of Labor Displacement

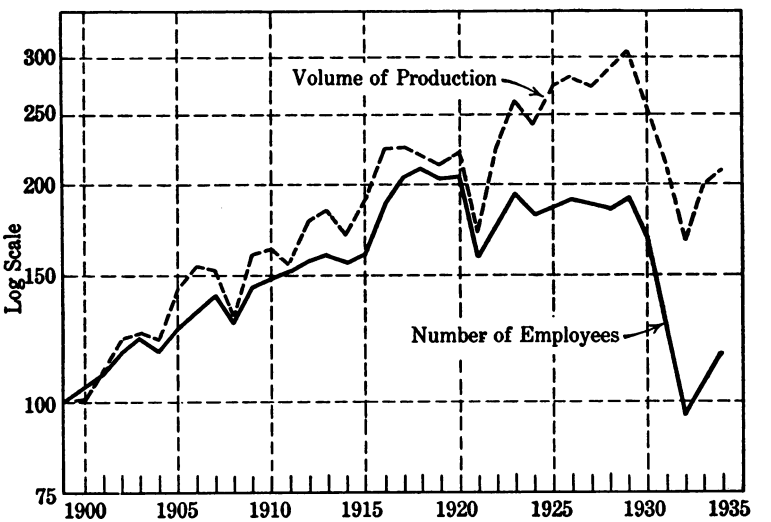
The preceding theoretical elaboration of the labor displacement theory has shown that its statistical verification or refutation demands the consideration of nearly all economic data. It makes assertions regarding money and credit phenomena, quantities of capital and relations involving capital, the distribution of income and disproportionalities in that distribution, increases in productivity, extent of employment, etc. One might therefore object that we are no longer dealing here with a mere consideration of the displacement theory, but rather with a consideration of the entire theory of the cycle. Whether this objection is correct or not, a fair evaluation of the displacement theory will always demand the weighing of all of these assertions. A static consideration of the problem which is too narrowly limited may actually be dangerous and may easily lead to erroneous conclusions. Naturally we too must limit ourselves here to the presentation of a few statistical series which are significant for the question of displacement.

The first question may well be whether after the war such ex-

[1] Hayek, Friedrich A., *Monetary Theory and the Trade Cycle* (London 1933) p. 56

traordinary increases in productivity were achieved as to justify the attempt to relate the present unemployment to technical development as a cause. The answer to this question can be given graphically by charting the development of the volume of manufacturing production and employment in the United States between 1899 and 1934. CHART II shows that until the end of the war

CHART II. VOLUME OF PRODUCTION AND NUMBER OF EMPLOYEES IN MANUFACTURING INDUSTRIES, 1899-1934 (1899=100)*



* Figures for 1899-1930 from Federal Reserve *Bulletin* (January 1931) p. 3 and p. 46; figures for 1931-35 are computed on the basis of the index of employment of the Bureau of Labor Statistics, the index of production of the Federal Reserve Board and the index of hours of work per week of the National Industrial Conference Board.

there was relatively little divergence between the two series. During that period an expansion in production called for a corresponding increase in labor. After the war, on the other hand, the volume of production continued to increase while the number of manufacturing wage earners remained constant or even declined. Although the composite curves tell us little about the developments in individual industries, still they do show that the mechani-

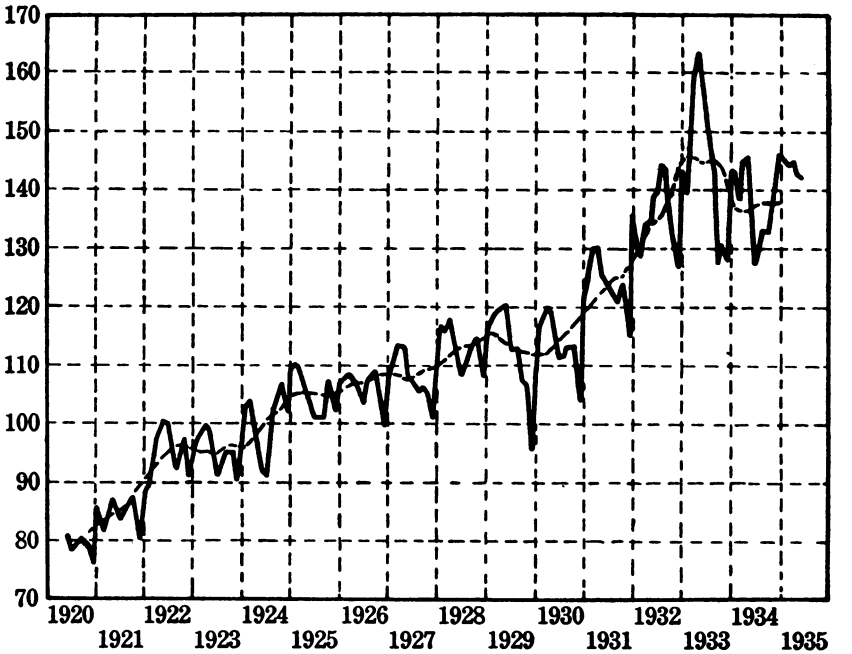
zation in the postwar decades was not simply a continuation of the prewar trend; it was in fact if not in appearance somewhat excessive, and may well have contributed heavily to the acuteness of the present depression.

More conclusions can be drawn from the curve of productivity for the period from 1920 to 1935, reproduced in CHART III. It is calculated from the monthly index of production of the Federal Reserve Board, divided by the product of the new Bureau of Labor Statistics index of employment in manufacturing industries, and the National Industrial Conference Board index of hours of work per week. The curve shows the gross value of product per hour of labor and should be distinguished from the curve of net productivity. The latter can only be based on the net value added by manufacture. Since mechanization tends to increase the consumption of materials per hour of labor, the increase in the net productivity of labor may be less than the increase in its gross productivity. Furthermore, the index should not be taken as absolutely accurate, since the data on which it is based are derived from various sources and do not cover identical groups of industries. The resulting error, however, probably does not seriously affect the utility of the curve for our purpose.

With regard to the composite curve it should be repeated in the first place that it indicates an extraordinary increase. This growth in productivity is distributed over the entire period. Nevertheless it is not difficult to establish that the periods of prosperity do not appear to have been especially favorable to increase in productivity. That is true of 1923, 1925 and 1929. Even more striking, however, is the rapid rise in the curve during the last depression, even granting that the peak figures for 1933 are accentuated by circumstances related to the uncertain currency and wages policy of that year. Possibly also the figures for 1932 are somewhat exaggerated, because the index of working hours is too sensitive. But the indicated general direction of the movement of productivity between 1930 and 1934-35 is probably hardly affected by these occurrences and these possible statistical errors. The result is important. It suggests

that a considerable part of the depression unemployment was brought about only after the break in the period of prosperity and as a result of the increase in productivity which then set in.

CHART III. OUTPUT PER MAN-HOUR IN MANUFACTURING INDUSTRIES, 1920-1935 (1923-25=100) AND TWELVE-MONTH MOVING AVERAGE[a]



[a] Calculated from the monthly index of production of the Federal Reserve Board, the index of employment in manufacturing industries of the Bureau of Labor Statistics and the index of hours of work per week of the National Industrial Conference Board.

The output per man-hour in 1933-34 was on the average not less than 25 per cent higher than the average for the year 1929, which meant that with the same volume of production, man-hour employment opportunities would be reduced by 20 per cent. Since during the depression the compensatory adjustments described in the first part of the article were not carried out, a portion of the present unemployment corresponding to this figure is directly

traceable to mechanization or rather to rationalization in general. This portion is also large enough to support Stern's[1] contention against King that an essential part of the present unemployment is due to uncompensated displacement of labor which took place after 1929.

The displacement theory would of course wish to attribute a larger percentage of the present unemployment to mechanization. This is easy to do, if the explanation of present unemployment is not limited to the increase in productivity in the period since 1929. If the comparison is carried back to the year 1920, for example, as Weintraub[2] has done for 1931, one would find an increase in productivity of 78.8 per cent, resulting in a displacement of 44 per cent in man-hours. Even in comparison with the peak of prosperity in 1923, there would be a decrease of 33 per cent in man-hours as a result of a 48 per cent increase in productivity. As compared with the above the decline in the volume of production during the present crisis from its 1923 level would have accounted for a decrease of only 23.5 per cent in man-hours. But theoretical considerations stand in the way of this explanation of present unemployment by comparing present productivity with that of earlier periods. If the workers in 1929 were fully employed, from the point of view of the compensation theorists this would indicate that up to that point the displacing effect of mechanization had been compensated for and therefore might no longer be used to explain subsequent unemployment. There is left then only the 20 per cent decrease in man-hour opportunities which developed after 1929, while the balance of the decline in employment is to be attributed to the shrinkage in the volume of production.

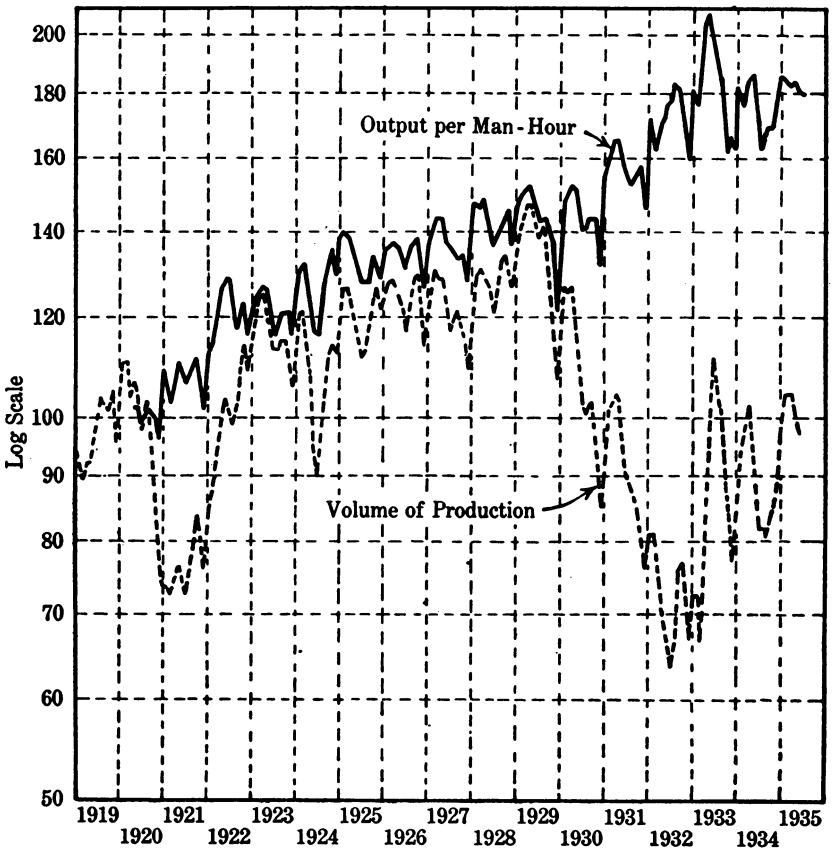
Before we take up again the question of the relation between mechanization and the business cycle, already discussed in the first

[1] Stern, Boris, "Technological Displacement of Labor and Technological Unemployment" in *Journal of the American Statistical Association, Proceedings* (1933) pp. 42-47.

[2] Weintraub, David, "The Displacement of Workers through Increases in Efficiency and Their Absorption by Industry" in *Journal of the American Statistical Association*, December 1932, pp. 383-400.

part, it might be useful to examine more closely this claim that compensatory adjustments for displacement occurred in industry at least until 1929. For this purpose let us examine the curves of

CHART IV. VOLUME OF PRODUCTION OF MANUFACTURING INDUSTRIES AND OUTPUT PER MAN-HOUR, 1919-1935 (1920=100) [a]



[a] Calculated from the monthly index of production of the Federal Reserve Board, the index of employment in manufacturing industries of the Bureau of Labor Statistics and the index of hours of work per week of the National Industrial Conference Board.

the volume of manufacturing production and of productivity (CHART IV). The curves are based on the monthly average for 1920 as 100. If employment opportunities measured in man-hours are

not to shrink, the volume of production must rise as rapidly as the output per man-hour. The production curve, however, shows that even in the record months of the prosperity periods of 1923 and 1929 employment opportunities in man-hours hardly equalled the 1920 average. The peak man-hour demand of 1920, on the other hand, was markedly higher than in the later periods. This decline in employment opportunities in manufacturing can also be perceived directly from the Bureau of Labor Statistics index of employment, although it does not take into account the decline in average weekly hours. This means that employment opportunities in manufacturing decreased between 1920 and 1929, in spite of a considerably increased volume of production and although the total number of gainfully occupied persons increased in this period by about 17 per cent. It is incorrect, therefore, to speak of a successful compensatory movement in manufacturing, even with reference to periods of prosperity. It should be easily comprehensible why, under such conditions, the depressions exhibited high unemployment figures. Nevertheless the significance of the displacement theory becomes completely clear only when the period after 1929 is considered. The curve of productivity rose even more and left the volume of production so far behind that it is doubtful whether the latter will ever again, through a corresponding increase in production, overtake the curve of productivity. The cyclical recovery must, in view of the present position of the two curves, bring an 80 to 90 per cent expansion in production in order simply to reach the man-hour employment opportunities of 1920. And this assumes that productivity will not have risen further in the meantime. This may well serve to illustrate statistically the effect of rapid rationalization upon unemployment.

Naturally the exponents of the theory of compensatory adjustments may argue that the adjustment need not necessarily take place in manufacturing itself. On the other hand manufacturing is not the only area in which labor is displaced. Jerome[1] even believes that in 1919-29 mechanization in agriculture, mining and steam

[1] Jerome, Harry, *Mechanization in Industry* (New York 1934) p. 22.

railroads was more intensive than in manufacturing. Thus the Bureau of Labor Statistics estimated the increase in productivity in agriculture between 1919 and 1927 at approximately 23 per cent, which is equivalent to the displacement of 2,530,000 persons; the number displaced was in fact reduced to 800,000 by the expansion of production.

The situation is as bad or even worse in coal mining, because here the rise in productivity since 1923 was accompanied by a reduction in the volume of output.[1]

The number of employment opportunities was thus decreased in all major branches of production—agriculture, manufacturing, mining. If despite that there was comparatively little unemployment in 1929, this was due to compensatory adjustments of the type referred to in the theoretical section of the article. The proportion of gainfully occupied in trade and transportation, for example, increased from 18 per cent to 20.7 per cent between 1920 and 1930. Similarly the percentage in domestic and personal service rose from 8.8 to 11.3. And construction, the volume of which is not included in the index of manufacturing production, was extraordinarily active until 1929, even though its peak was passed in 1928.

These three types of economic activity require little capital per labor unit and thereby facilitate compensatory adjustments. On the other hand employment in these pursuits depends upon the consumers in the higher income brackets and, for construction, upon increased capital investment. This, however, like the expansion in the manufacture of capital goods, makes the entire economy more sensitive to cyclical changes. The equilibrium which marks the last stages of prosperity is therefore an increasingly unstable one, and is violently disturbed as soon as investment slackens. But this still does not prove that the machine itself brings about the final collapse of the temporarily attained equilibrium.

There is little support in the productivity curve for the theory mentioned above, according to which mechanization is carried through during prosperity and, after the lapse of a certain period

[1] Weintraub, David, *loc. cit.*, p. 397.

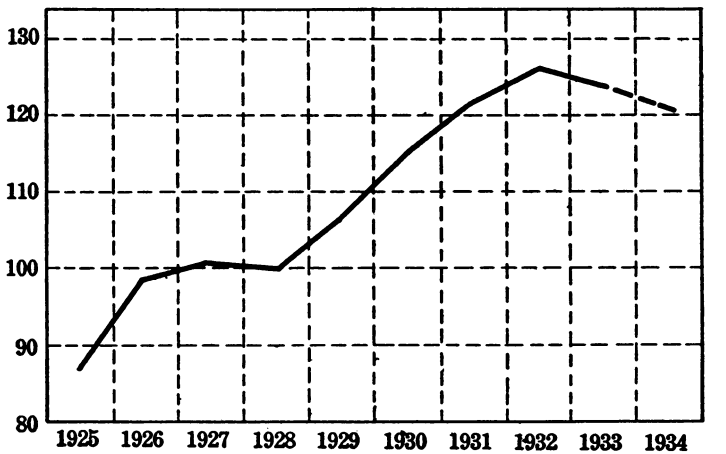
of gestation, is followed by widespread labor displacement leading to a crisis. True, there was a further increase in productivity in 1929, but the flattening of the curve in 1930 contradicts the view that the crisis is marked by a particularly steep rise in productivity. Also, in the 1923 cycle this increase definitely preceded the peak of prosperity. It may be argued that the technological prerequisites of the increase in productivity which occurred in 1931-33 were already achieved before the crisis and that their first effect was the crisis which temporarily inhibited the further unfolding of their consequences. This line of reasoning, however, is not particularly plausible.

On the other hand, the movement of the productivity curve supports Lederer's thesis that capital which has been rendered obsolete during a period of rationalization is discarded during depression. In any event the rapid rise in the productivity curve points to the fact that during this period the more efficient plants dominate the market. The discarding of obsolescent capital equipment, however, signifies also a recession in production and a further increase in unemployment. Mechanization therefore brings about unemployment during depressions not only through increased productivity of labor but also because it forces the discarding of capital equipment and a contraction of productive activities. The entire decline in production cannot of course be traced back in this way directly to rationalization. In order to do this we would have to follow the theory of disproportionality developed above, which cannot be accomplished here.

Finally it may be emphasized that not the whole increase in productivity during depression is due to the elimination of obsolete capital equipment. Undoubtedly mechanization, even if in the main it is typical of prosperity, continues also in depression. Upon it is superimposed rationalization in the broader sense of the term —tightening up of the organizational apparatus of production, intensification of the work tempo, etc.—a process carried on with particular vigor during depression. Such measures contribute to the increase in productivity only slightly less than the mechaniza-

tion proper of the prosperity period. It is furthermore clear that in depression employment is available only to the more efficient workers, which fact again raises productivity. It follows that when employment increases, the efficiency of the labor force, and with it productivity, drops; this is reflected in our curve for 1934 and 1935. Its decline in these years is not accidental; the productivity curve for Germany, presented in CHART V, exhibits a similar movement.

CHART V. OUTPUT PER MAN-HOUR IN MANUFACTURING INDUSTRIES IN GERMANY, 1925-1933 (1928=100)[a]



[a] Figures from *Wochenbericht des Instituts für Konjunkturforschung* (Berlin 1934, no. 45) pp. 209-210.

In conclusion, then, it may be repeated:

1. That compensatory adjustments for technological unemployment during a period of pronounced rationalization require an extraordinarily rapid expansion of production, an increase which was not attained in the United States even in 1929 as compared with 1920.

2. During depression the compensatory adjustments described above do not take place, while rationalization continues; the result is that displaced labor is not reemployed. Developments since 1929 make it appear improbable that in the next period of prosperity the pre-depression volume of employment opportunities in manufacturing industries will again become available.

3. Capital equipment which has been rendered obsolete as a result of mechanization is discarded in depression so that during this period mechanization contributes to a contraction in the volume of production.

4. Mechanization alters the structure of the economy in such a manner as to make it more sensitive to cyclical changes.

5. In order to explain the beginning of a crisis by the labor displacement theory it is necessary to accept the entire disproportionality or relative overcapitalization argument. The verification of the latter is beyond the scope of this article. Even so we believe we have shown that the labor displacement theory not only holds out certain interesting theoretical possibilities but also deals adequately with one of the most active elements in our economic structure.