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SUMMARY

- I *The total output of industrial materials has expanded more rapidly since the start of World War II than in the corresponding period of World War I, but the difference is not substantial. The rise from 1914 to 1917 was about 32 per cent; from 1939 to 1942, about 35 per cent.*
- II *The similarity between the two wars with respect to the rate of expansion in the total output of industrial materials reflects a corresponding tendency on the part of many individual commodities or groups of commodities. Construction materials and products of foreign origin are exceptions: the former increased from 1939 to 1942 but declined from 1914 to 1917, the latter declined between 1939 and 1942 but increased from 1914 to 1917.*
- III *In both wars the rate of increase in the total output of industrial materials diminished sharply after two or three years of expansion. In the current war this retardation occurred between 1941 and 1942. It seems unlikely that the total production of industrial materials will, in the near future, rise appreciably above the level reached in 1942.*
- IV *In peacetime, over short periods, there is a close correspondence between changes in the output of industrial materials and in total industrial production (materials and finished products). It is not easy to say how close this relationship is in wartime because of the difficulty of measuring total output. Hence it is uncertain in what degree our conclusions concerning the production of industrial materials apply also to total industrial production.*

The purpose of this paper is to review the record of industrial production in the United States during the current conflict (1939 to date) in the light of our experience in World War I (1914-18), and thereby to get a more reliable basis for expectations as to its future behavior. There are several reasons for believing that our experience in World War I will prove instructive. In the first place, students of business cycles have observed that expansions in general business activity have certain elements in common; therefore *any* general expansion, such as that experienced during the first world war, may be expected to provide analogies useful to the understanding of the current expansion. In the second place, it is reasonable to suppose that the expansion during the first war is more closely analogous to the current expansion than any peacetime expansion would be.

In both wars one of the principal initial stimuli to expansion of production was the placing of orders by foreign belligerents. In World War I these orders seem to have constituted the chief factor that turned the contraction prevailing during most of 1913 and 1914 into an expansion (beginning about December 1914). In World War II an expansion was already under way when war was declared in Europe (September 1939), having begun about June 1938; but the purchases of belligerents contributed much to its continuation. In both wars, moreover, a further tremendous stimulus to expansion came with the entry of the United States into the conflict—32 months after the start of the first war and 27 months after the start of the second. The contrast with peacetime expansions is clear: in this country exports have ordinarily played a relatively minor role, and there is no peacetime equivalent to the extraordinary acceleration of demand that comes when a nation devotes itself to war.

The change in the character of goods and services demanded is likewise without peacetime precedent. An outstanding feature of peacetime cyclical expansions is their generality. Roughly speaking, the demand for and the output of nearly everything increases. In at least the later phases of a wartime expansion, on the other hand, the demand for certain goods and services is so great and so imperative that the production of other goods and services cannot be maintained. To meet the demand for military equipment and men to serve in the armed forces, the production of less essential goods and services must be curtailed or stopped. Such sacrifices occurred both in this war and the preceding, and have left their mark on the statistics of production.

The nature of the change in the character of goods and services produced in wartime is of sufficient interest in itself to warrant comparison of the two war periods. But there is a further reason: when a country converts its factories from the production of peacetime goods to the construction of instruments of war, does it produce more, or less? The question would be puzzling enough if the statistical data at one's disposal were abundant. Unfortunately they are not. For World War I the available time series are patently inadequate to represent the physical output of military equipment; in both wars the extreme variations in the direction and rate of change in the output of other goods raise doubts concerning the adequacy of the series that purport to represent them.

The statistical difficulties may be largely avoided if we concentrate upon the materials used in industry rather than the final products.

Changes in kinds of raw and semifabricated materials are relatively slight compared with changes in end products, in both war and peace. Largely because of this adaptability of materials to different ends, series representing the production or consumption of materials are both comprehensive and continuous. In addition, the materials are of interest since they constitute a considerable fraction of total output and have an important influence on the output of finished goods. Indeed, the measurement of the input of materials is one approach to the knotty theoretical problem involved in measuring changes in total output when its composition is radically altered, as it is during a war.

For these reasons our study of industrial production in the two wars is based primarily on statistics relating to materials. We have compiled annual data for 1913-19, 1932, and 1937-42 on the production (or consumption) of 47 industrial materials (App. Tables 1 and 2). Since most of the basic materials that go into the final products of manufacturing and construction industries, in both war and peace, are included, an index in which these series are combined is, in a sense, comprehensive. It must be recognized, however, that the concept of a material is not precise. Industry is so organized that to a large extent the 'finished' products of one enterprise are the 'raw' materials of another. Although one could identify reasonably well the strictly *raw* materials used in manufacturing (i.e., materials that have not yet entered the manufacturing process), and study their production or consumption alone, this would not fully exploit the available data, with which one can cover at least the early stages of manufacturing. In constructing an index of 'industrial materials production' our purpose is to measure as large a segment of industrial production as we can, and the term 'materials' merely calls attention to the fact that the missing parts are largely the more highly fabricated products.¹ Of course, the degree to which the later stages of production are not

¹ The use of the term 'production' requires explanation also, since series representing consumption and imports of materials are included in the index. Such series are assumed to represent the output of commodities made from the materials. The weights applied to imports, or to agricultural materials consumed, are not the values of the materials themselves (values produced outside domestic industry), but the values added to them by manufacture. We endeavor to restrict the assumed coverage to the immediate (semifabricated) products of the materials. However, it must be admitted that imports of materials and their industrial use may not fluctuate concomitantly. It is difficult to defend, for example, our selection of the series, imports of unmanufactured rubber, which was originally chosen on the ground that it was the only 'rubber' series covering both wars. We would have done better to assume (as we did in the case of tin) that consumption could be represented by imports in the first war, and to use a consumption series in the second war, including consumption of secondary and synthetic rubber.

covered differs from industry to industry—some commodities included in our index, for example, are ready for final consumption. (This would be true, incidentally, even if we restricted the coverage to *raw* materials, since the degree of fabrication to which raw materials are subjected varies widely.) Unfortunately, the uncertainties as to the representativeness of our index and its components cannot be entirely removed; in the first three sections we confine the inquiry to industrial materials output *per se*; in the final section we consider the relation between industrial materials output and total industrial production. (Some further details concerning the coverage and weighting of our index are given in Appendix A.)

I THE RISE IN TOTAL OUTPUT OF INDUSTRIAL MATERIALS

The output of industrial materials in the United States was considerably greater at the beginning of the second world war (1939) than at the beginning of the first (1914). Our production index (using 1939 values as weights) rises nearly 60% in the twenty-five year interval (Table 1, col. 3). In 1939 we produced, among other things, about twice as much steel, five times as much petroleum, six times as much aluminum; consumed 35% more cotton and 50% more tobacco; and imported six times as much crude rubber as in 1914. The output of a few of the commodities in our index was smaller in 1939 than in 1914; this was true, for example, of bituminous and anthracite coal, lumber, newsprint, wheat flour, and malt liquors.

Although the 60% increase in the total between the two wars is substantial, the annual rate is less than 2% per year, and is dwarfed by the expansions that took place during both wars. In measuring the percentage changes in the total production of materials in the two wars it is not necessary to use the same weights (values) for both periods. We therefore base the index for World War I on 1914 values, which seem more appropriate to the situation at that time than weights reflecting the scale of values twenty-five years later.² From 1914 to 1917 the production of industrial materials increased 32%, or slightly less than 10% per year, while from 1939 to 1942 it rose 35%, or slightly more than 10% per year (Chart 1).³ In both wars

² It is this index for World War I to which we shall refer throughout the paper, unless the one using 1939 weights is specifically indicated.

³ All the charts (except Chart 5) are drawn on a semilogarithmic scale to facilitate comparison of percentage changes. In Charts 1-4 the indexes for World War II are arbitrarily placed below those for World War I; their position in this respect does not indicate the actual difference in the level of production.