CHAPTER V

PATTERN OF TRADE IN NON-FERROUS METALS

- COPPER, LEAD AND ZINC
This chapter is an attempt to analyse the trends in the US trade in non-ferrous metals over the period 1970-1980. The study will be made with special reference to three non-ferrous metals - copper, lead and zinc.

I

SHIFT IN TRADE PATTERN

Amongst all the natural resource products in the US, the group of minerals, as a whole, shows the fastest rate of change in its structure of foreign trade. This is, particularly speaking, true of the non-ferrous metals like copper, lead and zinc. In the beginning of the period under study, the United States was a major net exporter of these metals. Only a very small amount of these products was being imported. Over a period of time, however, imports have risen sharply and, in fact, the United States has become a net importer of all the three metals - copper, lead and zinc (evidence for this will be cited later on in this chapter).

The major factor causing the shift in trade pattern

What factor has been primarily responsible for leading to increase in imports and shift in the trade pattern of these non-ferrous metals? There could be two answers to this question - (a) increasing domestic consumption; (b) scarcity of
natural resources or the shrinking base of natural resources. Usually, in the case of all minerals it has been the second answer, the growing scarcity of natural resources, that has been increas-ingly resorted to for explaining the shift in their trade pattern. In our view, however, shift in the trade pattern of non-ferrous metals is primarily explainable in terms of factor (a) mentioned above i.e., the domestic consumption has risen at an increasing rate. The tendency for imports to rise might have been acceler-ated because of the fact that mineral reserves are subject to rapid depletion. However, this supply factor cannot be assigned any great importance. The reason for this is that in the case of most of the metals, production from scrap is immensely important. The greatest advantage of an industrial economy lies in the fact that she tends to accumulate these metals in the finished forms from which a large part of the metal is recoverable. To the extent that the United States is a net importer of metals, her stock of metals in finished form is increasing. So increased consumption of metals does not mean that the economy is becoming poorer in the reserves of such metals. Even if the natural deposits of metals tend to deplete, this factor is to a great extent offset by the addition to supply that is made possible by recovery of the metal from scrap. Resource extinction itself is thus somewhat mitigated and development of resource scarcity retarded. So the active factor in increased imports cannot be taken to be the deple-tion of ore deposits or the shrinking base of metal deposits. It is rather more a question of demand for
metals which has outstripped both the mine production and the depreciation of metal products.

This demand for metals has been a function of the industrial growth of the economy. However, while the domestic absorption of metals by the industrial sector has tended to make the US increasingly dependent on outside sources, technological progress, that has been achieved along with industrial growth, has somewhat tended to retard this tendency. Technological progress has taken place in the form of substitution of abundant metals for the scarce ones, and the development of substitutes in the field of various uses of these metals. The result of this has been that the level of imports in most cases has been kept below what it would have been in the absence of technological innovations.

II

We will now try to examine the above analysis by making a case study of each of the three metals - copper, lead and zinc.

COPPER

By 1970, the copper industry of America had already entered a phase of expansion. The production was based on the rich copper deposits of Michigan - discovered first in 1945. However, the industry entered a period of its most rapid growth
during the decades from 1870s to 1890s. During this period, the

copper deposits of Arizona and Montana were discovered. The
copper output of these two areas soon surpassed the levels

achieved in Michigan.\footnote{See F.E. Richter, "The Copper-Mining Industry In The United
States, 1945-1925", \textit{The Quarterly Journal of Economics}
(Cambridge, Mass.), vol. 41, February 1927, p. 236.}

Though the domestic consumption was

increasing during these decades, however, the domestic output,

as a consequence of the exploitation of deposits in these two

new areas, outstripped it. Thus the imports of copper were

almost negligible (except during the years 1871-73 and 1880).
The average annual exports, as a percentage of output, steadily

increased from 1.6 during 1871-74 to 46.62 during 1895-99.\footnote{Yearly average figures and percentages calculated from data
(preferred series of the source) given in Neal Potter and
Francis P. Christy, Jr., \textit{Tracts In Natural Resource Economics: A Statistical Study of Prices, Output, Consumption, World
Trade and Employment In The United States, 1860-1957}
(Baltimore, Md., 1962), pp. 575, 834.}

This situation changed rapidly with the turn of the
century and more so since the First World War. Copper imports

started increasing enormously - the rise in imports being noticed

in the middle of the 1890s itself. On the other hand, the

average annual net exports, as a percentage of output (primary +

secondary), declined steadily from 30.01 in 1900-04 to 16.26 in

1915-19, 14.39 in 1920-24, 10.92 in 1925-29, 16.68 in 1930-34 and

recovered somewhat to 9.88 in 1935-39.\footnote{See Table 4 and Figure 3 given at the end of Chapter II, pp. 61, 86.} After the 1930s, the

United States became a net importer of copper. The average

annual net imports, as a percentage of output, were 30.10 during

1940-44, 30.06 during 1945-49 and 34.86 in 1950.  

This growing dependence on outside sources has resulted more from a sharp expansion in the consumption of copper than from a depletion of domestic reserves. Copper has high electrical and thermal conductivity, and so with the growth of electrical industries since the 1970s and more so in the twentieth century the most important single demand for copper has come from the manufacturers of electrical equipment and electric utilities and the communications industry. Besides, copper is non-corrosive (unlike iron and steel) and so this metal has been in great demand in the construction industry. Moreover, copper is a strategic metal for defence and so demand for it during a period of war is enormous. The supply side cannot be given much significance over these demand factors because of the following two reasons.

Firstly, though the grade of copper ore has declined over the period 1900-50, however, it has been possible to recover copper from low grade ores which are supposed to be abundant in the earth's crust. Because of this, the domestic mine production of copper does not show any definite downward tendency. Over the period 1900-50, it is only during the periods of depression that the output declined. Copper production prior to the 1940s was at its peak during 1935-39. During 1935-39, production was lower than this peak level. However, the important thing to note is that the following years from 1940 to 1944, when the US first shifted to a position of a major net importer, production once

---

4. Ibid.
5. See Table 4 given at the end of Chapter II, p. 81.
again rose and was at its highest level for the entire period - 1900 to 1950. In fact as compared to 1930-33, the primary output had increased by 189.5 per cent by the year 1950. 6

Secondly, copper has high lasting qualities and about 80 per cent to 90 per cent of it goes into durable producers' and consumers' goods. Because of its durability it can be re-used more frequently. It has been estimated that about 60 per cent of copper put into use is eventually recoverable. 7 Copper recovered from scrap is thus an important addition to domestic mine supply. In the United States, the proportion of secondary production to primary output rose from about 1/3 in 1910 to about one half in 1950. 8 Secondary production has thus contributed considerably towards increasing the total production of copper.

Because of the above two facts, copper production (primary + secondary) rose by about 14.1 per cent during the years from 1925-33 (the period of peak production over the period 1900-33) to 1940-44. 9 Even though the total production declined in 1945-49, after reaching the record level in 1940-44, it was not far below the level of 1925-33. 10 In fact, in 1950 the production once again increased and even exceeded the level reached in 1925-33. 11

6. Percentage increase calculated from ibid.


9. Percentage increase calculated from Table 4 given at the end of Chapter II, p. 81.

10. See ibid.

11. Ibid.
This growth in the output of copper has, however, been outstripped by an even more rapid increase in its domestic consumption. This is clearly evident from the trends in the domestic output and consumption of copper shown in Figure 1 (presented at the end of this chapter). Over the years from 1925-29 to 1945-49, the consumption of copper increased by about 44.7 per cent. 12 (Consumption was at its highest level during 1940-44). Between 1900-04 and 1945-49, total output (primary + secondary) increased by about 261.9 per cent but consumption increased by nearly 572.7 per cent. 13 All this indicates that it has been primarily the demand side which has been more vital than the supply side in bringing about a shift in the position of the US towards a net importer of copper.

The rise in domestic consumption would have been even more significant but for the fact that a faster rate of growth of domestic consumption than that of domestic production has induced the development of substitutes. The most important of these substitute products for copper has been aluminum. Aluminum is the most abundant metal in the earth's crust. For quite some time it was a costly metal. This was so because it is found along with a complex of other materials and so recovery of the metal was difficult. However, once efficient

12. Percentage increase calculated from Ibid.
13. Ibid.
methods of recovery were developed it has become a cheaper metal than copper, lead and zinc.\textsuperscript{14} It is also similar to copper in many of its qualities. Because of these two factors, substitution of copper by aluminum has been increasingly favoured. The largest substitution has taken place in the electrical industry. Aluminum wire with a steel core has displaced copper for long-distance transmission lines. Other typical substitutions of aluminum for copper are in bus bars, fractional horsepower motor windings and lightbulb bases.\textsuperscript{15} Aluminum and stainless steel have also somewhat reduced the use of copper in the building industry.\textsuperscript{16} The demand for aluminum has thus been much higher than for copper in many of its uses - mostly in electrical industries. Further, the introduction of copper clad metals means that less metal is required than what is required by the use of solid copper. Printed electrical circuits have also come into the field as a substitute for copper wire and plastic tubing replaces copper in some automobiles and appliances and other uses.\textsuperscript{17}

Thus the imports of copper have been depressed because of the suppression of the rate of growth of copper consumption on account of these substitutions.


\textsuperscript{16} Ibid.

\textsuperscript{17} Ibid.
LEAD

The United States was also a major net exporter of lead in the beginning of the period under consideration. During 1900-04, the average annual net exports amounted to 24.71 per cent of the total domestic output of lead. By 1915-19, the average annual net exports had declined to 13.31 per cent of output. During and after the 1920s, net exports declined rapidly and in fact by the 1940s the US had become a major net importer of lead. During 1940-44, on an average, annual net imports of 44.35 per cent of the domestic output of lead were recorded; and by 1950, net imports had increased to 66.58 per cent of output.

There is no doubt that in the case of lead, primary output has declined from its highest levels reached during the years from 1925 to 1929. The decline in output has been general throughout the United States - both in the case of major lead ore producing districts, the straight lead ore districts, and also in the districts having mixed lead and zinc deposits. Nevertheless, in an explanation for increase in imports, this decline in output cannot be given the prime importance. This is so because secondary production from old scrap is more

18. See Table 5 and Figure 3 given at the end of Chapter II, pp. 82, 86.
19. Ibid.
20. Ibid.
important for lead than for any other metal. With the steady growth of the stock of lead using products, the amount of scrap recovered from the stock in each successive year also grows. To determine the amount of lead that is recovered and reused as secondary lead, it is necessary to distinguish between its dissipative and non-dissipative uses. Lead is used mainly in storage batteries, tetraethyl lead, cable coverings and in type and bearing metal. It has been estimated that 25 per cent of the metal used in storage batteries, 90 per cent in cable coverings, 15 per cent in building, 60 per cent in bearing metal, 90 per cent in type metal and 32 per cent in other uses is recoverable. 22 The consumption pattern of lead, in the US, shows that its consumption has increased in those uses from which a large part of the metal is recoverable. In the United States, the largest single consumer of lead, throughout, has been the storage batteries. In the increased lead consumption during 1925-30, consumption in storage batteries increased by 125 per cent. 23 These batteries have a short life span of two years and this combined with the fact that 25 per cent of the metal used in these batteries is recoverable means that the proportion of lead recovered is very high. Combined with

22, Ibid., p. 41.

this factor is the fact that though the development of substitutes for lead has expanded very rapidly, this has not been very successful in the case of storage batteries. The substitutes for these have been found out to be the durable cadmium batteries. Though cadmium batteries are to be preferred over the perishable lead acid batteries, however, the limiting factor has been the non-availability of adequate quantities of cadmium to replace any sizable quantity of lead. Also a nickel-cadmium battery costs more than a lead acid battery. 24

The second largest consumer of lead till the year 1950 was the cable industry (90 per cent of metal used in cable coverings is recoverable) though this position since then has been taken by tetraethyl lead which on the whole has shown a very high rate of growth— from being almost negligible in 1925 it accounted for about 9.1 per cent of the total consumption of lead in 1950. 25 In solder and type metal also the consumption of lead has increased. 26

In short, we can say that the increased consumption of lead in storage batteries and the fact that till 1950 the


25. Percentage increase in consumption calculated from data given in Biegfeld and Borzina, n. 23, p. 265, Table 13-B.

26. See Ibid.
cable industry was the second largest consumer of lead means that, over the period of our study, consumption has mainly increased in those uses from which a large part of the metal is recoverable. All these factors have raised the importance of secondary lead production. Thus in spite of a decline in primary lead output, secondary production has helped to maintain the total production. For example, between 1925-29 and 1945-49, the primary output fell by about 40.6 per cent, but secondary output rose by about 83.8 per cent.  

Figure 2 (presented at the end of this chapter), which shows the trends in the domestic output and consumption of lead, aptly illustrates that although the total lead production in 1945-49 was still less than in 1925-29 (the years of peak production), however, the production was higher than in any of the years before 1925-29. In fact, during 1940-45, when the US became a major net importer, both primary and secondary output rose from the levels of 1935-39.  

However, domestic consumption has far outgrown this increase in production. Over the years from 1935-39 to 1940-45, total output increased by about 22.6 per cent (primary output by about 16.9 per cent and secondary output by about 35.4 per cent) whereas consumption increased by about 84.9 per cent. Even if the production level of 1925-29

27. Percentages calculated from Table 5 given at the end of Chapter II, p. 82.
28. For data see ibid.
29. Percentages calculated from ibid.
had been maintained, net imports would still have followed in the face of this increased domestic consumption. This increasing trend in domestic consumption is clearly evident from Figure 2.

So we can conclude that though the output of lead has fallen, still the active factor in the shift in the trade pattern of lead has originated from the demand side in the USA.

However, a great number of substitutes have been found out for lead in uses other than the storage batteries. Titanium is steadily replacing the lead content of paints. A favourable factor in this substitution process being the large quantity of titanium that is potentially available. In cable coverings also lead has met increasing competition from polyethylene. To some extent here, the industry faces competition from aluminum also. But because of various economic and technical shortcomings the use of aluminum has not been very widespread. However, lead faces increasing competition from aluminum and plastics in the building industry.

As a result of the development of substitutes, the rate of growth of lead imports has been lower than what it ought to have been in the absence of technical progress.

31. Ibid.
32. Ibid.
In the case of zinc too, the US has shifted to a position of net importer since the latter half of the 1930s. The average annual net exports, as a percentage of domestic output, declined from 33.85 during 1900-04 to 22.69 during 1915-19 and to 2.15 during 1930-34. In fact, during 1935-39, the average annual net imports of 2.88 per cent of domestic production were recorded. Since the 1940s, imports have risen enormously and so net imports have also become very significant. The average annual net imports of zinc, as a percentage of domestic output, were 23.05 during 1940-44, 33.06 during 1945-49 and 55.12 in 1950.

So far as secondary production is concerned, zinc represents a very different picture from the case of copper and lead - recovery from metal scrap being rather unimportant here. The principal uses of zinc are: galvanizing, die castings, pigments and salts, brass and bronze, and rolled zinc, which together account for nearly 90 per cent of the total consumption. Most of the recovery of this metal is from brass and bronze with lesser amounts coming from die castings and rolled zinc products. Zinc used in galvanizing iron and steel sheets

---

33. See Table 6 and Figure 3 given at the end of Chapter II, pp. 23, 26.
34. Ibid.
35. Ibid.
is not recoverable. But the galvanizing industry is the largest single consumer of zinc in the US (accounting for about 33 per cent of the total zinc consumption in 1947-50). Besides, since the year 1940, the use of zinc in die castings has increased whereas its use in rolled zinc products and in the making of brass products has largely declined. All these factors have meant that in the case of zinc although the secondary production has shown a rising trend, it has been very small in amount. The proportion of secondary production to mine production was largest in 1940-44 but amounted to only about 11.3 per cent of the mine production.

However, in the case of zinc, primary output, excluding the years of depression, has not shown any marked signs of decline. The average annual mine production (measured in thousands of short tons of Pb), rose steadily from 153.6 in 1900-04 to 724.8 in 1925-29, and to 739.6 in 1940-44 (the highest level reached during the period 1900-50). Domestic output, however, fell to 610.6 thousand of short tons of Pb in 1945-49 but this was matched by a fall in domestic consumption.

37. Bidwell, p. 72.
40. See Table 6 given at the end of Chapter II, p. 83.
41. Ibid.
also. On the whole, we can say that the mine production of zinc had not fallen till 1940-44 (i.e., the years when the US became a major net importer of zinc).

But as compared to this, consumption has risen tremendously. Between the period 1935-39 and 1940-44, total domestic production (primary + secondary) rose by about 31.7 per cent whereas domestic consumption has increased by about 63.9 per cent, while the level of output of 1925-29 was reached once again and even surpassed in 1940-44 (total production stood at 805,6 thousands of short tons of Pb in the former period and at 812,0 thousands of short tons of Pb in the latter), consumption grew at a faster rate - it increased by about 48.7 per cent over these years. This faster rate of growth of domestic consumption than that of output is very clearly evident from Figure 3 (presented at the end of this chapter).

So the increased consumption of zinc within the United States has been more vital than the supply factor in bringing about a change in the pattern of trade in zinc.

Unlike the case of lead, however, the tendency for the imports of zinc to increase has not been depressed because not many substitutes for zinc have been found out. For galvanizing iron and steel products there is no adequate

42. Ibid.
43. Percentages calculated from ibid.
44. Ibid.
substitute, Ceramic and plastic coatings are employed in a narrow field. Cadmium is used for electroplating, but its cost and the quantity available limit it as a substitute for zinc in galvanizing. No commercial reserves of cadmium are found. It is recovered only as a by-product while smelting zinc ores or zinc-bearing lead ores. Thus the reserves of cadmium depend upon the zinc reserves and the cadmium content of these reserves. The cadmium content of zinc concentrates normally ranges from 0.17 per cent to 1.4 per cent. Secondary production is also not important because most of its uses are dissipative in nature. Other metals, particularly aluminum, may be substituted for zinc coating on steel in some instances but the cost to date has inhibited extensive use. In certain die-casting applications, aluminum competes with zinc. The competition between the two metals is influenced to some extent by metal prices, but usually the selection of an alloy depends upon the properties desired in the finishing casting. Moreover, where the use of electro-deposited coatings is desired, zinc has a great advantage because of the ease with which finishes can be applied over diecastings of zinc alloy. In the paint industry, although titanium is a competitor of zinc,

46. Ibid., p. 165.
47. Ibid., p. 983.
48. Ibid., pp. 982-4.
in most paint formulations, titanium pigments supplement rather than compete with zinc oxide. 49

All this shows that substitution has not proceeded very far in the case of zinc.

CONCLUSION

A case study of the US pattern of trade in copper, lead and zinc supports our analysis developed in Section I that the dominant factor causing a shift in the trade pattern of these non-ferrous metals has been the enormous increase in demand for them rather than the shrinking base of the metal deposits in the United States.

49. Ibid., p. 384.
Figure 1

TRENDS IN DOMESTIC OUTPUT AND CONSUMPTION.

CH - CH1 = Domestic output.
CC - CC1 = Domestic consumption.

Scale
X-AXIS 2 divisions = YEAR
Y-AXIS 1 LINE = 66 Thousands of short tons of copper.

Thousands of Short Tons of Copper.
FIGURE 5
ZINC
TRENDS IN DOMESTIC OUTPUT AND CONSUMPTION.
ZP - ZP1 = Domestic output.
ZC - ZC1 = Domestic consumption.
Scale
X-AXIS 1 division = YEAR
Y-AXIS 1 division = 5 Thousands of short tons of Lead.