The Movement of Capital's Composition: Long Term Fluctuations and Trends

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Preface

As part of a catalytic activity on the issues of long-term economic development, we try to present papers, that in our believe, would, for various reasons, obtain less attention than they deserve as they present new ideas and approaches.

This paper by Professor Louis Fontvieille is of this character. It presents the results of long-term research that proves a hypotheses put forward by the author sometime ago. The main idea is to track down the role of labor in economic development, and its relation to other economic factors. Only few attempts have been made to cover this issue. The major interest in long-term studies is given to the role of raw materials, production processes, technology at large, etc.

The author's idea is that capital and labor absorbed in products reflects the productivity of these components. Their mutual share is changing over time, along with their productivity which mediates the transfer of the value of capital and labor to product. As the author points out, these shares (relations) seem to show changes with time that appear to be related to the recession of the economy as a whole, at least for data derived from the coal mining company.

The conclusions point to interesting ideas regarding the relationship of the profit rate movement and the composition of capital, and the possible mechanisms behind them. Several other questions also arise that warrant further study.

In reading this paper it is useful to be familiar with terms from Marxist economic theory.

This paper was written in French and translated by me into English — hopefully not causing it to lose its attractiveness. I would like also to hope that, with this publication, we are rendering a service to our colleagues working on long-term developments.

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Leader
Clearinghouse Activities

The Movement of Capital's Composition: Long Term Fluctuations and Trends

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1. Introduction

In 1979 I put forward the hypothesis[1] that Kondratieff cycles express the movement in the regulation of the relation in capitalist production. I understood by this the fact that long-term fluctuation, observed in a series of production or price data, originated in the development of contradictions between the production relations and the productive forces. This development poses the question of changing the tendency and partial or total transformation of these very relations. For example, at a certain stage the tendency to increase the relative exploitation gets into contradiction with the development of material and human productive forces, and thus poses the necessity of changing the tendency. The origin of fluctuation is in the contradiction and this is in the nature of capital

If the hypothesis is correct, a detailed study and measure of production relations should show fluctuations during which the regulation acts. This was the basic direction of the study on coal that started in 1980.

Here we present an analysis of its partial results, the study continues. The confirmation withheld, they bring a new insight into the analysis of long-term fluctuation, at the same time posing questions on other important aspects of economic

theory. The sources and methods that helped to construct the statistical series shown, and the description of their content have been published[2], and we refer the reader to them.

1.1. The Efficiency of Productive Forces

The efficiency of productive forces determines by the quantity of use value they are able to produce at a given moment. The efficiency determines, at the same time, the reproduction and development of the productive forces. A growing efficiency evokes the material development of production and creates the material base of human development. This efficiency is widely related to an array of social relations that organize its cooperation. To the extent that, man is the main production force, these relations cannot be reduced to technical dimensions, for example, good use of machines.

The efficiency of a producing man is widely related to its own development and so to the consumption of the products of his work. If the organization of circulation relations, redistribution and consumption of produced products leads to such expropriation of producer products that he is unable to secure his own development, his productive capacity is influenced.

This is the key principle of historical materialism because it is the inability of production relations to secure the future development of productive forces that in a given moment puts them in question. The collorary to our hypotheses is the idea that in this process the movement in production relations (in a general sense) at a certain stage causes a lower growth or a decline in the efficiency of the production forces. This decline is the origin of structural crisis, and exposes inappropriate production relations and the necessity for their partial transformation.

The measurement of the efficiency of productive forces is a pertinent question for the analysis and understanding of the processes leading to long-term fluc-

tuation. Unfortunately this measurement is not as simple as it seems. It would be ideal to relate the quantity of use value of the product to the total quantity of (work) time spent on its production. Here one can embark on questions of measuring the value and the problems they pose.

Work can be defined as a human activity that is determined by its relation to the social and technical conditions in which it is performed. These conditions are evidently related to the historical development of the productive forces. The qualifications, the physical and mental effort, the know-how, duration of working time and its intensity, are components of the social and technical conditions of production at any moment. It would be just as useless to try to find the absolute value of work as it would be to try to measure movement as anything other than movement. The work duration on which the value is based is a general measure of all kinds of work only in relation to socially and historically determined conditions.

The duration of work is measured regularly in years, days, or hours, especially in the coal industry. This allows obtaining a first class picture of the efficiency of the productive forces. On the other hand, past work accumulated in products and production equipment has not, as such, been measured. This can only be approached by indirect methods. Because the distortive elements are permanently acting, the explaining variables are never completely independent of the explained variables.

1.2. The Productivity of Labor

Curve C 1 of graph 1 shows the evolution of productivity in the Anzin Company between 1810 and 1897, and curve C 2 shows that of French production as a whole, between 1870 and 1970. For the Anzin Company, extraction is related to the total number of wage-earners, including employees and executives. For national production, only mineshaft and daylight workers are taken into account. The measure

GRAPH 1 : LABOR PRODUCTIVITY *

C 1 – Anzin Company
C 2 – All of France
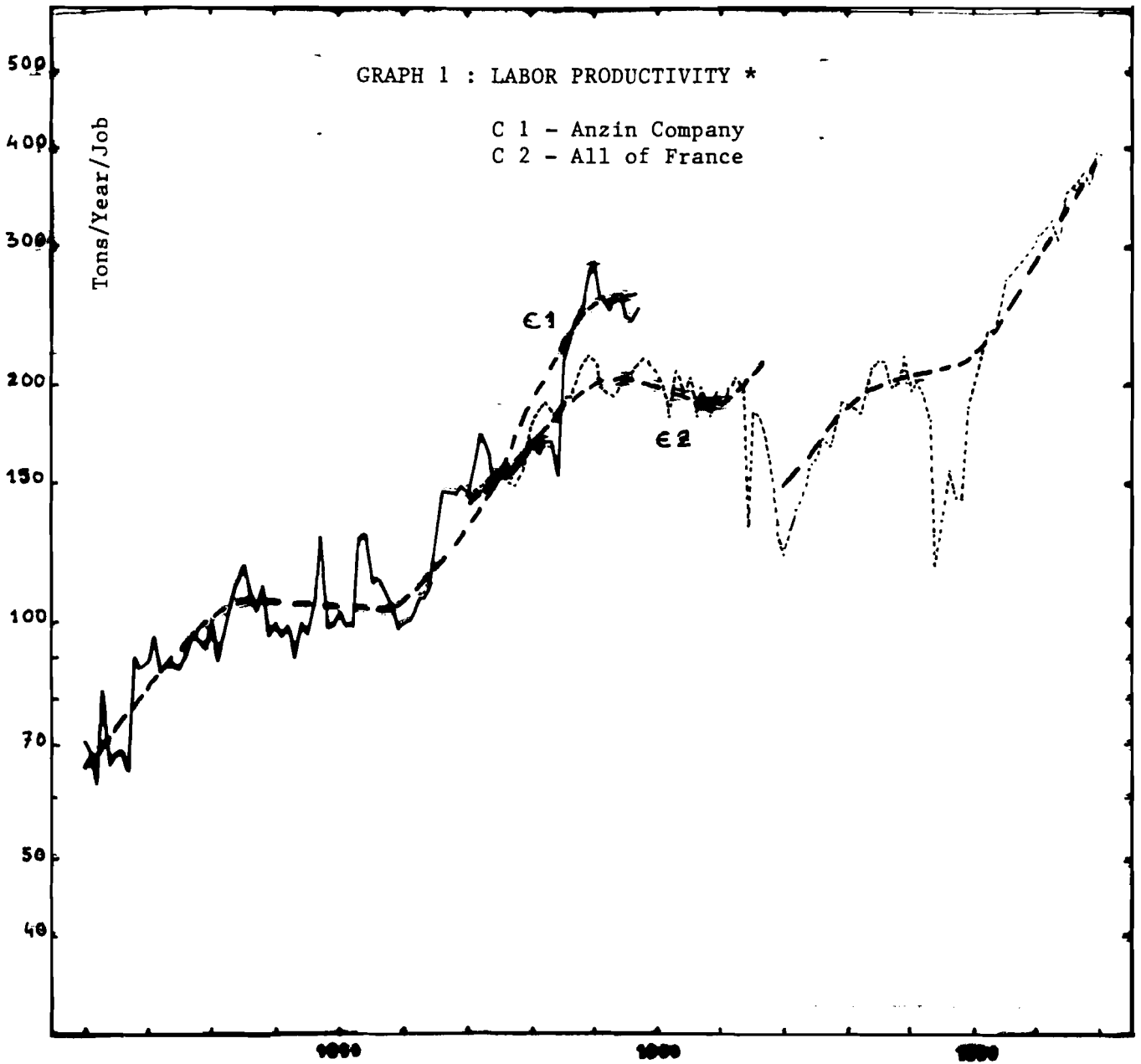
*   The dotted curves, visible on this graph and on those that follow,
    represent our interpretation of the long-terme cycle. We have been
    careful to follow as closely as possible the long tendencies,
    while eliminating accidents of history.

thus obtained, especially for the Anzin Company, corresponds to the apparent productivity of the "collective worker", that is, to the ensemble of qualifications used in the social conditions of working time in operation at the time the measure was taken. It is noticeable here that the selected notion of time and nature of work is practically identical to that which enters into the definition of the value.

By examining graph 1, it is possible to mark a long-term fluctuation, out of phase by a quarter of a cycle, with an increase in labor productivity from the middle of the prosperity phase to the middle of the recession phase, and stagnation or decrease from the middle of the recession phase to the middle of the next prosperity phase. The movement is without any possible ambiguity from 1810 to 1905, but some supplementary explanations are necessary after that.

After 1905, it may be pointed out that productivity progresses only very weakly, and that the maximum level achieved in 1889 is not passed again before 1952. Next, it is visible that the war from 1914 to 1918 marks a rupture, with a productivity drop on the order of thirty percent.

The issue of the 1914–1918 rupture evidently calls for new research to accurately determine the causes. Among the possible hypotheses, the most realistic being that of a breakdown of the output norm, at the level of the average duration of working time and possibly at that of socially tolerated cadences. After the war, people did not work the same way they had before.

If the principle of the 1914 breakdown is accepted, then the fluctuation movement is encountered again with growth from 1920 to 1934, stagnation from 1935 to 1952, and growth again after 1952.

The stagnation of productivity at the end of the recession phase and at the beginning of the next prosperity phase is obviously astonishing with regard to the idea of the reversal one can have. In fact, thee way it is measured, productivity partially measures the labor force's position in production ratios. It translates

probably socially accepted improvements of working conditions, given in cadency or intensity or in annual duration of work, and so expresses the revalorization of labor. On the contrary, the increase of the apparent productivity at the end of the prosperity phase and at the beginning of the depression would translate in part the relative decline of the position of labor.

1.3. The "Efficiency" of Past Work

To measure the efficiency of the material means used in production is not easy if one intends to use this approach to find the total productivity of work in the sense of the total quantity of work necessary to produce a product. Such an approach, even now, is only in the research stage. For more distant periods, the description of use and repartition of individual products are missing. It is, therefore, only possible to approach this question through more or less time indicators describing the various components of total productivity, without the possibility of merging them together.

In reality, our main interest here is the ratio fixed capital/variable capital (labor cost). For that reason we will focus on productivity of the fixed capital (productive part). The intermediate consumptions play an important part in the value of the product, but this does not relate in the same way to the variable capital (live work). To a large part, the increase in intermediate consumption translates into an increase in the social division of work. When a factory uses pre-prepared logs instead of having them sawed or squared at the factory, what it is doing is displacing the place where the live work is performed. From the product point of view, it does not modify the productive combinations. It is not so when a new machine eliminates the live work. Of course the intermediate consumption can also play a similar role if, for example, when a new cutting scheme reduces the consumption of logs by one-third, but this is not what dominates the

movement of intermediate consumption.

To approach the "efficiency" of the past work, one can use different types of indicators, the sales value of equipment, starting with the evaluation of productive stock of fixed income. If we assume that the various problems connected with such an evaluation are solved, it can be taken as representing the quality of work under two conditions. First, there is no inflationary distortion of prices, and second, the composition of capital in branches supplying the manufacturing equipment develops as the average composition of all capitals. If there is an inflationary distortion of prices, the value of sales deviates from value, and so from the value of the work it represents. If the price deviates positively from value during the prosperity phase, and negatively through a depression, the measured productivity would be diminished during prosperity and increased during a depression.

The composition of capital has similar effects as the value of sales. If the composition of capital in the equipment producing industry increases faster than the average, the price of this branch will incorporate a part of the increased plus-value, and so increase the value. In this case, the productivity measured on the basis of sales value will incorporate a diminished increase.

To eliminate the inflationary or deflationary effects one can evaluate the capital stock in constant prices[3]. By doing this we also eliminate the price variations introduced by value variations, and so the quantity of work represented. One falls into a similar situation that emerges with the use of physical indicators, with an additional picture of productivity differentials in capital industries in comparison to the whole assembly.

The two numbers that follow give a picture of productivity development calculated from these indicators.

The first indicator, based on the evaluation of current prices of capital stock, show long-term fluctuation with a phase not in tune with the reference cycle. The

GRAPH 2 : CAPITAL PRODUCTIVITY
Tons by current francs
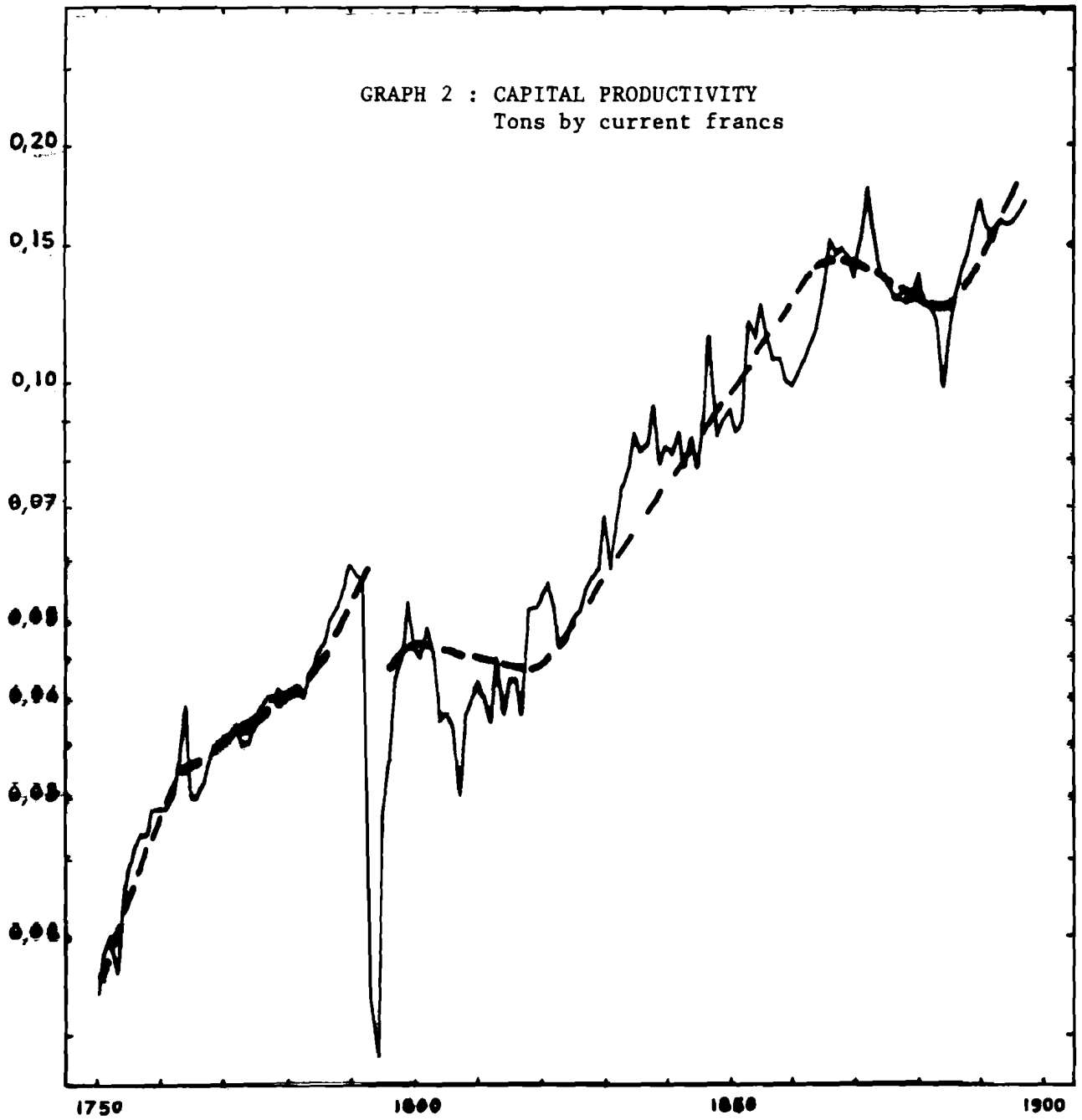
phase of increased productivity of capital falls approximately into the phase going from the center of a depression to the center of the following prosperity period; the decrease extends from the center of prosperity to the center of depression.

This movement is clearly seen in the period 1750–1790. The Revolution provoked important changes, a breakdown of production and, at the same time, a not negligible inflationary deviation. The Companie d'Anzin was deeply disturbed by these events. Was it the attempt to nationalize? Was it the emigration of most of its administrators? Or, was it the change in management that followed? In any event, in the year 1817 it was necessary to achieve the production tonnage of 1789. The capital that normally should have grown until 1805 broke down, and it was only in 1830 that it achieved the level of 1790. From then productivity achieved a high rate of growth practically from the beginning of the depression phase. It is possible to observe that the constant price data series shows the start of the increase in 1831, fourteen years after the start of the price fall (we always use price movements as fluctuation of reference). The increase in the productivity continued high up to the beginning of the prosperity phase (1855), and then again in 1863–64. The decline in productivity between 1855 and 1860 (approximately 25%) had special causes. These years correspond to the production increase in Pas-de-Calais. If, in the 1840s the Companie d'Anzin had been able to face the challenge of competition from the North, it could not have resisted the new exploitation in Pas-de-Calais. After three years of explorations the Courrière mines could cover basic expenses from its income, and all new equipment was provided by auto-financment. The Companie d'Anzin had to reduce production at a time they should have accelerated the modernization of equipment. By not doing this their productivity grew only up to the beginning of the 1860s. If one abstracts the coal ‚crisis of 1873 – the oil shock of the time – productivity declined from 1865 to 1884, it grew again in 1897, marking the end of the great depression, and also the end of

our data series.

The constant price series reproduces, in a more compressed form, the current price series. The period 1855–1960 is hardly touched, probably due to the elimination of the inflation effects. On the other hand, the deflation that characterized the end of the depression did away with the growth of productivity between 1884 and 1897.

These long-term fluctuations of capital productivity are very important. The slowdown that intervened in the center of the prosperity phase indicates the limits obtained by the development of production relations. We have already identified symmetric fluctuations of work productivity with increases from the center of prosperity to the center of the depression. This movement of work productivity did not compensate for the inverse movement of capital productivity, just the opposite, it revealed its harmful nature. This double movement presents, in terms of capital composition, a blow-up of fixed-capital (in the product, the "past work"), and a contraction of live work (labor). The first causes the decrease in the level of profit, and the second causes unemployment.

2. Production Relations

The study of capital and labor productivity gives a first approach to the conditions of blocking the development of the productive forces. We now have to analyze the movements of production relations in order to show the development of contradictions between this movement and the productive forces.

In this way we will examine, consecutively, the movement of the exploitation ratio, and thus approach the level of surplus value, after that, the development of the capital-labor ratio, attempting to introduce the concept of the organic composition of capital. From all of this we will deduce the rate of profit movement.

GRAPH 3 : CAPITAL PRODUCTIVITY
Tons by constant francs
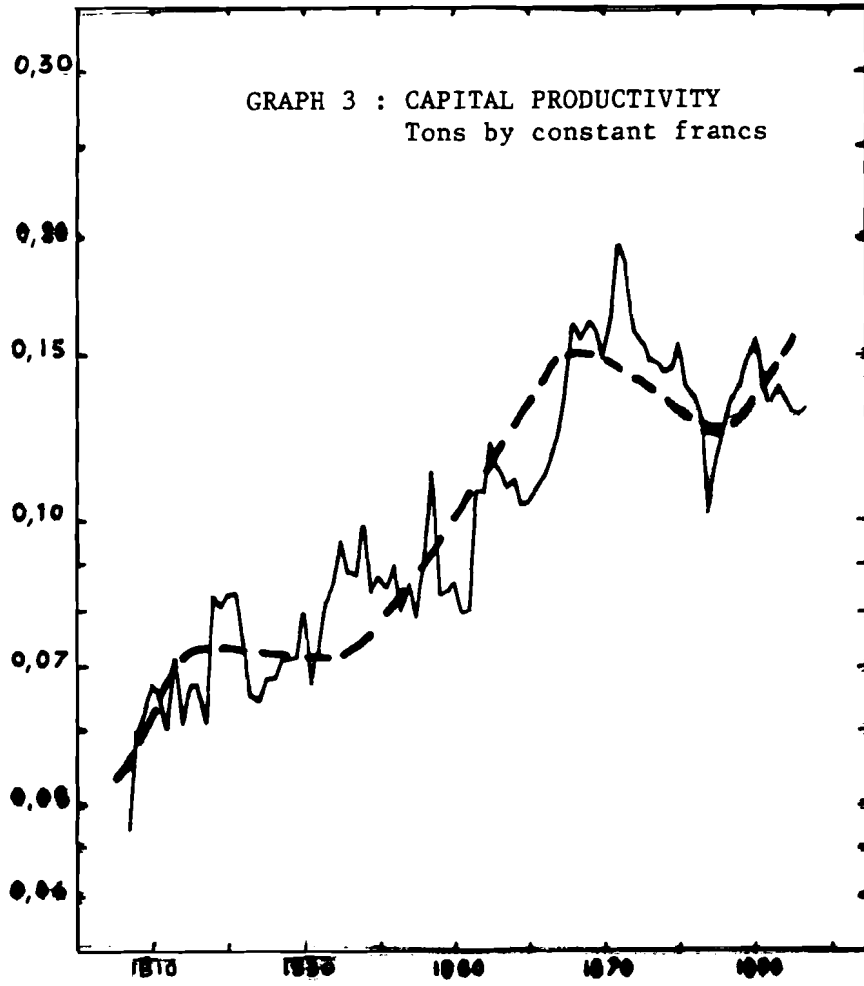
2.1. The Development of Exploitation Ratio

2.1.1. Wage costs and the product value

The importance of the wage costs in the product value gives us a more accurate image of the productive structure and its evolution. It creates a connection between the cost of the labor force (variable capital), and the other elements constituting the value of the product: intermediate consumption (circulating capital), depreciation (value transmitted by fixed capital), and the net trading profit (surplus value).

If intermediate consumption and depreciation are deducted from the product value to obtain the net value-added, then variable capital and surplus value are connected, and an image of the movement of the surplus value rate is obtained.

The coal industry is a primary industry in which intermediate consumption constitutes only a small part of the product value. The part of the wage costs may therefore be considered as a satisfactory indicator of the movement of the surplus value rate.

The following graph 4 confirms this proposition. Curve C 1 shows the evolution of the share of the wage costs in the product value at the Anzin Company, and curve C 3 shows the same evolution with respect to the net value-added. The two ratios follow the same movement, both in tendency and annual conjuncturs, the only difference being the degree of sensitivity to the conjuncture.

The two curves reveal the existence of a long-term fluctuation inverted with respect to the reference fluctuation: the share of the wage costs in the product value passes from 36% in the years 1810–1813 to 27% in 1820–1923. Then, it increases to more than 55% in 1848–1852, coming down to 41% in the early 1870s. It rises again in 1894–1897 to reach 60%.

GRAPH 4 : WAGE COSTS AND PRODUCTION

C 1 - WAGE COSTS/PRODUCTION IN ANZIN COMPANY
C 2 - WAGES/PRODUCTION IN ALL OF FRANCE
C 3 - WAGE COSTS/VALUE-ADDED IN ANZIN COMPANY
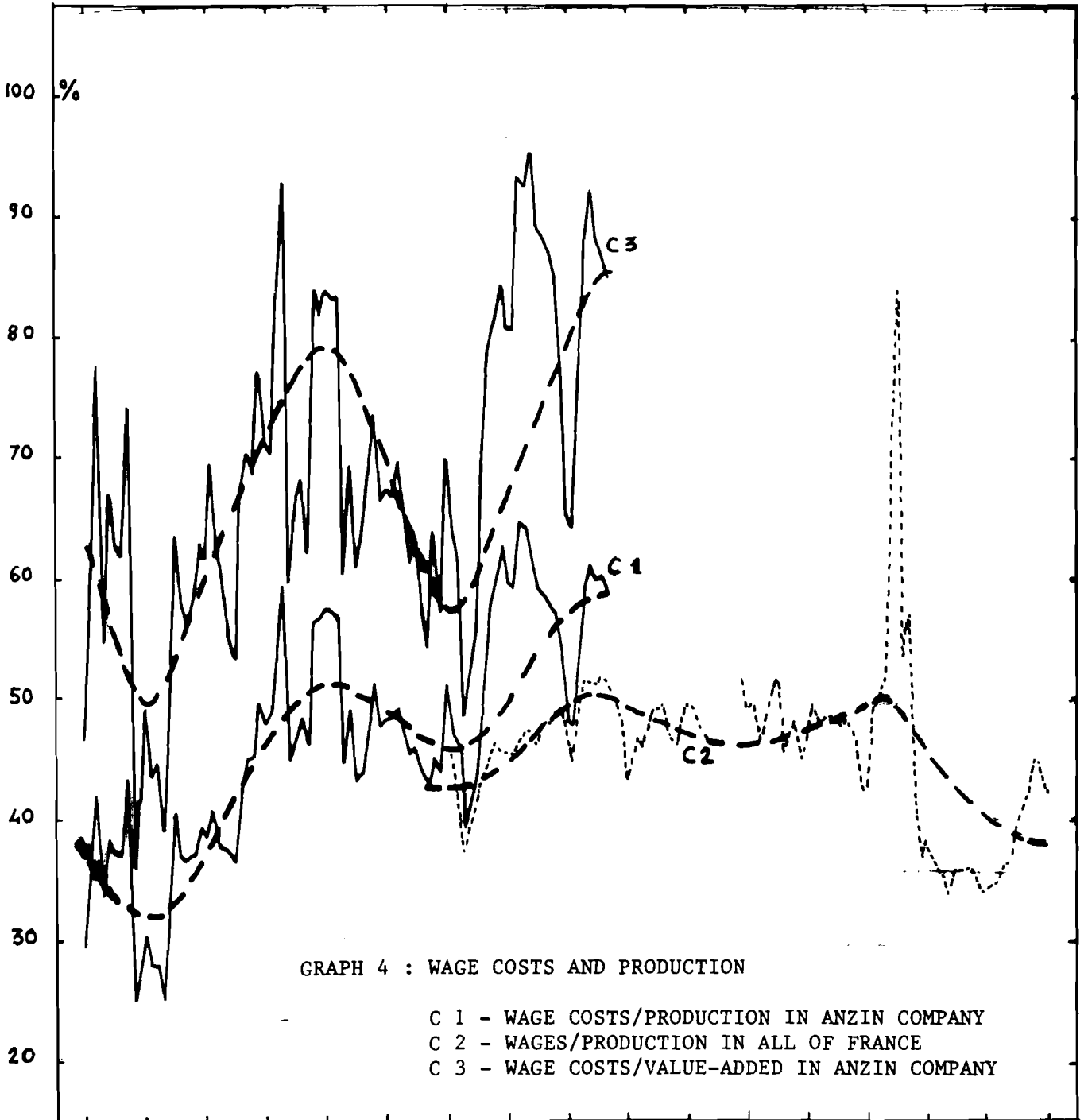
For the overall French production, wages in relation to production (curve C 2) stagnate during the Second Empire, increase strongly from 1873 to 1897, and then decrease again until World War I. Between the two wars, the upward movement is much less obvious. In fact, from our point of view here, the data on wages, which is the only one available on a national level, tends to deviate more and more from the data on wage costs because of the development of indirect or deferred forms of wages. However, these new forms are principally developed during recession phases. For the Anzin Company, social spending represented 2.84% of direct wages in 1873, and 9.43% in 1897, with retirement pensions appearing in 1884. We have no further indications on the importance of social costs in the coal industry. On the other hand, in the steel industry, incidental costs from hourly wages for social insurance, family allowance and accidents, passes from 8.73% in 1935 to 12.60% in 1939, then to 27.03% in 1945 and 28.71% in 1949[4]. Under these conditions, it is reasonable to believe that the total wage costs, as a part of the product, are in visible progression in the 1920–1947 period.

We could hastily infer that the increase in wage costs during the recession phase originated the crisis. In this case, an explanation would be necessary for the fact that the reversal to prosperity happens when the share of wages reaches its highest level, and conversely, the reversal to recession occurs when this share is at its lowest level.

We believe the contrary, that the revalorization of the labor force during the recession phase is the condition for the return to prosperity. In these new conditions of productivity, it is the only factor likely to open an outlet.

2.1.2. The cost of the labor force

The ratio of the annual wage costs to the number of staff gives the average cost of the labor force. This, evidently, concerns the labor force effectively em-

ployed in the mine. In this case, it incorporates all the elements of the structure of the collective worker, the division of men-women-children, the range of qualifications, average seniority, etc. It also includes the changes in the social conditions of production and, more particularly, the changes in the annual duration of work and in the labor intensity. Finally, it takes into account the elements of the social reproduction of the labor force, in the general meaning, supported by the mine such as pensions to widows, orphans, and retirees, health services, instruction, religion, etc., sponsored by the company.

On graph 5, following, an inverted long-term fluctuation of the wage costs is noticeable, but hardly perceived (curve C 1). If this inverse fluctuation were confirmed in following research, it would tend to prove a cyclical structural transformation of the labor force. Indeed, F. Simiand observed a normal fluctuation (in the same direction as that of prices) in the nominal hourly wages for most categories of wage-earners. If the long-term fluctuation reverses in passing from hourly wage rates to average cost, it means that the structure has been modified.

2.1.3. Purchasing power

The average cost of the work force is an important element in the management of the mine, but a rise in this cost does not necessarily imply that the work force's situation is improving. That is why we tried to balance this average cost with an index of retail prices.

For this, we used the Froment and Portzampac index[5] for the period 1815–1941, which we extended to 1970, with attention to indexes of retail prices successively produced by the National Institute of Statistics[6]. It is certain than an index constructed in that manner leaves a lot to be desired, from a technical point of view. But it also must be recognized that the construction of indexes representative of the very long period has not been resolved, either technically or

theoretically. What is important to us here is not so much to measure the exact amplitude of the rise in purchasing power between the two dates, as it is to point out the changes in growth rhythms and to situate their inflections in time.

On graph 5, curve C 2 shows the evolution of the purchasing power of the average wage costs at the Anzin Company, and curve C 3 shows the purchasing power of the average direct wage of the French coal industry as a whole.

The two curves reveal the existence of an inverse long-term fluctuation, seemingly slightly out of phase; the increase in purchasing power is prolonged for several more years in the beginning of the prosperity phases, in the same way as stagnation still remains in the beginning of recession phases.

This, of course, is contrary to common sense. One would naturally expect an increase in purchasing power during a prosperity phase. This difference between the apparent and the real is explained by the fact that we measure the effective use of the labor force, with the variations in qualifications it implies, as well as the changes in the job structure. Another explicative factor certainly involves the importance of aspirations to access new products, entailed in the development of productive forces.

The fact that purchasing power progresses strongly when social production principally tends to stagnate, and that its growth slows or becomes nil when production starts to develop again, leads one to think that the distribution of the social product tends to change in favor of the work force during the recession phase and in favor of capital in the prosperity phase.

2.1.4. Purchasing power and productivity

If the purchasing power of wages progresses as the productivity of labor that justifies it, the relative position of labor remains, in principle, unchanged. In effect, the social product increases because of the gain in productivity, and labor

GRAPH 5 : AVERAGE WAGE

C 1 — AVERAGE WAGE IN ANZIN COMPANY
C 2 — PURCHASING POWER OF AVERAGE WAGE IN ANZIN COMPANY
C 3 — PURCHASING POWER OF AVERAGE WAGE IN ALL OF FRANCE
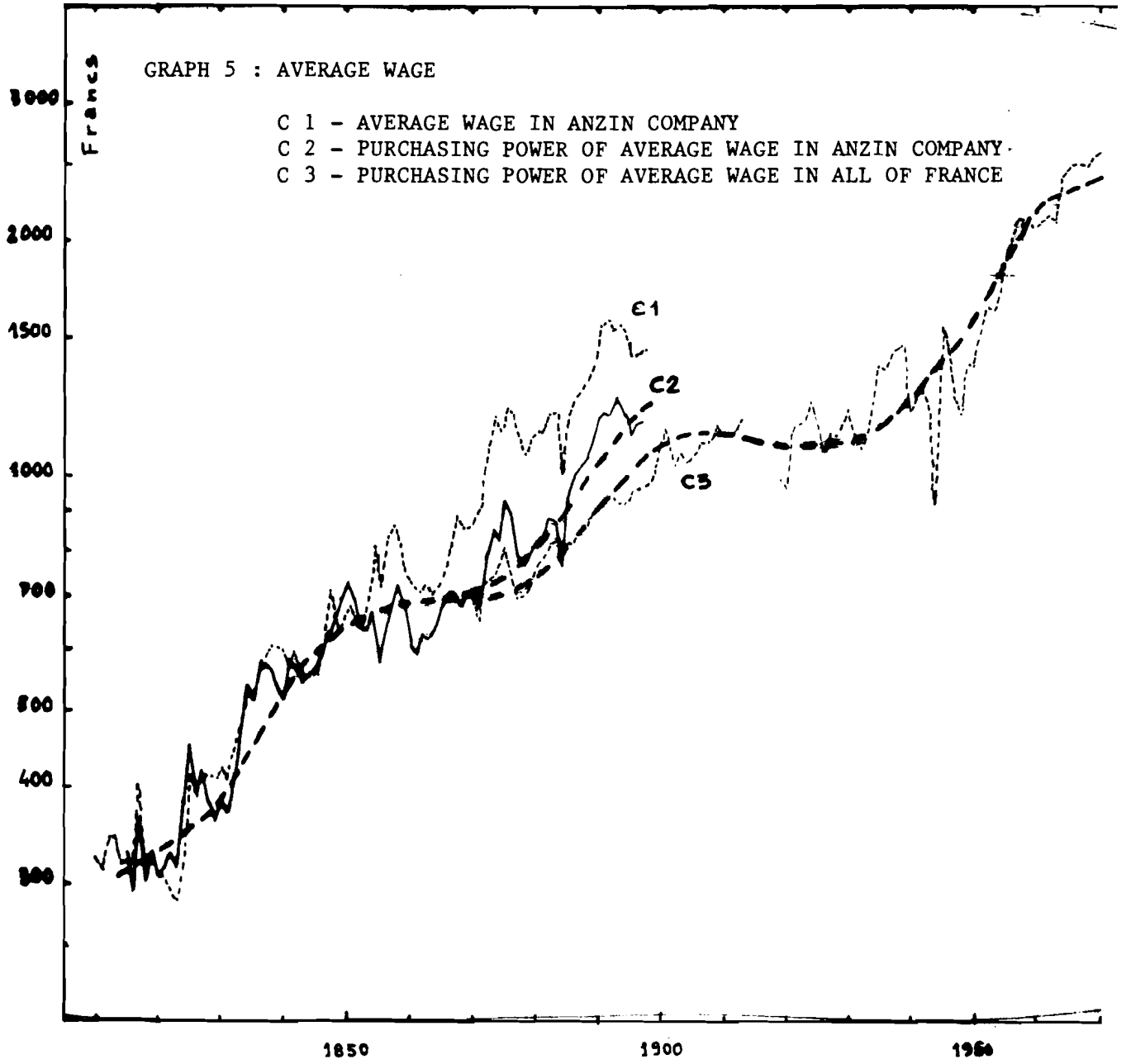
receives a share of the supplementary production in an identical proportion to the part it had in the initial production. If purchasing power increases faster than productivity, the relative position of the labor force improves. If it increases slower, its relative position worsens, while, at the same time, the increase in purchasing power objectively allows greater consumption.

The movement of the ratio of the purchasing power of the annual wage costs per job to the labor productivity, measured in the same conditions, should therefore indicate the evolution of the relative position of the labor force in the sharing of the social product.

Graph 6, which reports the evolution of this ratio for the Anzin Company (curve 1) and for all of France (curve 2), makes the existence of an inverted long-term fluctuation, slightly out of phase, clearly apparent: purchasing power increases faster than productivity between 1826 and 1856, then again between 1880 and 1907, and finally between 1930 and 1950. The results, therefore, confirm the hypothesis of a revalorization of the labor force during a recession phase. Furthermore, over the very long run, the general tendency is upward. This trend would be even clearer if the "all of France" curve took into account the total wage costs, and not only direct wages. The ratio should be closer to 9.2, instead of a 6.2, in the years 1948–1950. It appears that, from one cycle to another, the relative position of the labor force improves.

It is clear that the theoretical impact of the result would be considered if the movement were verified at the level of the economy as a whole.

Over the very long term, we can assume that the average wage costs in coal industry do not deviate much from the average wage costs in the rest of the economy. In order to balance the relative upward tendency of the purchasing power, it would be necessary that productivity increases faster in the national economy as a whole than in the coal industry. Indeed, productivity in coal mining companies does

GRAPH 6 : RATIO $\dfrac{\text{PURCHASING POWER OF AVERAGE WAGE}}{\text{LABOR PRODUCTIVITY}}$

C 1 - ANZIN COMPANY
C 2 - ALL OF FRANCE
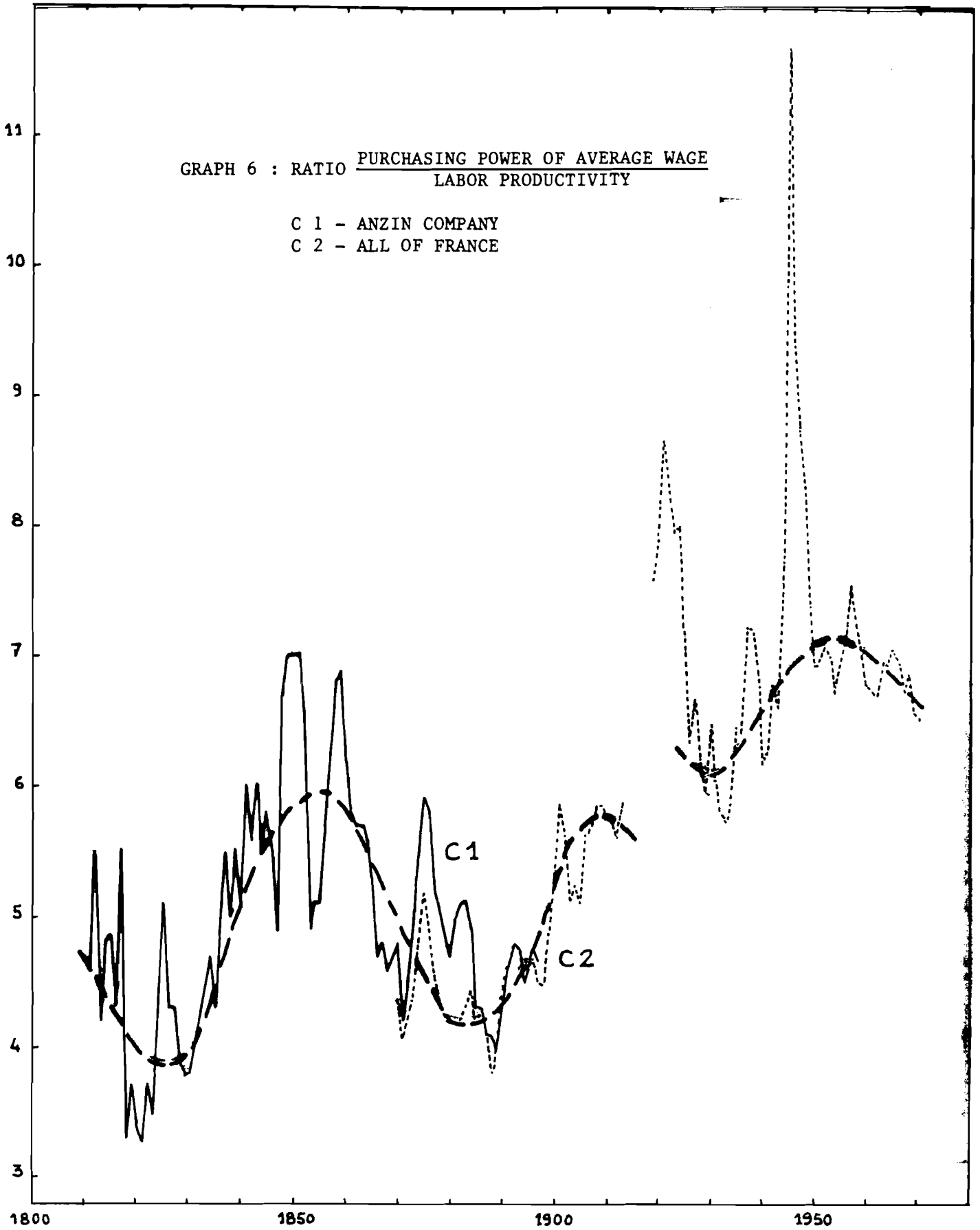
not improve between 1889 and 1952. But the measure performed corresponds to the annual productivity per job, and thus, does not take into account the decrease in working time. But during the same period, the latter passes from 3800 hours to approximately 2200 hours. Since the reduction of working time affects overall employment, the annual productivity per job at a general level should not have increased much faster in coal mining industries. The hypothesis of an increase in purchasing power faster than that of productivity, on the level of the economy as a whole, is thus very possible.

The revalorization of the labor force supposes a correlative decrease in surplus value. The movement should be found, even accentuated on the level of surplus value.

2.1.5. The surplus value rate

The net value-added, diminished by wage costs, gives the net product, understood as a surplus-labor produced by the labor force. The ratio between this net product and the wage costs is thus equivalent to the surplus value rate, multiplied obviously by a coefficient proportional to the relative intensity of capital in the studied sector.

Graph 7 shows the evolution of this ratio. In order to try to give a picture of what happens later in the twentieth century, we established, for France as a whole, the ratio of the production value minus direct wages over direct wages. Different from the first ratio, this new ratio keeps depreciation, intermediate consumption, and indirect wages in the numerator. The denominator, however, does not include indirect wages.

The examination of this graph permits pointing out the existence of a long-term fluctuation, with an increase in the surplus value rate during the prosperity phase and a decrease during the recession phase. Moreover, there is a general

GRAPH 7 : RATIO OF SURPLUS VALUE

C 1 - ANZIN COMPANY
C 2 - ALL OF FRANCE
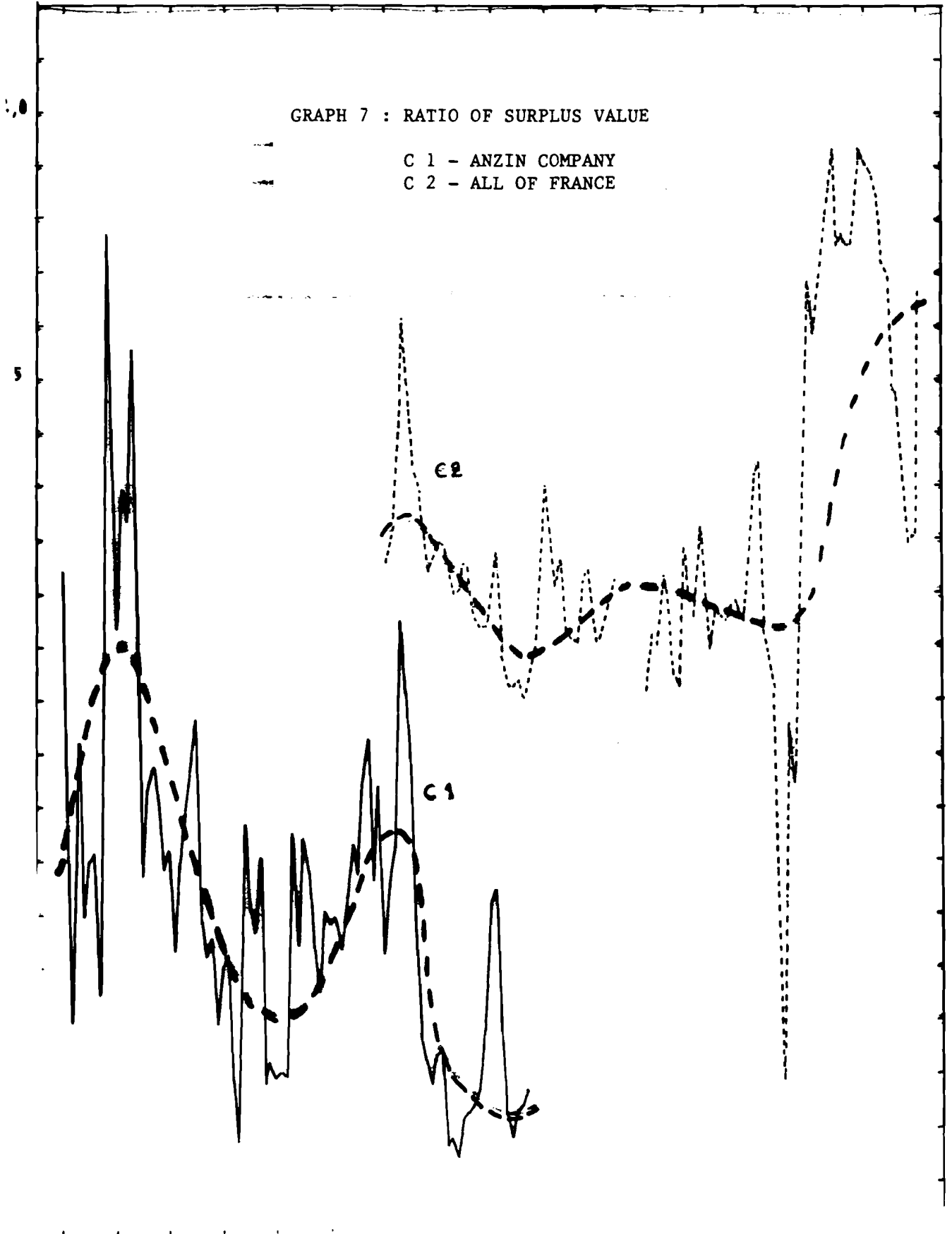
downward trend, at least until the end of the nineteenth century. The fact that indirect wages are not taken into account in the "France as a whole" series lets us assume that the downward tendency was maintained in the twentieth century, at least until World War II.

2.2. Work, Capital, and the Level of Profit

2.2.1. The composition of capital

The technological composition of capital expresses the structure of the productive forces; that is the quantity of the means of production necessary for work, the machines, and raw material on the one side, and the work of labor on the other. The ratio of fixed capital value to variable capital value, the composition of capital value is the picture that a capitalist is drawing, but this is a deformed image because it does not take into account the live work in its totality, but only the value of the labor force. The value image of the technological composition is given by the organic composition of capital. It puts into ratio the value of the means of production, the constant capital (past work), and the live work in its integrity whose value can be decomposed into variable capital and surplus value.

In terms of commodity value, it is in prices, the ratio of intermediate consumption and the productive part of fixed capital to value added give a picture of the organic composition of capital expressed in value. If one knew the real rotation period of the different components of capital, one could make a real picture of the level. In the opposite case, the picture is representative with a factor x (proxy). As for the trend, the picture should be satisfactory under conditions that there is no distortion between the development of capital composition in the branch under consideration and the development of the average composition of capital (unification of profit rate leads to the necessity to consider the differences in the compo-

sition of capital in the formation of productive prices). In principle: the impact of inflationary or deflationary distortions of prices in relation to value should not have and important impact for the development because it acts both in numerator and denominator of a fraction.

We will first establish separately the relation of intermediate consumption and the productive part of fixed-capital stock for the net value added. We then give an evaluation of the organic composition of capital based on a period of rotation of intermediate consumption and the live work equal to six months.

Figures 8, 9, and 10 show the evolution of the organic composition calculated this way and its coproducts.

One can observe, very clearly for the organic composition and for the ratio fixed capital/value added, the existence of long-term fluctuations, displaced with the tread of decline from the center of depression to the center of prosperity. One merges here an observation made above on the development of apparent labor productivity and the productivity of capital. The ratio of these two productivities gives in reality a picture of technological composition of capital. It is normal that the organic composition of capital shows the same movement. An increase in organic composition of capital at the end of the prosperity phase shows the development of the "past work" at at the expense of the live work and brings with it structural unemployment and increased constraints released. The effects of the increase are marked by the progression of the rate of surplus value, but in the depth the structure is degrading. With the first decrease of the surplus-value rate, the rate of profit is permanently decreased.

To expose the long-term fluctuations of the capital composition is one of the main contributions of this research. It should be proved on a large level then the Compagnie d'Anzin. But it seems to us that it is even more important that the long-term tendency of decline has been revealed.
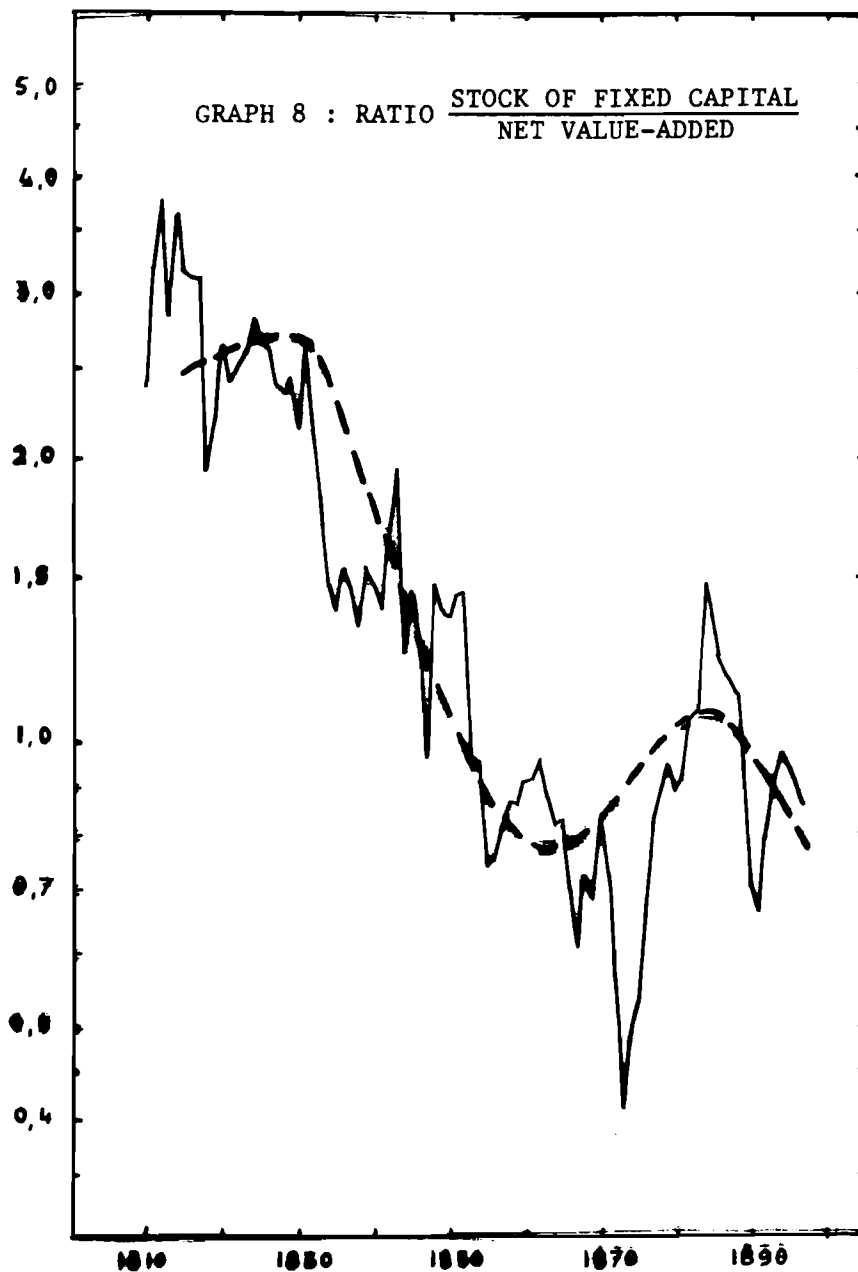
The decrease in the organic composition of capital is evidently a surprise, and its amplitude is such that the cause cannot be attributed to an eventual bias in the construction of the data series. We know that Marx based the law of tendencial decrease of the profit rate on the increase of the organic composition of capital, and on the impossibility of increasing the surplus value rates in a proportion sufficient to balance this increase. Indeed, the principle was accepted before Marx, by Ricardo, and was never contested afterwards, either by the Marxists, or by his critics. In the 1979 article, I considered the possibility of a fluctuation in the organic composition, but carried by a generally upward trend. If the organic composition of capital decreases, the whole prospect is overturned.

It is thus extremely important to know if this is a general phenomenon or if it is a phenomenon specific to the coal industry, or even to the Anzin Company alone.

It is true that the coal industry presents totally specific characteristics, notably it is necessary to dig deeper and deeper to extract coal, and that implies the putting to work of increasing material means. This factor of exhaustion of resources does not occur in other industries. On the contrary, the development of working techniques, the improvements achieved in the conducting of excavation, in ventilation, in the product circulation speed between the bottom and the surface, and the increase in the average duration of life of the pits, all allow increasing in the number of miners even faster than increasing in volume of equipment. The major part of these mutations occurs before 1870 and thus, explains the importance of the decrease in the technical and organic composition of capital in the beginning of the nineteenth century. On the contrary, after 1870, it seems like the factor of resource exhaustion tends to become dominant.

What is the case in other industries? The question will only be answered by new research. The working of several industries, the process of eliminating human labor as a motor power, the relative expansion of equipment industries seem to act

GRAPH 9 : RATIO $\dfrac{\text{INTERMEDIATE CONSUMPTION}}{\text{NET VALUE-ADDED}}$

GRAPH 10 : ORGANIC COMPOSITION OF CAPITAL
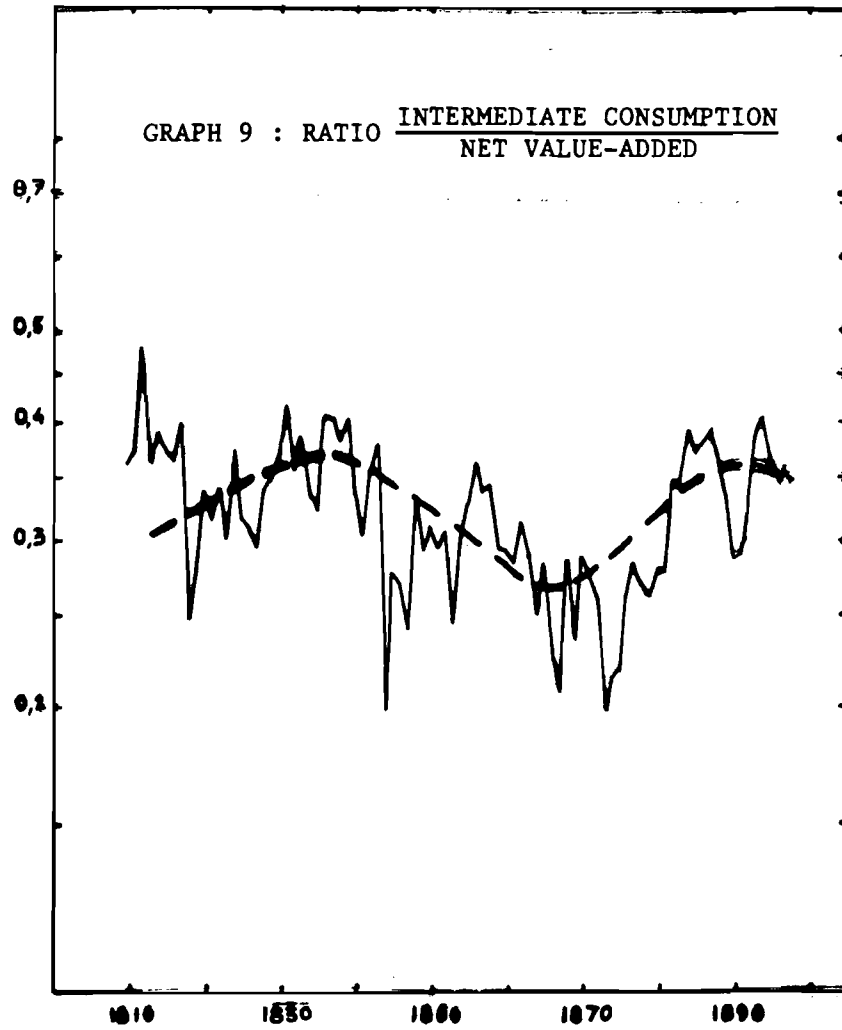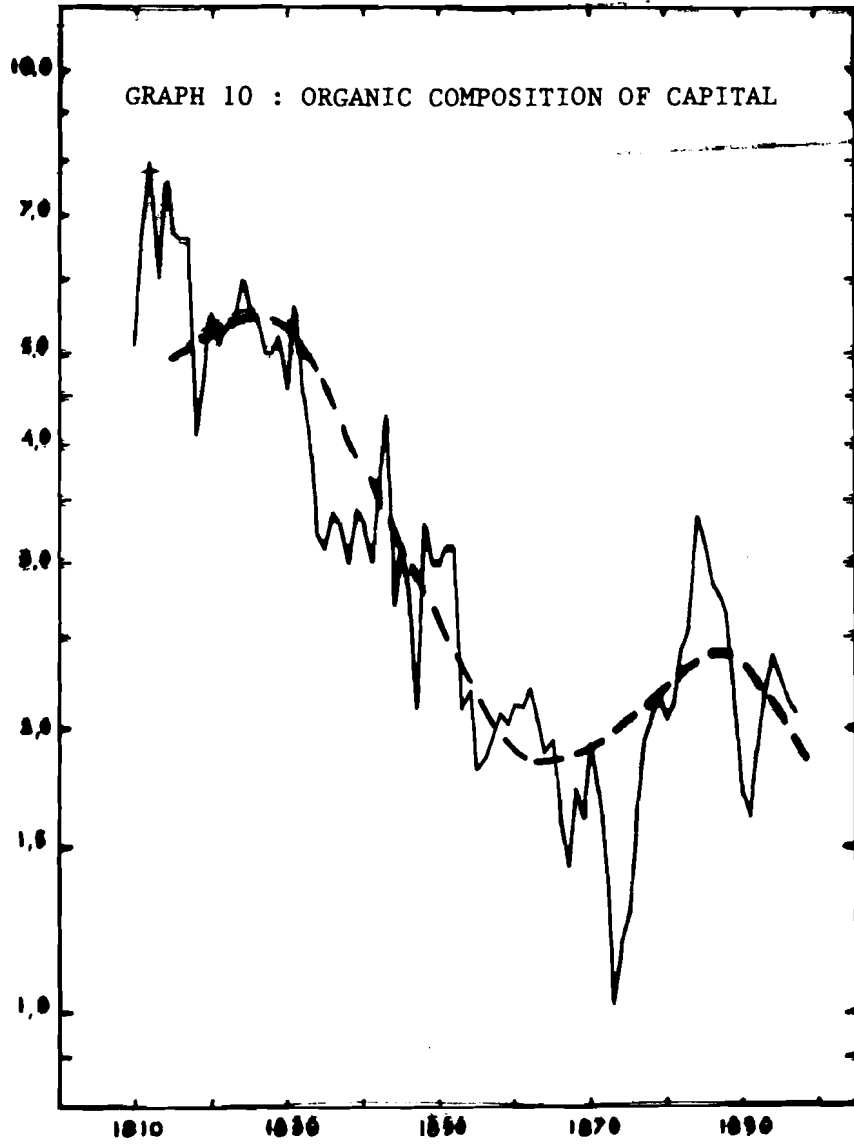
in favor of an increase in the organic composition of capital. But inversely, do we not underestimate the decrease in value of the equipment, the changes in production processes, the utilization of new products?

We do not have the evaluation of the productive part of fixed-capital stock of other industries, but the physical indicators could give a first approximation. So, for example in the French railroad one can observe the following trend.[7]

	1861	1900	1950	1965
No. of employees/km of used road	8.94	7.64	10.92	9.44
No. of employees per machine	25.6	27.4	34.7	58.1
No. of employees per personal wagon (couches)	11.47	10.0	24.7	25.8
No. of employees per railroad car (load carrying)	1.27	1.05	1.13	1.20

2.2.2. The rate of profit

The long-term changes in the organic composition of capital and the rate of surplus value evidently poses the question of profit rate. The ratio between the surplus value (net value added- wage costs) and the total of advanced capital (stock of fixed capital + intermediate consumption + wage costs) gives us a good approximation of the annual rate of profit. For this calculation we have assumed that the intermediate consumption and wage costs has a six months period of rotation. The profit calculated this way contains taxes and some expenses that do not have a productive character and specifically some expenses of commercialization.

One can observe long-term fluctuation of profit rate with a tendency to increase during the prosperity phase and a declining tendency during the depression. For very long periods the declining tendency of the profit rate are not evident. The tendency is to increase in the period 1810–1873, on the other hand the decrease after 1875 is extremely strong.

GRAPH 11 - PROFIT RATE
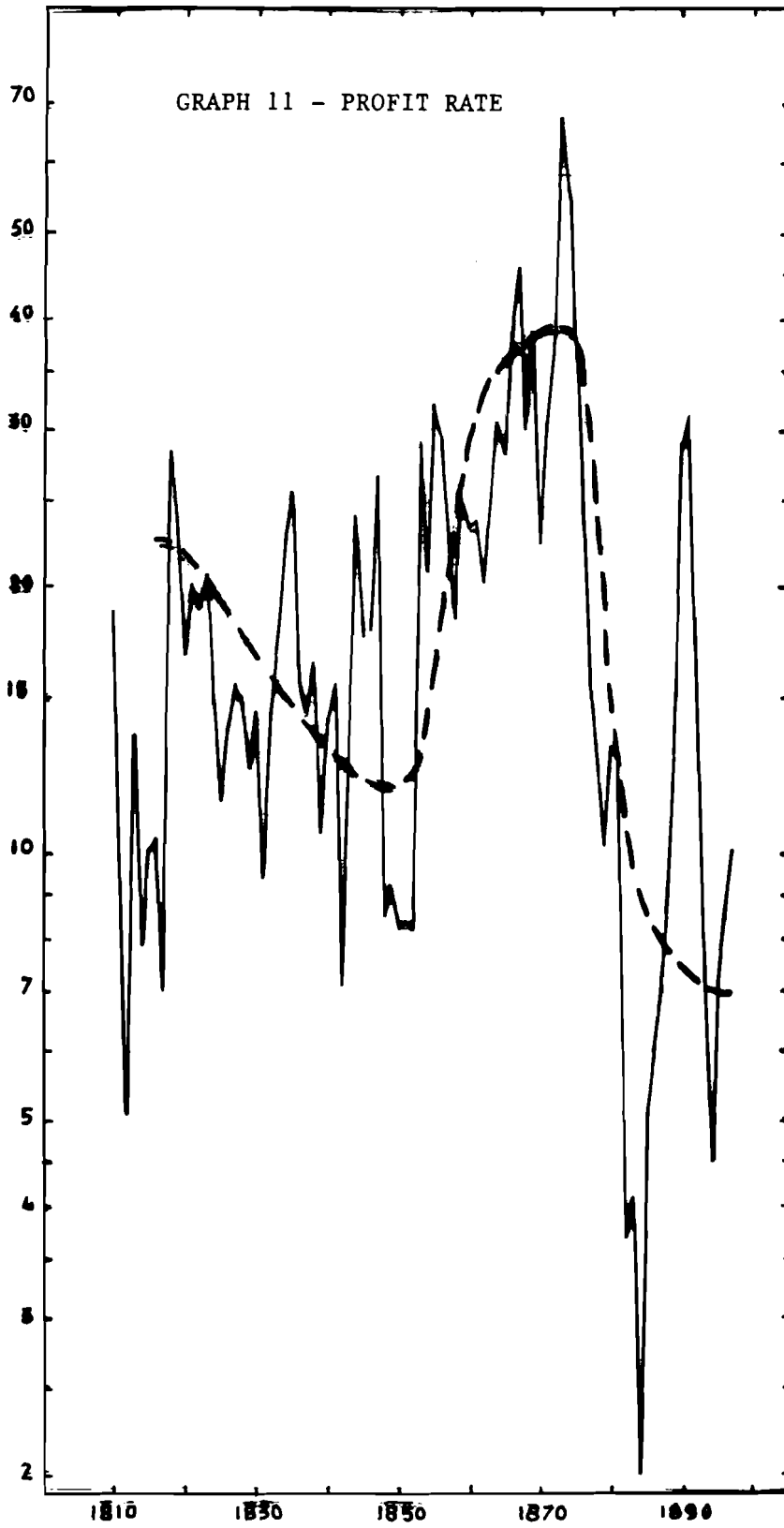
3. Conclusion

The study presented is based on the analysis of the production relation, and particularly on the ratios capital – labor. By limiting us to the approach using values of main production relations, bypassing the sphere of circulation, the ratio of exchange and consumption, the relation of appropriation we condemned us to see only a part of the processes acting in the long-term movement. It would be an error to consider this approach as a global one. For sure, the series shown here, its complementarity give an illusion of a closed system producing its contradictions and then solving them. The measurement accentuate illusion!

One cannot treat everything at the same time. We have treated here only a part of the movement. Such fundamental aspects as the processes of overaccumulation and structural devalorization have not been touched. We have presented the state of production relation without mentioning what makes them develop and especially the subjective perception of these relations, the consciousness of needs and the possibility to satisfy them that are preconditions of social struggles. We have also passed quickly over the fundamental question of the qualitative dimensions of productive forces, the knowhow and qualification of people, innovation, the creation of new products and processes of production. Studies that are still in the beginning stages about these questions should enable us to have these transformations take place.

These limits passed, the obtained results confirm some of the hypotheses forwarded in the article of 1979: the long-term movement emerged, perhaps still more clearly, as the process of misadoption and later readoption of the production relation to the development of productive forces. But from here they pose new questions for theory. So, from the long-term fluctuation that affect them, the probability of declining long-term trends of organic composition of capital, and a semi-certainty of an even stronger decline of the rate of surplus value forces us to

re-think some steps. It is evident that the declining trend of these relations would lead to a change of views of Marx without modifying the basic tendency: profit rate would not decline because of an increase in the organic composition of capital, but it would decline because of revalorization of labor.

We can further ask what we make of capital. Marx there evidently insists on the increase of the organic composition of capital as a basic tendency of the capitalist production relations. But is this contradictory to the very long-term decline? So, because he writes "In order to give it an expression completely general, here is what constitutes the contradiction: the capitalist production system implicitly assumes a tendency of absolute development of production forces, meanwhile the system has a goal to preserve the existing value-capital and its maximal revaluation (...). Its specific character is based on existing value-capital consideration as a means to maximally revalue this value. The method the capitalist production uses to achieve its goal contain: decrease of the profit rate, depreciation of the existing capital and development of productive forces of labor at the expense of those that have been already produced".[8]

Does this not mean that in spite of inherent tendency of capitalist production relations to increase the composition of capital, the development of productive forces impose in very long term an inverse movement? This contradictory movement manifests itself in terms of measurement by superposition of fluctuations, both business as structural ones.

Certainly, one has to be careful in generalizing results achieved still in a very limited scale. Should it be confirmed, this reversal of perspective would remove an important contradiction between the theory of historical materialism and the theory of capital as worked out by Marx (at least as we have interpreted it up to now).

The increase in the organic composition of capital and in that of the surplus value rate gave to past work, and thus to capital, a growing economic importance in the production ratios. It was thus difficult to explain why a social class, whose economic importance was increasing, should have ceded its place. The feudal production mode would never have disappeared if the economic importance of the land rent had been increasing, reinforcing in that manner the nobility's situation as a social class.

The revalorization of the labor force, with its resulting decrease in the surplus value rate, as well as the decrease in the organic composition of capital carry within themselves the decreasing role of capital in the economic relations, and thus, its decreasing part as a social class. On the contrary, the increasing importance of the labor force in the economic relations gives it a more and more important part as a social class. This double movement defines the historical nature of the capitalistic mode of production.

It is certain that this vision of development of the productive forces places the man in a basically different position with respect to a machine. The revalorization of labor and the decrease of organic composition of capital that has attached to it, give a permanently increasing role to productive men with respect to his tools. This is completely opposite to the apocalyptic visions that predict the man a role as slave of a machine. Sure, it is the logic of capital to imagine a world made to its own image. But the development of productive forces goes in diametrically opposite directions and escapes it more and more. It poses more strongly than ever the necessity of developing the productive relations where the man would emancipate of non-conscientious and anarchic regulation of capital in order to be dependent only on the will of consistent producers becoming themselves the object of this development.

NOTES

1. Fontvieille, Louis (1979). "Les mouvements langes de Kondratieff et la théorie de la régulation" *Issues*, 4, 3e,4e trim., 13-36.

2. "Contribution à l'etude des fluctuations longues: Le cadre, les Sources et les methodes de l'enguite sur l'exploitation du charbon dans le Nord. Pas de Calais de 1815 à 1914" *Cahiers Recherches et travanx de l'Institut d'Histoire Economique et Sociale de l'Universite de Paris I No. 10, November 1981.* "The labor force in long-term fluctuations" *Review*, X, 3. Winter 1987. "Fluctuation longues et rafforts de production" *Issues*, 25, 2 trim 1986, p. 43-94.

3. Nous avons pondéré la F.B.C.F. par l'indice des prix de gros de 45 articles, établi par A. Sauvy pour l'Institut de la Statistique. Nous l'avons rétropol/*'e jusqu'en 1782 avec l'indice correspondant pour l'Angleterre.

4. *I.N.S.E.E.*, Annuaire Statistique de la France 1966 — šumé rétrospectif. p. 427.

5. Froment et Portzamparc, "Les intérêts réels du capital entre les deux guerres et antérieurement", *Institut de la Canjoncture, Etude Spéciale No. 1*, Paris 1956

6. 1942-1954: Prix de détail à Paris, 34 articles – I.N.S.E.E.

1955-1956: Prix de détail à Paris, 213 articles – I.N.S.E.E.

1957-1963: Prix de détail, agglomèration parisienne, 250 articles – I.N.S.E.E.

1964-1970: Prix de détail, agglomèration parisienne, 259 articles – I.N.S.E.E.

7. *Insee.* Annuaire Statistique de la France 1966 — Résum/*'e rétrospectif p. 319-321.

8. *Le Capital*, livre troisième. Loi de la baisse tendancielle du taux de profit. Chapitre XV – Conflit entre l'extension de la production et la mise en valeur.

TABLE 1   ANZIN COMPANY   CAPITAL AND ITS FORMATION

ANNEE	6016	6060	6070	6038	6068	6069
1716	—	20	—	18600	17892	708
1717	—	60	—	37100	52639	2353
1718	—	60	8	26000	75405	3234
1719	—	50	8	27000	98257	4148
1720	—	—	8	27000	120194	5063
1721	—	—	8	—	115131	5063
1722	—	65	8	109000	213597	10534
1723	—	130	16	28500	230555	11542
1724	—	130	16	1500	220434	11621
1725	—	182	16	36700	244260	12874
1726	—	190	16	60900	289731	15429
1727	—	130	24	2000	276191	15540
1728	—	278	24	169000	422167	23024
1729	—	335	32	96400	491775	26792
1730	—	421	40	202500	658327	35948
1731	—	521	106	105300	722827	40800
1732	—	516	106	144500	820222	47105
1733	—	745	114	135900	904078	52044
1734	—	754	114	83800	933725	54153
1735	—	616	114	28500	906877	55348
1736	—	705	114	162300	1008231	60946
1737	—	1086	114	316400	1251521	73110
1738	—	1485	172	314600	1480498	85623
1739	—	1390	172	113000	1507448	86050
1740	—	1495	188	304500	1713729	98219
1741	—	1775	246	250700	1856058	108371
1742	—	1645	246	119500	1861560	113998
1743	—	1611	246	96000	1840830	116730
1744	39685	1679	246	161200	1878782	123248
1745	40900	1701	246	64000	1820421	122361
1746	41500	1694	238	271000	1958268	133153
1747	42400	1694	238	165500	1988967	134801
1748	41200	1614	238	701501	2516387	174081
1749	41700	1634	238	81500	2424193	173694

60 16   Extraction in tons
60 60   Total depth of pits in meters
60 70   Power of steam powered machines in horse power
60 38   Gross formation of Fixed Capital in current francs
60 68   Stock of productive fixed capital in current francs
60.69   Depreciation in current francs

TABLE 1 ANZIN COMPANY CAPITAL AND ITS FORMATION

ANNEE	6016	6060	6070	6038	6068	6069
1750	45000	1762	238	331600	2570860	184933
1751	52700	2025	296	333700	2706754	197806
1752	62500	2355	312	630400	3116204	220950
1753	59800	2599	328	358600	3241377	233427
1754	82800	3002	328	458500	3451322	248555
1755	88200	3140	386	471200	3658124	264398
1756	100000	3490	444	404800	3783251	279673
1757	102000	3490	444	168800	3669719	282332
1758	101000	3605	444	290300	3668543	291476
1759	103000	3433	494	154800	3531232	292111
1760	110000	3585	494	498800	3720561	309471
1761	119000	4417	560	685000	4075217	330344
1762	128000	4429	584	486800	4215144	346873
1763	135000	4287	584	175800	4044962	345982
1764	176000	5380	584	784300	4460635	368627
1765	152000	5978	600	803000	4908405	355230
1766	160000	6384	666	637000	5164920	380485
1767	165000	6572	732	492400	5264220	393100
1768	178000	6572	740	291000	5162258	392962
1769	180000	6572	740	242000	5013620	390638
1770	175000	6572	740	299000	4915232	397388
1771	183000	6878	740	527000	5038240	403992
1772	190000	6872	748	484600	5113094	409746
1773	202000	8222	756	936200	5612802	436492
1774	210000	8350	830	693000	5849202	456600
1775	220000	8410	838	456600	5840271	465531
1776	225000	8290	888	373600	5735856	478015
1777	234000	8645	888	587100	5834513	488443
1778	236000	8886	896	483700	5820795	497418
1779	237000	8231	896	384200	5700677	504318
1780	238000	8565	896	668700	5844900	524477
1781	238000	8513	896	423200	5741882	526218
1782	239000	8643	896	606200	5811342	536740
1783	240000	8646	896	606700	5886557	531485
1784	245000	8042	896	285200	5649309	522448
1785	252000	8112	880	323000	5457011	515298
1786	260000	8368	680	549000	5485101	520910
1787	272000	7916	880	460000	5423408	521693
1788	280000	7558	872	387400	5284965	525843
1789	290000	7728	864	509800	5262522	532243
1790	310000	7963	864	465300	5190699	537123
1791	291000	8188	864	437300	5095543	532456
1792	275000	8062	864	293800	4870637	518706
1793	80000	7599	806	275500	4640508	505629
1794	65000	7409	774	281500	4419602	502406
1795	123600	7534	716	367800	4303700	483702
1796	138631	7634	716	337500	4171451	469749
1797	184791	7952	724	628200	4328061	471590
1798	213540	8550	724	809000	4651044	486017
1799	248076	8733	674	455600	4618287	488357

TABLE 1 ANZIN COMPANY CAPITAL AND ITS FORMATION

ANNEE	6016	6060	6070	6038	6068	6069
1800	213840	8888	674	441200	4568755	490732
1801	203864	9008	686	366600	4441121	494234
1802	216274	9148	686	437300	4380754	497667
1803	229443	10301	690	1060820	4924788	516786
1804	208382	11317	706	1217290	5610824	531254
1805	225813	12038	726	752100	5827823	535101
1806	230693	12361	738	940860	6218809	549874
1807	194183	12155	742	630720	6288379	561150
1808	252106	11840	738	797500	6514242	571637
1809	260202	12092	742	513060	6452436	574866
1810	279865	11882	718	743330	6607445	588321
1811	268815	11642	686	557740	6581139	584046
1812	245092	11755	668	608870	6599591	590418
1813	289840	11755	622	319590	6339770	579411
1814	233023	11755	630	332070	6102862	568978
1815	247404	11755	624	302790	5842617	563035
1816	250044	11915	626	576610	5847962	571265
1817	242219	12305	662	963020	6224019	586963
1818	334482	12760	822	747240	6367833	603426
1819	323947	12910	882	421420	6188359	600894
1820	330189	12940	864	482790	6069456	601693
1821	353763	13032	796	853540	6310350	612646
1822	340449	13135	926	805250	6494416	621184
1823	318576	13175	928	999360	6847802	645974
1824	327327	13036	983	753020	6944304	656518
1825	358457	12871	1071	771300	7044406	671198
1826	376986	13351	1071	915280	7267458	692228
1827	400668	13530	1103	663380	7225133	705705
1828	416593	14046	1055	769310	7280171	714272
1829	410632	14198	1035	437830	7010549	707452
1830	461821	14655	1068	482700	6780083	713166
1831	412934	14975	1103	1045610	7082189	743504
1832	453218	15448	1204	736750	7062002	756937
1833	521741	15572	1170	721580	7018455	765127
1834	576927	15238	1156	1003220	7258473	763202
1835	647233	15915	1208	871790	7383040	747223
1836	606174	16161	1236	703300	7338758	747582
1837	603845	15691	1230	624510	7224077	739191
1838	674913	15843	1255	647110	7141706	729481
1839	608796	16227	1357	1227460	7623178	745988
1840	617970	15911	1316	522660	7412832	733006
1841	607783	16120	1415	749920	7434091	728661
1842	656671	15087	1578	848080	7547501	734670
1843	596993	15473	1605	825140	7643621	729020
1844	639016	15460	1397	570620	7477585	736656
1845	605712	15444	1292	971530	7685338	763777
1846	667209	15423	1432	491190	7405113	771415
1847	836988	15280	1403	628000	7251706	781407
1848	622077	15164	1525	667180	7156895	761991
1849	617157	14799	1608	494700	6894884	756711

TABLE 1   ANZIN COMPANY   CAPITAL AND ITS FORMATION

ANNEE	6016	6060	6070	6038	6068	6069
1850	641345	15151	1419	712672	6841604	765952
1851	616997	15351	1450	976615	7040334	777885
1852	628870	15584	1457	770762	7030162	780934
1853	838917	15336	1731	789865	7038183	781844
1854	860847	15481	1879	1257051	7489558	805676
1855	970014	16111	1879	956137	7622248	823447
1856	929597	16212	2200	1280654	8058986	843916
1857	899049	16792	2194	1149633	8346519	862100
1858	928745	17038	2243	1081658	8545906	882271
1859	879048	17058	2102	995382	8654613	886675
1860	874505	17098	2394	963039	8705893	911759
1861	915256	17301	2394	980422	8748565	937750
1862	943302	17620	2661	1028779	8834931	942413
1863	986413	17813	2710	914714	8791472	958173
1864	1022453	17502	2836	845129	8675181	961420
1865	1146317	17551	2873	1044535	8743337	976379
1866	1357948	17797	3035	1156789	8905553	994573
1867	1407122	18058	3100	1734720	9604135	1036138
1868	1575019	17608	3152	2011568	10536173	1079530
1869	1621583	17705	3459	1764033	11180518	1119688
1870	1561491	17848	3447	1311131	11369223	1122426
1871	1727027	17947	3457	1116496	11357735	1127984
1872	2068251	18071	3457	1350402	11561605	1146532
1873	2169471	18297	3625	2581614	12949320	1193899
1874	2007863	18297	3870	2672400	14368080	1253640
1875	2090897	18583	4646	2475803	15529212	1314671
1876	2136878	19026	4750	2416928	16569872	1376268
1877	2118681	19267	4021	1322976	16502015	1390833
1878	2085554	19693	4473	1229508	16324448	1407075
1879	2110086	18941	4323	1483755	16376085	1432118
1880	2383543	18872	4331	2277783	17151144	1502724
1881	2284086	18770	4691	2389094	17968403	1571835
1882	2241992	18712	4790	1453847	17828574	1593676
1883	2182475	17572	5030	1835256	18037880	1625950
1884	1796685	17720	5701	1882370	18257605	1662645
1885	2070442	17577	5860	1323052	17918658	1661999
1886	2261450	17466	6036	1320511	17570381	1668788
1887	2427474	18116	6766	1294917	17187333	1677965
1888	2512547	18885	7388	1654020	17150181	1691172
1889	2768025	16919	7751	1769337	17219174	1700344
1890	3017291	17250	8606	2123969	17617909	1725234
1891	2824994	18545	8686	1906122	17766383	1757648
1892	2693334	19238	9860	1608198	17608039	1766542
1893	2817288	19394	10563	1641241	17486202	1763078
1894	2826328	19847	11358	1940952	17627882	1799272
1895	2816965	19562	11377	1763395	17566459	1824818
1896	2883153	20036	12494	1848491	17574267	1840683
1897	2971049	20305	13067	1679611	17426184	1827694

TABLE 2   ANZIN COMPANY   PRODUCT AND OPERATING COSTS

ANNEE	6048	6022	6031	6065	6067	6001
1810	4348418	998793	2761304	1229770	1289840	3967
1811	3413376	764695	2064635	1174800	1237538	3916
1812	3185676	843406	1751852	1288650	1353692	3905
1813	3622500	809166	2233923	1167210	1227659	3537
1814	2912278	659347	1683953	1061100	1125055	3537
1815	3092050	683253	1845762	1090500	1156066	3635
1816	3125050	682540	1871245	1090500	1159746	3635
1817	3401878	808054	2006861	1111200	1489393	3704
1818	4682210	745764	3333020	1107300	1181482	3691
1819	4210812	635988	2973930	1101393	1178213	3702
1820	3697687	638272	2457722	1048590	1137908	3704
1821	4050148	648871	2788631	1048590	1138072	3704
1822	4081003	883257	2576562	1093300	1154049	3931
1823	4089582	798667	2644941	982500	1034428	3606
1824	4018979	915067	2447394	1055400	1246329	3694
1825	4162921	839274	2652449	1486267	1689201	4085
1826	4345365	864477	2788660	1417592	1608891	4125
1827	4619658	891760	3022193	1484072	1701434	4152
1828	4861027	1053859	3092896	1576091	1803946	4362
1829	4578428	1001392	2869584	1587975	1809611	4412
1830	5027071	1161142	3152763	1711186	1946279	4620
1831	4553783	1125456	2684823	1641000	1876652	4629
1832	5275112	1185975	3332200	1795150	2085307	4710
1833	6240997	1528738	3947132	2026361	2346823	4886
1834	7339619	1639829	4936588	2405449	2756251	5086
1835	7779100	1719806	5312071	2490000	2849208	5470
1836	7457777	1942414	4767781	2833704	3211309	5582
1837	7631607	1986489	4905927	3045000	3460369	5857
1838	8109646	2039975	5340190	3256098	3680402	6051
1839	7685348	1987581	4951779	3385744	3828348	6341
1840	7409211	1669197	5007008	3136000	3565362	6190
1841	7702748	1622378	5351709	3338052	3776282	6338
1842	6964374	1632071	4597633	3445283	3863531	6697
1843	6103178	1481070	3893088	3231302	3626533	6585
1844	7858619	1179958	5942005	3141738	3561077	6405
1845	7502084	1473970	5264337	3124874	3497542	6264
1846	8067975	1571562	5724998	3554001	3925094	6350
1847	10071289	1830809	7459073	4144913	4666234	6544
1848	7179062	1974358	4442713	3668941	4052490	6380
1849	7202701	1885807	4560183	3691241	4089129	6234

6048	Extraction in current Francs
6022	Intermediate consumptions in current francs
6031	Net value added in current francs
6065	Direct wages in current francs
6067	Wages costs in current francs
6001	Employment

TABLE 2   ANZIN COMPANY   PRODUCT AND OPERATING COSTS

ANNEE	6048	6022	6031	6065	6067	6001
1850	7346979	2003520	4577507	3845943	4222949	6253
1851	7134835	1893095	4463855	3686197	4095471	6313
1852	7159718	1951835	4426949	3692482	4081641	6455
1853	10129113	2366922	6980347	4169035	4546842	6549
1854	10969884	3031616	7132592	4936043	5414673	6640
1855	14470394	4110116	9536831	5714562	6265719	8645
1856	15512263	4506470	10161877	6210684	6816104	8182
1857	14528646	4154290	9512256	6435240	7049048	8183
1858	14069519	4044315	9142933	6643132	7251290	8783
1859	13907102	3621549	9398878	6062979	6686373	8953
1860	13177020	3543563	8721698	5768260	6399439	8835
1861	13267669	3470333	8859586	5806602	6438424	9068
1862	12943365	3648771	8352181	5774370	6391369	8806
1863	13731990	3662412	9111405	5822685	6470840	9173
1864	14158829	3430496	9766913	5823307	6483893	9055
1865	14485156	3798375	9710402	6025219	6684940	8978
1866	16685391	3767000	11923818	6681946	7374063	9270
1867	20048841	4356170	14656533	7771608	8609744	9695
1868	19785742	5647558	13058654	8476174	9294362	10851
1869	21283467	5361410	14802369	8555796	9383489	10912
1870	18624223	5477523	12024274	8682853	9534060	10752
1871	21311179	5796555	14386640	9247177	10091987	10920
1872	27152348	6960787	19045029	11701013	12672571	11869
1873	38911751	8037928	29679924	14161875	15351203	12937
1874	37031129	8403943	27373546	14105246	15398732	13485
1875	36989293	8479320	27195302	14813020	16317407	13373
1876	32300343	8493474	22430601	15279237	17011867	14175
1877	26830873	7565558	17874482	13880292	15519999	14132
1878	24333677	6369779	16556823	12907679	14695197	13724
1879	23168314	6059329	15676867	12739936	14537191	13100
1880	26222518	7189692	17530102	13994979	15655778	13780
1881	26535943	7259939	17704169	14215402	15758148	13970
1882	24293096	6655234	16044186	14208930	15760807	13149
1883	23982257	6564162	15792145	13980126	15464034	12866
1884	18746652	5515142	11568865	10248518	11719501	11632
1885	19450985	5551652	12237334	10081850	11567247	9588
1886	21187576	6235987	13282801	10947923	12487089	9897
1887	22002383	6583463	13740955	11184366	12732865	9970
1888	22512555	6507615	14313768	11221764	12940683	9842
1889	25857532	7039877	17117311	12148486	13941535	9985
1890	33813838	8146302	23942302	14364691	16381016	10534
1891	36064323	8622217	25684458	14949602	17226906	10877
1892	30871703	8361299	20743862	14312225	16565702	10754
1893	28207120	8235651	18208391	14642878	16832739	10770
1894	26867474	8269614	16798588	14340550	16474418	10786
1895	27049084	7437535	17786731	14135498	16289931	11569
1896	27892688	7332939	18719066	14567327	16830202	11852
1897	29315351	7901470	19586187	14920626	17199314	11824