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Abstract
Twenty years later, the question of the impact of the oil shock on the economy remains controversial. Mainstream economic analysis, carried out in sectoral studies or formal macroeconomic models, most often leads to the conclusion that the impacts were very substantial in terms of a slowing down in growth or productivity gains. But in a larger perspective, drawing upon analysis of the world economy over the long term, the judgement is qualified. In short, it appears that a "long-wave" analysis, inspired by the work of neo-Schumpeterian economists, allows one to see more clearly how the world economy and the international energy system fit together within a dynamic framework. Within this perspective one can approach the question of whether there will be additional oil shocks in the future.

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Energy Crises and Economic Crisis: A Long-Period Perspective

PATRICK CRIQUI

Twenty years later, the question of the impact of the oil shock on the economy remains controversial. Mainstream economic analysis, carried out in sectoral studies or formal macroeconomic models, most often leads to the conclusion that the impacts were very substantial in terms of a slowing down in growth or productivity gains. But in a larger perspective, drawing upon analysis of the world economy over the long term, the judgement is qualified. In short, it appears that a "long-wave" analysis, inspired by the work of neo-Schumpeterian economists, allows one to see more clearly how the world economy and the international energy system fit together within a dynamic framework. Within this perspective one can approach the question of whether there will be additional oil shocks in the future.

Vingt ans après, la question des impacts des chocs pétroliers sur l'économie demeure controversée. L'analyse économique "mainstream," menée en termes d'analyses sectorielles ou de modèles macroéconomiques formalisés, conclut le plus souvent à la très grande importance de ces impacts, du point de vue du ralentissement de la croissance ou des gains de productivité. Mais un élargissement de la perspective s'appuyant sur les apports de l'analyse en longue période du système économique mondial permet de relativiser ce jugement. Enfin, il apparaît que l'approche en termes de "long waves" inspirée notamment des travaux des économistes néo-schumpeteriens permet de mieux articuler dans le temps la dynamique d'ensemble de l'économie et celle du système énergétique international. C'est dans cette perspective que peut être abordée la question de l'éventualité d'un retour des chocs pétroliers.

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Introduction

The year 1973 is often considered as the starting point of the transformation in the economy that is sometimes referred to in Europe as "the Economic Crisis." The oil shocks were, however, not the only cause for the slowing down of the world economy that had begun. An exceptionally long period of economic expansion followed the Second World War — the "golden age" of economic growth (Maddison, 1989), or the "thirty glorious years" as they were called in France (Fourastié, 1985). This period of growing prosperity appears to come to an end with the first oil shock in the fall of 1973. The regular rhythm of expansion — at least in the industrialized nations of the North — was succeeded by increases in inflation and unemployment, a slowdown of growth in productivity, and rises in internal and external deficits. These symptoms continued in an aggravated form after the second oil shock of 1979-1980.

At the time, the sudden rise in the price of oil was put forward as the major cause of economic difficulties, and most of the mass media in the consuming countries blamed the exporting nations, grouped under the Organization of Petroleum Exporting Countries (OPEC), for triggering the crisis. But severe and multiple forms of economic disequilibrium continued into the 1980s and numerous studies have tried to elaborate in greater detail the roles of different causes, with one set of explanations simply emphasizing a slowing down of growth due to external shocks, and ano-

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ther set referring to a profound crisis of change in the world economy.

This article is an attempt to draw lessons from these different types of analysis of the oil shocks and their economic impacts. It aims in particular to show:

- that the oil shocks were not the unique cause of the slowdown in growth of the world economy, even though they could have played the roles of detonator and amplifier of the crisis; and
- that the shocks were the result of neither pure chance nor the greed of the producing countries in the sharing of rents from oil production.

The oil shocks will appear here more as the necessary result of the development of an economic and technical system based mainly on the intensive use of non-renewable natural resources, with resources which are abundant but concentrated and supply capacities which are difficult to regulate. This leads us to consider seriously the possibility of a recurrence of shocks, within a time frame that may be less distant than that envisaged by most oil analysts.

The paper proceeds in four stages. The first presents a synthesis of the lessons provided by standard economic analysis of the impact on the macro-economy of what were viewed as exogenous shocks. The second section enlarges the perspective by considering economic history in the long run, a systemic view of the world economy, and analyses of economic fluctuations. In the third stage it is argued that only a neo-Schumpeterian approach, framed in terms of long-run trends, allows the integration of the analysis of energy trends and the analysis of transformations of the world economy. Finally, we use this approach to try to consider the possibility of the occurrence of new shocks before the end of the present decade.

Mainstream Economic Analysis and the Impact of Oil Shocks

From the point of view of macroeconomic analyses, two tendencies characterize the period after 1973 and differentiate it from the "golden age:"

- a general productivity slowdown, which itself explains the slowing down of the growth in gross domestic product (Fischer, 1988);
- a simultaneous increase of inflation and unemployment — stagflation — while the Phillips curve had earlier been viewed as indicating possible trade-offs between inflation and unemployment (Helliwell, 1988).

Stagflation and productivity slowdown are clearly evident from the statistics, even though there are difficult problems involved in measuring productivity (Griliches, 1988). From 1973 onwards, for the whole OECD taken together, the decrease in average rates of growth of GDP and productivity of labour was around two percentage points. While inflation had already increased a lot since 1968, going from 3% to 6% per year, it accelerated even further and reached 9% between the two oil shocks, before again falling to 5%. Finally, unemployment went up in each sub-period, but with a net acceleration after 1973.

This is one way of briefly describing different aspects of the same reality — the disappearance at the beginning of the 1970s of the conditions for a sustained and equilibrated growth. Yet these two aspects have been dealt with differently in economic analysis. While analyses in the economic literature of the slowdown of productivity growth have been viewed in thematic or sectoral terms, the problem of stagflation has been analyzed in relation to the debates during the last 20 years on the foundations of macroeconomics.

The Productivity Slowdown: Looking for a Culprit

The slowing of productivity gains has been the object of numerous studies, including a special issue of the *Journal of Economic Perspectives* in 1988 which provides a useful synthesis. In these papers one senses very clearly the search for a guilty party, even though certain authors admit that the crime has never really been established (Fischer, 1988). Three potential suspects have been given hearings:

- a slowing down of technical progress linked to a reduced production of knowledge, which could itself be due to a lowering of the R&D effort or to decreasing returns to R&D;
- rises in the prices of natural resources, and in particular of energy, which could have rever-

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Table 1: Average annual growth rates of Gross Domestic Product, Productivity and Prices, average level of unemployment

OECD	GDP	GDP /worker	Inflation	Unemployment rate
1960-68	5.1	4.1	3.2	2.7*
1968-73	4.6	3.4	6.2	3.2
1973-79	2.7	1.6	8.8	4.9
1979-88	2.7	1.6	5.3	7.4

*1964-68

Source: OECD, *Historical Statistics*, 1960-1988, Paris 1990

sed the movement to substitute capital and energy for labour which had characterized the golden age; and

- the rise of corporatism and the tendency towards "institutional sclerosis" (Olson, 1988) in industrial societies, which had made them less capable of adaptation and more vulnerable to external shocks.

The first theory rests on the fact that it is possible to show, using neoclassical growth models, that technical progress has explained about one-half of past growth in per capita income in the industrialized countries (Fischer, 1988). The slowing down of this technical progress would therefore be largely sufficient as an explanation of the levelling off of growth at the beginning of the seventies. But empirical proof is lacking: it is for example difficult to imagine that the progress in information technologies during the last two decades has not allowed a fantastic accumulation of knowledge.

Of course, there was evidence of a downward trend in total expenditures on R&D in the United States from the middle of the 1960s, but Griliches (1988) shows that this can explain only a very small part of the productivity slowdown. Isolating the effect of industrial research, which he believes was more significant, would still not show up the decline. Furthermore, it was also necessary to recognize the positive effects of the spillovers of this industrial research into other sectors. Thus there remain some open questions in regard to the evaluation of the impact of R&D. In any case, there is no proof that allows one to lay the blame squarely on a slowing down in the creation of knowledge.

Jorgenson (1988) has few doubts about the causes of the productivity slowdown. With econometric tests to back up his argument, the rise in the price of energy is designated as the principal cause. His study, carried out for American industry, is based on disaggregated production functions with capital, labour, energy and natural resources as inputs. The coefficients of these functions are econometrically estimated for 35 industries and examined in light of Hicks' concept of biased technical progress. For example, technical progress presents a positive bias for capital if it brings about an increase in the share of its value in the production function; it is then said to be "capital using." For 19 of the 35 industries studied, Jorgenson identifies technical progress that is "capital using - labour using - energy using - materials saving," while six industries had technical progress that was "energy saving." For industries in which technical progress was accompanied in the past by an increased utilization of energy, the rise in its price induces, according to Jorgenson, a return to a less productive combination of inputs. The direct effects of rises in energy prices would then be sufficient to explain the slowdown of productivity growth.

This opinion is not shared by Olson (1988), according to whom the importance of energy in the whole economy is too low for a rise in its price to have such devastating direct effects — the tail cannot wag the dog. He proposes an alternative interpretation of oil shocks in an American institutionalist perspective, putting the emphasis on their indirect effects. The existence of institutional rigidities, and more particularly the existence of pressure groups such as labour unions, is, in this vision, the primary cause of the productivity slowdown. In an economy subject to institutional sclerosis due to the activities of pressure groups, a shock on the price of a factor of production, instead of being absorbed by a downward adjustment of wages, is on the contrary amplified from the initial perturbation by inflationary expectations and salary indexations. Basing itself on an analysis of the logic of collective action and social rigidities, this approach leads to the same conclusions as certain macroeconomic models of stagflation.

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Stagflation and the End of the Consensus Among Macroeconomists

The regular growth of the golden age had been a favourable environment for a reconciliation between neoclassical economists and Keynesian macroeconomists, in what has been called the "neoclassical synthesis." Conversely, the economic crisis and stagflation marks a new division between economists who try to explain crises and cyclical fluctuations in the framework of general equilibrium models and perfect markets without price rigidities (the New Classical economists), and those who rely on the analysis of market imperfections and price rigidities (the new Keynesians) (Mankiw,1990, Boyer,1993). However, the macroeconomics of stagflation (Helliwell, 1988) borrows elements from each of the main schools of thought.

Initially, the rise in the price of energy is analyzed as a supply shock (i.e. shifting the aggregate supply curve for the economy upwards, reflecting an increase in unit costs for a given level of production). This model is therefore comparable to the productivity shocks that are at the heart of the theory of Real Business Cycles of the New Classical economists: the rise in energy prices brings about a negative productivity shock, which is equivalent to a technological regression, because at a given level of production it becomes necessary to mobilise more factors of production, not in quantity but in value.

The second key element of the macroeconomics of stagflation is wage rigidity, which obviously comes from the Keynesian approach. After the oil shocks, with the reduction of purchasing power brought about by the rise in the relative prices of energy, the rigidity of real wages in turn brought about a fall in the demand for labour. Thus differences in the flexibility of real wages between countries would be the factor explaining differences in the rates of unemployment. This is the heart of the theory of Bruno and Sachs (1985), the principal source in this area. It represents in a certain sense a formalized equivalent of the approach proposed by Olson (1988). Insisting on the negative impact of the rigidity of prices and wages, however, this approach clearly demarcates itself from the other trend among the New Keynesians, in which the rigidities, within a context of risk aversion, allow expectations to be stabilized and thus to limit economic fluctuations (Greenwald and Stiglitz, 1993).

Thus the macroeconomics of stagflation extends the research on the productivity slowdown by offering a more complete framework of analysis. In both cases, the rise in the price of energy appears to be the number one suspect in the search for causes of lower growth. But one must recognize that the econometric evidence is often fragile, that the measurement of direct and indirect effects poses a lot of problems, and that the theoretical frameworks remain very controversial. To these shortcomings one has to add that all of these analyses apply only to the evolution of national economies in the short and medium term, and do not take into account either the historical or the international dimensions of the upheavals that have taken place in the last two decades. To deal with these matters would undoubtedly be asking a great deal from formal explanatory models, which remain very abstract. However, even though they are less formalized, some approaches that are different from the conventional analyses provide a very useful perspective.

An Enlarged Vision: Historical Analysis, Systemic Analysis and Business Cycles

One can refer to the slowing down of growth or productivity only with reference to a norm; obviously the norm for the studies referred to above is the golden age. The objective of long-period analyses of growth is to put post-war economic performance into perspective and to bring out its rather exceptional character in relation to world economic history. Should one talk of the rupture after 1973, or rather of a return to long-term tendencies?

Growth and Crisis: a Long-Period Perspective

Basing his analysis on long-run time series and the disaggregation of technical progress into dif-

ferent categories,[1] Maddison (1987, 1989) identifies four sub-periods in the economic history of the 20th century: 1900-13 "an international liberal order," 1913-50 "wars, depression, autarky," 1950 -73 "the golden age," and since 1973 "the slowing down of the world economy." He also tries to contribute to the explanation of the transition from one period to another.

The first evidence, which is quantitative, is that the golden age marked an acceleration without precedent in the rate of growth of output and productivity. The rise in the productivity of labour in the OECD countries, stable at 1.9% per year during the first half of the century, went up to 4.5%/yr during the golden age before falling back to 2.2%/yr since 1973 (Maddison, 1989). The second lesson, more qualitative, is that taking into account a limited number of supplementary factors (nine in all) allows one to reduce the unexplained residual considerably. Thus the closing of the technological gap between the United States and other countries, changes in the structure of economic activity (between primary, secondary and tertiary sectors), and the boom in international trade all help to explain a large part of the variations in growth across countries and sub-periods (Maddison, 1987).

The three factors referred to above (closing the technological gap, structural change and the opening of trade) are among the key elements that brought about the acceleration of growth after the Second World War. However, each of these major trends is susceptible to slowing down or arriving at a limit. This is obvious for the closing of the technological gap, which was almost completed in the European countries in the middle of the 1980s. The trend is also very clear for structural change: in 1950 the agricultural sector — with its lower productivity — still represented 25% of employment in the OECD countries; by 1980 this figure had fallen to 7%, and the transition had been completed. Alone among the three trends, the opening up of economies and the associated increases in world trade remain important after 1973 and can continue to exercise a pulling-along effect on growth. Maddison (1989) is therefore an attempt to explain the slowing down of growth, not only by oil shocks and the changes in direction of the economic policies, but also by the exhaustion of the growth factors specific to the previous period, which is a more original explanation.

The Systemic Dimension: Oil Shocks and Financial Shocks

Another indispensable aspect of placing economic trends in perspective is an analysis of international economic and financial flows over the last 20 years. However, outside the international organizations, there have been very few studies of the impacts of shocks from the viewpoint of the world economic system. This is all the more surprising given that the transformation in the world economy of the last 20 years can be characterized largely as a response to the necessity of re-equilibrating external accounts as a result of energy shocks and the "dollar-shock."[2] These adjustments and the increased uncertainty to which they gave rise — in contrast to the stability of international flows in the golden age — could well appear as a factor bringing about the slowdown of the economy.

Brender and Kessler (1987) describe in a broad perspective the increase in international trade: for goods, it has gone up from less than 10% of world output before 1973 to around 14% since then, and for all current account items, from 14 to 22%. This increased intensity of interdependence is explained to a substantial extent by price variables: the price of oil in the 1970s, exchange rates and interest rates in the 1980s. The correlated rise of current account deficits (representing 4% of world trade in 1973, and almost 8% in 1986) is proof of the difficulty of restoring equilibrium to international trade and capital flows after each of the major systemic shocks.

1/ This refers to an application of Solow's residual analysis; that is, the difference between actual product growth and the weighted growth of inputs.

2/ On the latter, see the research at CEPII (1983, 1984, and 1992).

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Oil Shocks and Business Cycles

The unforeseen character and the magnitude of the turn-around in the economic situation in the early 1990s have undoubtedly contributed to a revival of interest in the analysis of economic cycles. In the same way, fluctuations in the 19th century had stimulated the analysis of economic crises and subsequently the emergence, in the United States, of the idea of the business cycle.[3]

According to the theory of real business cycles, current short-term economic fluctuations are explained only by exogenous shocks. For other authors these fluctuations result from endogenous mechanisms, related to the non-convergent dynamics of investment and savings (Adda and Sigogne, 1993). If short-term fluctuations constitute an irreducible element of economic evolution, it is appropriate to analyze business cycles in relation to disturbances such as oil shocks.

Péléraux (1993) has, for example, criticized the NBER's analysis according to which the American economy experienced the second-longest period of economic growth of the post-war period from December 1982 to July 1990 (the longest being from March 1961 to December 1969). This analysis led some to talk about the disappearance of cycles, after the difficult intervening period of the oil shocks. It is possible to show that the reality is probably very different; that the cycles have not disappeared but have been absorbed by the counter shock in oil markets of the mid-1980s, after having been accentuated by upward shocks in the 1970s. Péléraux's analysis is based on a definition of cycles different from that of the NBER: while the latter defines as recessions only those periods during which GDP falls (in three-monthly data), he identifies a cycle in the growth rate in which the ascending phase is defined by the acceleration of the rate of growth and the descending phase by its slowdown.

The quarrel of definitions would only be academic if it did not lead to radically different diagnoses on economic dynamics. Thus, in the US the 1980s would have been dominated, in Péléraux's perspective, by phases of the slowing down of economic activity, though it had practically no recession according to the NBER definition. Breaking up time periods differently throws considerable light on the interactions between business cycles and exogenous shocks. Indeed it appears in the case of the United States:

- that all recessions are not explained by exogenous shocks (those of 1953-54 and 1957-58, for example);
- that the reductions in the rate of growth leading to the recessions of 1974-75 and 1980-82 had started several months before the shocks on the prices of oil; and finally,
- that the combined effect of the fall in the dollar from 1985 and the oil counter-shock of 1986 had enabled a recession to be avoided in 1986, though a descending phase had already started as early as the end of 1983.

Several observations can be made. First, contrary to the theory of real cycles, economic fluctuations cannot be explained only by exogenous shocks. At the same time, such shocks can accentuate fluctuations and aggravate recessions, or in the case of counter-shocks enable them to be avoided. This explains why the oil shocks appeared to have a much greater direct impact than would have been expected. In the same way, one can explain the mystery of "The Boom That Wasn't" in 1987 after the counter-shock (Olson, 1988).

On a lot of points, this understanding of economic dynamics, involving business cycles and exogenous shocks, allows one to better appreciate the real impact of the oil shocks. It remains, however, an analysis of the short run situation, and the predictions that can be based on such analysis, including the prediction of the permanence of the business cycle, are relevant only in that perspective. In this light, it does not explain the slowing down of the average level of growth from the beginning of the 1970s; furthermore, it gives energy shocks the status of an unpredictable event. On these two points, a new enlargement of the perspective will allow us to advance our understanding of the causes and the conse-

3/ See Sigogne and Riches (1993) and the other articles in the special issue of *Observation et diagnostic économique* dealing with cycles.

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quences of cycles.

Energy in the Perspective of Long Waves

In 1935, four years before *Business Cycles*, Schumpeter published an article entitled "The Analysis of Economic Change," which presents all the elements of an explanatory scheme for economic progress, by developing in particular the process of innovation and economic cycles (Schumpeter, 1935). The analysis begins with a fundamental question: Do there exist fluctuations that are inherent in the evolution of the economic process over time? The answer is yes and the model proposed is that of an economic process that proceeds like a wave.

The fundamental factor that explains the nature of this economic evolution is obviously innovation, which does not propagate itself continuously, but in clusters, because of a resistance towards novelty. It involves fundamentally an assumption about imitation, in which innovation expands contagiously, thus creating economic waves. ("It is much easier not only to do the same thing, but also to do similar things in different directions.") To this overall scheme a second key hypothesis is added, according to which three types of cycles superpose on each other within a dynamic process: the long cycles of Kondratieff (from 54 to 60 years), which include six Juglar cycles (9 to 10 years), which themselves include three short Kitchin cycles (40 months).

Schumpeter's two key assumptions — the clustering of innovations and the superposing of cycles — have been and still are widely criticized. For some, the assumption of clustering is not based on any solid empirical evidence, and is not even necessary because the simple interaction of circuits of diffusion in the framework of the inter-industry input-output table is sufficient to bring about long movements in the economy (De Bresson, 1991). In the same way, the assumption of the superposition of cycles is criticized for its excessively systematic character and as totally lacking a statistical basis (Sigogne and Riches, 1993). However, Schumpeter had been prudent in his article, insisting on the fact that he was presenting working assumptions, confirmed until then by economic observations.

Kondratieff Long Cycles as Seen by Schumpeter

In regard to long waves, the brief description of economic evolution offered by Schumpeter is a striking synthesis. Not only can it be extended over the 60 years of economic history that have passed since the article was written, but it can also be widened to include changes that have occurred in other sectors of the economy and society. Anticipating his critics, Schumpeter wrote that his assumption needed to be tested against the facts: "Look around you in industrial life and see for yourself whether it is not so... ." Let us recall the principal elements of his synthesis:

- the first Kondratieff cycle (1783-1842) is that of the first industrial revolution, notable for the rise of textile industries in Great Britain;
- the second (1842-1897) corresponds to the age of steam and steel, notable for the spread of railroads throughout the world, with all of its forward and backward consequences for industry;
- the third long cycle (in 1935 Schumpeter considered it to be three-quarters complete, which would have brought it to an end between 1945 and 1950) was notable for the growth of electricity, chemicals, and the automobile.

Following other authors (Stoffaes, 1987), it is possible to continue with a fourth Kondratieff cycle and even to put forward hypotheses about the future.

- The fourth cycle, begun in 1945, corresponds to the extension of the American model — based on petrochemicals, plastics and especially the automobile industry — to all the countries of Europe and Japan. It reaches a peak in the early 1970s and may be completed towards the middle or the end of the 1990s.
- Could a fifth Kondratieff start with the return to a long phase of growth? Not inevitably, and the main elements necessary for a recovery are not well-defined, but if it does it is probable that in the forefront would be the information technologies and biotechnologies,

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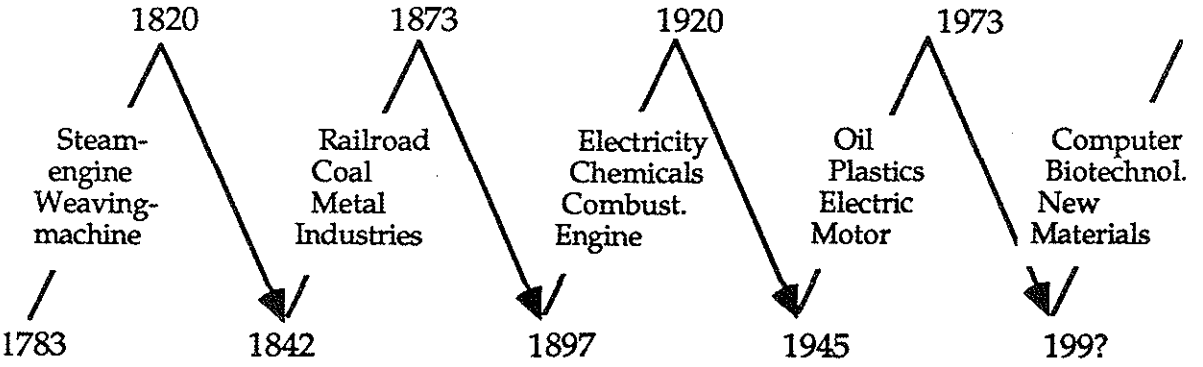

Figure 1: Industries, long waves and Kondratieff cycles

Source: Stoffaes (1987)

as well as the increasing weight of Asia in the world economy.

Thus the framework of analysis constructed by Schumpeter in 1935 is still applicable today. This is not a meagre achievement, particularly since it is possible to enrich the analysis by making it more coherent and by integrating other economic and political observations (Stoffaes, 1987, Freeman and Perez, 1988, Boyer, 1988): trends in consumer goods, the mobilization of energy sources, the organization of firms and wage relationships, dominant nations and international currency, etc. The neo-Schumpeterians have developed the concept of a techno-economic paradigm (Freeman and Perez, 1988), an hypothesized state of the economy, described by a few dominant structural characteristics, which updates Schumpeter's vision. It allows the original scheme to incorporate:

- stable, ordered and coherent configurations of technical systems and the economy in which growth is created by the pervasive diffusion of a number of innovations combined; and
- transition phases between paradigms during which the industries in place stabilize or regress, while new products and processes emerge only progressively.

This is how one can conceive of the process of "creative gales of destruction" on which nowadays the evolutionary school in economics bases its analysis and emphasizes technical change as the motor element in economic dynamics.[4] To this view one can oppose that of the "dialectics of growth and crises," among whose proponents the *école de la régulation*[5] tends to emphasize the analysis of institutional change and social relations, both within the firm and at the macroeconomic level.

The evolutionary and *régulationniste* approaches are no doubt complementary rather than contradictory and most applied economic analyses show that it is necessary to articulate both the process of technical change and the process of institutional change in order to understand the dynamics of a sector such as energy. That is, it appears that the techno-economic paradigms of the neo-Schumpeterians and the socioeconomic paradigms of the *régulationnistes* need to be combined in order to analyze the causes, nature and consequences of oil shocks.

Oil Shocks in the Descending Phase of the Fourth Kondratieff

The oil shocks were not the main factor that triggered off the deceleration of growth. At different

4/ Miles (1993) develops a synthesis of the neo-Schumpeterian and evolutionary schools, who are especially evident in Great Britain.

5/ Whose representatives are mainly French. See, among others, Billaudot and Gauron (1985), Boyer and Orléan (1991), and Dockès (1993).

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points in the economic system the first cracks appeared at the end of the 1960s or in the early 1970s. Among the most significant, one can include the slowing down of world industrial growth from 1967 (CEPII 1983), the rise of inflation from 1968 (see Table 1), the breakup of the Bretton Woods system which ended the convertibility of the dollar to gold (the "Nixon-shock" of August 1971), and the generalized floating of currencies in March 1973.

In the framework of the neo-Schumpeterian and *régulationniste* analyses, the economic crisis resulted from the exhaustion of the margin of growth within a state of the world dominated by an increase in the usage rates of household durable goods (e.g,, electronic appliances, cars). For a number of products these rates rose in the industrialized countries from less than 20% in 1950 to more than 80% in 1980. Within this trend, the automobile industry plays a very particular role for three reasons: first, the automobile and its accessory expenditures constitute an important part of household consumption; secondly, because of this the forward and backward linkage effects to other industries are very significant; finally, it is in the auto industry that a wage relationship was established based on the coordinated sharing of productivity gains between wages and the income from capital. It is certainly no accident that the Regulationists talk about "the fordist paradigm," taking up the concept of "fordism" coined by A. Gramsci before the Second World War to refer to an economy dominated by the combination of mass production and mass consumption.

Thus, in this view, the crisis was to a great extent due to the saturation of markets in the OECD countries, when the logistic curves that describe the diffusion of new products enter the final phase of slower growth.

The importance of household durable consumer goods also explains the high energy intensity associated with the fordist stage of the economy. While coal was in decline, the central role played by oil in both petrochemicals and the automobile industry explains the growth of its consumption: in the 1960s, 4% per year in the United States, 12% per year in Europe and 20% per year in Japan! Such a growth trend was possible only with a form of energy that was abundant with a price that was low or even falling in real terms. The "thirty glorious years," the "fordist paradigm," and "petro-prosperity" (Puiseux, 1977) refer to the same state of the economy, at least as far as the countries of the North are concerned.

There is a paradox in the fact that the energy crises arrived at the same time that the economic configuration referred to above began to lose its dynamism. In a geopolitical context profoundly unsettled by the decolonization movement, the level of world oil consumption around 1970 had become incompatible with the pursuit of the expansion of production in a limited number of regions gathered together in the OPEC countries, especially the Arabo-Persian Gulf.[6] The oil shocks then appear both as the result of the expansion of the fordist state of the economy and as a factor aggravating the crisis in process, as in the scheme of causality in Figure 2.

We therefore have an explanatory scheme of economic evolution that integrates the facts about energy:

- the long period of growth that starts at the end of the Second World War and is based on a rapid diffusion in Europe and Japan of a group of product and process innovations created in the US between the two World Wars;
- the diffusion of these innovations and the rise in living standards engendered in them brings about a very rapid growth of energy consumption, especially of oil, indispensable for chemical and automobile industries;
- even as growth slowed down because of the exhaustion of productivity gains and a relative saturation of markets in industrialized countries, the dynamics of oil demand faced by the OPEC countries became incompatible with the rhythm of capacity expansion in these countries;
- this created shocks, considerably aggravating economic difficulties and slowing down growth, which in turn led to a fall in the consumption of oil, to the appearance of massive excess capacity and to the counter-shock.

6/ See, among others, Criqui and Kousnetzoff (1987).

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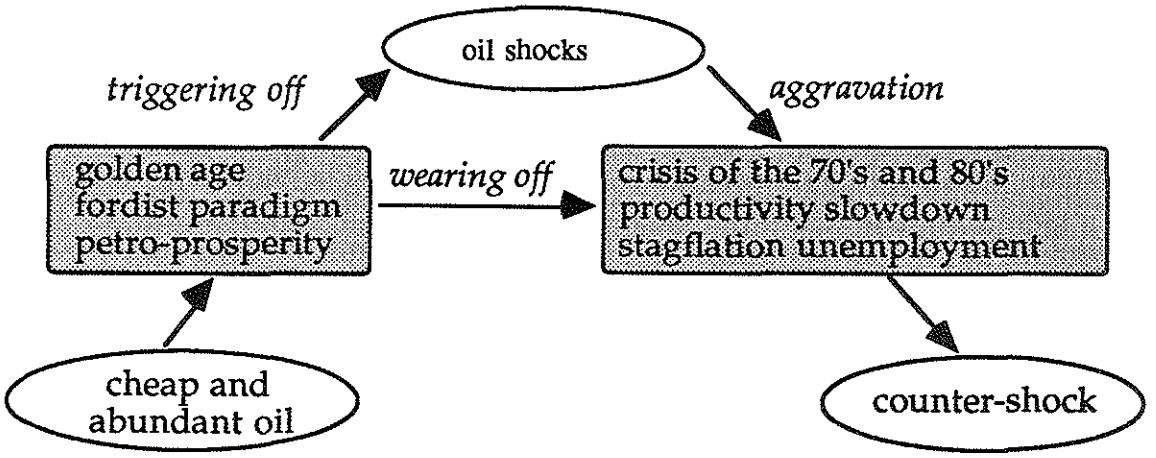

Figure 2: Energy crises and economic crisis

This scheme enables the shocks to be considered not as events of a political nature, contingent and random, but both as cause and consequence of movements in the rest of the economy. The crisis of the last two decades is therefore also that of a techno-economic pattern of the economy involving a high level of consumption of nonrenewable resources, which are still abundant but geographically very concentrated and therefore very difficult to manage. It is in this light that one has to try to reply to the obvious question about the future: is the era of oil shocks over?

Has the Era of Oil Shocks Come to an End?

After more than 10 years of detente in international markets, after the counter-shock of 1986 and the Gulf War, the risks of new shocks have, according to some, been averted. Is there not now substantial unutilized capacities (essentially those of Iraq) at the same time that the various players in the oil game, both inside and outside OPEC, have learned the lessons of the past and would like to avoid any sudden variations in prices? All the conditions for a durable stabilization of markets have apparently been brought together.

Analyzing the hypothesis according to which the oil consuming nations would be trapped in a never-ending cycle of growth of energy prices, Jorgenson (1986) considered that the hypothesis should be rejected. Not that the previous shocks had a negligible impact on the economy because, according to his own research (see above), the rise in energy prices was the first cause of the productivity slowdown and in turn of the slowing down of growth. But the sequence "first shock — recession — recovery — second shock" has, according to Jorgenson, much less chance of being repeated: the modification of American energy policy and in particular the abandonment of price controls on energy (as of May 1980) would lead to more rapid adjustments between supply and demand. In fact, the substantial fall in American imports at the beginning of the 1980s largely contributed to market slackening, just as their uncontrolled rise had been a central element in the increase of tensions.

If oil prices at the beginning of 1994 have fallen to their lowest level in 20 years, can one conclude from this that the slackening of markets is going to last? Middle-term trends in oil prices are determined by the relative dynamics of two key variables: the demand for oil addressed to the Gulf countries and the production capacities of this region.[7]

In fact, Gulf oil can be viewed as the residual energy source, used to close the total world energy balance. Thus it is influenced by the

7/ A simple model of oil shocks is described in Criqui (1991).

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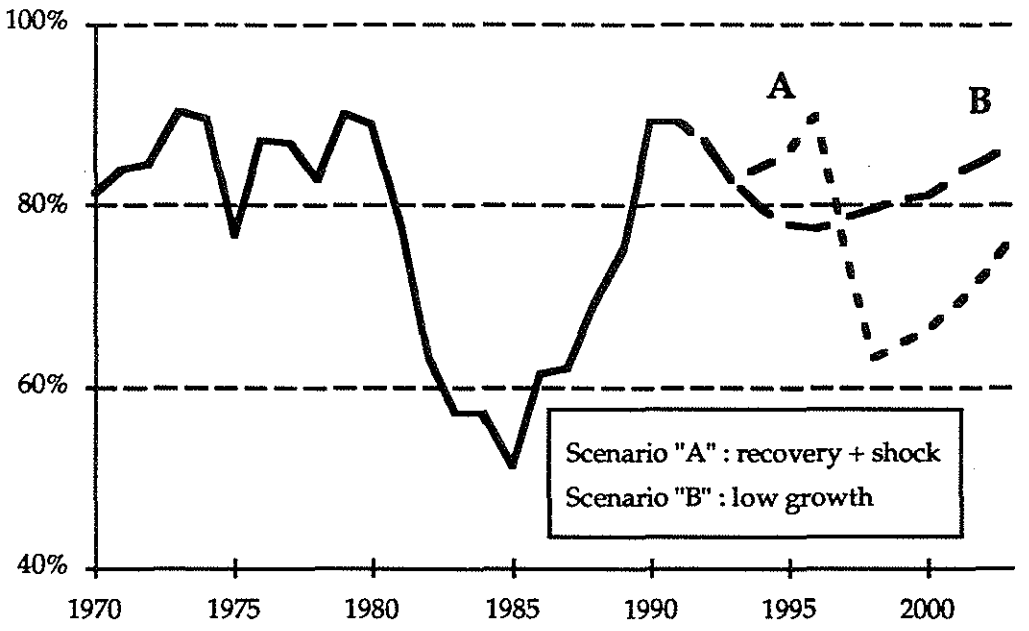

Figure 3: Capacity utilization rates of the Gulf countries and risks of oil shocks

Source: TOTAL (1993).

ability of the consuming countries to substitute other energy sources for oil. Various factors limit such flexibility in the short to medium term:

- the growth of hydraulic and nuclear energies is facing constraints on resources and social acceptability;
- the market for coal is mainly from electric power stations and thus can be adjusted only over a time horizon of at least five years;
- similarly the development of natural gas is constrained in the short-to-medium term by pipelines or LNG facilities.

Faced with these rigidities, the Gulf region retains its status of the world swing producer of energy.

In regard to the second factor, the evolution of production capacity in the Gulf region flows from the strategies of the producing nations and the oil companies. In a context of strong uncertainty and financial constraints, and given the time lags in capacity development, will the rise in capacity be sufficient in the coming years to satisfy the growth of demand? A lot will depend on the rhythm of the growth in energy demand and thus of economic growth. An examination of several empirical studies for the horizon 2000 or 2010[8] allows one to think that:

- the rise in demand for Gulf oil could be compatible with the evolution of production capacity if world economic growth were to remain moderate during the current decade (at around 2.5% per year);
- if instead there was more support for growth (say 3.5% per year), the rise in demand could exceed the rise in supply capacity; then, as a result of the internal dynamics of the system and relatively independently of the strategies of the actors, the outcome would be a temporary rupture of supplies before the year 2000. This would be something like a third oil shock.

This leads to a somewhat paradoxical statement: looking towards the next decade, slow growth would allow an energy shock to be avoided, while a stronger recovery of the economy could result in an energy crisis, which would

8/ See in particular TOTAL (1993).

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not be without its effect on economic growth. Furthermore, oil cycles, of variable length and configuration, could be repeated in the future so long as the evolution of the energy system does not adjust in some long term way to deal with both the exhaustion of resources and the pressures linked to demographic change in the countries of the South.

Conclusion: the Search for a New Paradigm

For Adelman (1987), the price of a natural resource is the result of an endless struggle between nature (the exhaustion of reserves, demographic growth) and knowledge (the progress in efficient techniques of production and consumption). By the end of the 1960s, progress in efficient techniques had become insufficient to offset reserve depletion in an energy-intensive mass-production society. In spite of the relaunching of technical progress in the energy sector after the shocks, the outlook for the coming years remains very uncertain, especially in light of the tendency to simply extend the mass-production and consumption model to the countries of the South, which is likely to come up against resource and environmental constraints.

Is there an alternative? It would undoubtedly be overly simple to define the next techno-economic system only as having to be a "green paradigm" (Freeman, 1992). However, it seems clear that the information and communication industries are going to play a continuously increasing role in the international economic dynamics. Not only do these industries consume very little energy and natural resources themselves; information processing techniques also lead to less need for resources elsewhere, and to more efficient production and consumption of energy. The past shocks had the merit of hastening these developments and starting off profound changes in the world economy (Bourdaire and Chatillon, 1992). Paradoxically, one can consider that the next oil shock might be "necessary" in a double sense:

- necessary because it would be determined by the evolution of the economy and the world energy system and would thus be the result of a non-random sequence of events; and
- necessary because, by stimulating technical progress, it would encourage the diffusion of energy production and use profiles that would be more compatible with resource constraints and with the local and global environment.

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