

NOT FOR QUOTATION  
WITHOUT PERMISSION  
OF THE AUTHOR

RECESSION 1983.  
TEN MORE YEARS TO GO?

C. Marchetti

March 1983  
WP-83-35

*Working Papers* are interim reports on work of the International Institute for Applied Systems Analysis and have received only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute or of its National Member Organizations.

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS  
A-2361 Laxenburg, Austria

## RECESSION 1983. TEN MORE YEARS TO GO?

That the present recession is a really serious one, more and more people convene. That it has many aspects in common with the recession at the end of the 1920's, more and more people perceive. But on the quality, strength and time characteristic of the analogy the opinions are dispersed and the underlying logic is weak. It is this logic I shall try to buttress and clarify.

How does a recession manifest itself? The first tangible sign is that people start losing their jobs beyond the level of two or three percent of the work force. This level is considered physiological, and can be in good part attributed to the mobility of the work force. A month gap between one job and the next makes already a ten percent for the year for the person that moves. In the US twenty to thirty percent of jobs are swapped each year.

To examine in detail how people lose jobs is very revealing of the underlying mechanism. I recently made a study of the development of the car system during this century [Marchetti 1982] and I will use it extensively to illustrate the situation. This is not only because the car has so much weight in western economies, but because many other products and industries that gave lift to the boom of the 1950's and 1960's went through the same development and find themselves in a similar predicament now.

A characteristic in common to my analysis of economic and social structures is that they are based on quantities and not on value. These quantities are physical, such as the number of objects or tons of coal (if equivalent). The mental image I use to explore the time dynamics of these quantities is the Darwinian competition between species, and its mathematical counterpart of Volterra's ecological equations. This image is perfectly captured by Heraklit's statement that competition is the father of everything, and the king too. In modern words it is the creative and regulatory force.

Coming back to our cars I formally assumed they were an animal species expanding in various niches territorially coinciding with political entities, like the US or France or Italy.

The expansion of a species in a habitat, being bacteria or foxes, is best described by a logistic equation and I obviously tried that. The precision of the fit with the historical data is unexpected. To give a precise example the deviations from the fit, for the car population in Italy over twenty years, are less than one part per cent (Figure 1).

These logistics have only three parameters, or three knobs to turn in order to fit them to the data. One fixes the position in time of the phenomena. The second gives the dynamics of the process, and the third the size of the niche, that is the maximum number of animals that the niche can support. If the quality of the data is good, as in the case of car populations, i.e. there are no hiccups and uncertainties, then the three parameters can be directly calculated from the data without requiring further external information.

The last fact is extremely important because it permits the calculation of the final capacity of a market intrinsically from the dynamics of its penetration. And it cuts the Gordian knot of congested econometric hypotheses, where the result usually depends on the investigators' opinions, or more often on those of the sponsor. It has, however, the disturbing characteristic of not giving explanations, if false. It is like calculating a trajectory of a projectile, from a limited stretch of it, without knowing anything about guns, powders and the hidden motives of the gunman. The justification of the use of such technique is that it applies to all sort of ballistic trajectories. We have in fact a portfolio of about four hundred cases of economic and social behavior analyzed in this way.

In the case of the car a saturation level can then be ascribed to each nation, which curiously is not directly related to population or wealth or area or length of roads. Economic modelers may not like it, but I can't help it. Second, and more disturbing, it appears that most of the western countries' markets are practically saturated. This is shown in Figure 2, where the penetration curves are reported for six countries. For graphical reasons the ordinates have been chosen to make them appear as straight lines, instead of S-curves as in Figure 1.

Now what happens when an industry as a whole finds that the market is saturated. First, it will notice that it has excess capacity, because everybody in the trade operates in the business as usual configuration, expecting expansion to continue for ever, or at least up to the time of his retirement. To start with, the capital burden will increase its weight.

Second, production will go into satisfying replacement demand, which is basically a fixed demand. Tampering with the life of the product may change somehow this level, but flexibility is limited and the feedback is slow.

A fixed demand would not be so bad if overcapacity were not present, and if the dynamic of salaries would not push total costs up. The only short-term solution is to increase productivity, which is in any case part of the internal dynamics of the company. But increased productivity with constant production means shedding jobs. The car output of Fiat could be kept the same after sacking seventy thousand people out of a work force in the car area of perhaps two hundred thousand.

The really curious fact about market saturation is that it comes practically at the same time all over the world, in spite of the fact that the car entered in various areas in a very sparse order. But latecomers moved faster to the point of overcompensating as in the case of Japan. There is in fact a precise relationship between the starting date of the massive penetration of cars in a certain geographical area, and the rate of successive penetration, as shown in Figure 3.

The fact that the world markets saturate at the same time means that the usual valve of exporting to compensate sluggish internal markets, does not work any more. Or it works the other way, because competition heats up just at the international market with dire consequences for the old and established enterprises. If we look at details, in order to slash costs one has to show the utmost flexibility at the level of engineering, labor and management. In an old established company, let's call it GM, engineers tend to be oldish and ranked, labor rigid and greedy,

management exhausted by the gratification of obtaining so much with so little swimming, when riding the wave of the boom. The young company, let's call it Toyota, still has young and experienced engineers, no labor problem as it still expands, and a management fully terrorized by the saturation of the local market that it sees coming under his eyes. You name the winner. In spite of all institutional barriers the losers will erect, my Darwinian forecast attributes to Japan half the cars produced in the world in the year 1995.

The automotive industry pumps through the western economy an amount of money that classes into the trillion of dollars per year. It is clear that its hiccups will shake the whole body. But if it were the only industry in shambles, the problem could be faced. Reabsorbing a million or two workers and employees is peanuts for economies occupying a hundred times as many. The real problem is that if we look e.g. at the whole spectrum of electric appliances, the situation is exactly the same. Going a little beyond what I have already proven in detail, I would say that all the industries that together fed the boom of the 1950's and 1960's now face saturated markets and overcapacity, with the consequent need to shed personnel. The wave then spreads, downward to the transportation and distribution sectors, upward to the procurement and investment. Companies with problems and people out of work will become cautious spenders and limit their purchase of services. The wave spreads here too; I could cite the airlines moving together into bankruptcy worldwide, naturally over-equipped and overstaffed. They are starting to shed personnel too.

I think the picture is clear enough for our needs, i.e. to go to the next step of the why's, how's and when's. Why do so many

industries saturate the market at the same time, how can we get out of the doldrums, and when will the vital trade winds blow again? The problems of a large recession like the one in the 1930's were visible enough to stimulate much theoretical work, foremost that of Schumpeter, into whose mill my waters will flow. The fact that there are a host of theories implies that the mechanisms are basically not understood. To help understanding I will use the results of system studies which I did for completely different purposes, like the car study which was originally meant to analyze the intrinsic dynamic of the spread of an innovation per se, enucleated from its economic impact. The curious result is that at global level the time for a basic innovation to go from 10 percent to 90 percent of the available market is usually fifty years, whether the innovation is margarine, vacuum cleaners, or the theory of relativity.

I am pretty convinced, although the full demonstration still requires that I shuffle a heap of statistics, that this is linked to basic human behavior, which seems to show an extreme stability at least for the last 300 years I plowed forth and back. A brilliant demonstration of this stability is given in Figure 4, where market penetration of primary energies at world level is reported. Incidentally, the time constant here is 100 years, but the point I am aiming at is that the rate of penetration, expressed in the proper parameter in the equation, stays constant to within a fraction of one percent over the whole record.

Now, if many industries happen to doldrum together, with similar time constants underlying, this means they are born more or less together, and the question is why. Here comes to help a system study of invention and innovation during the last three centuries in the western world, which I made with another purpose

in mind, that of being able to predict when a new source of energy is accepted into the game [Marchetti 1981].

The final result of the study is reported in Figure 5 where the couple of lines represent invention waves and innovation waves, respectively. The invention wave describes the conception of new products (prototypes), whose success will be sanctioned by the start of a new industry (innovation). The lines themselves represent the cumulative number of inventions (or innovations) at a certain date, expressed as a percentage of the total number in the wave. The curious fact here is that formally the sets of innovations grew as if they were a population filling an empty ecological niche, that of the need of innovations by the "system" just to continue the analogy.

The question now arises what generates the empty niche. Simple: a former population dying. If the mental model holds, then the innovation waves should be separated by about 50 years. They are. In fact, the distance between their center points, when half of the innovations in the waves have been made, is precisely 54 years.

Now a picture starts emerging: dying industries create the vacuum, the niche, where the new species, the new innovations, rush in. The spacing between rushes is dictated by the time of market saturation of the various industries, that is the final consumer behavior, which puts that time in the 50 years bracket. Because the same time has been necessary to mesh into the daily routine of the physicist a basic innovation like the general relativity theory, I propose to give this time an anthropological significance.



The internal dynamic of each of the rushes on the contrary changes, in the sense of accelerating, practically doubling speed every century. I have not found a clue to this very regular acceleration nor for that of car penetration, where the time to penetrate successive markets decreases exponentially with the time of introduction. The same phenomenon occurs with steel for the countries which in succession took the leadership in steel production, from the 16th century on: France, Germany, Britain, the US, the USSR (for a short stretch), and soon Japan.

The present innovation rush will formally start in 1984 with 10 percent of the basic innovations introduced and end in 2002 with 90 percent of the basic innovations introduced. These innovations are the seeds of the next boom that will start when the industries they started will be large enough to influence the whole economy. But let's look now more in detail at the timing.

The 54 years which so steadily hold for such a long time, are an obvious reminder of the Kondratieff cycles. I read again his brilliant papers [Kondratieff 1926, 1928], and I should say that not much has been said after him that he himself did not say. He is by the way the tip of the iceberg as the study of economic cycles was well developed at the beginning of the century [Kautsky 1901] and their political implications were well appreciated by men like Trotzky [1923] and Lenin. The inevitability of the down-fall process also irritated the capitalistic economists, who resented being told they cannot turn knobs to regulate the economy, and their expensive advice is not really worth the candle.

I reached many of the conclusions Kondratieff had guessed following my completely different line of thought and profiting

from the extra cycle that came in between. The situation seems to me now so clear conceptually and quantitatively so well mapped as to be beyond doubt.

Kondratieff was fought by most, and the arguments were usually based on econometric analyses tending to disprove what he said because these cycles, like the Loch Ness monster, could appear or disappear depending on who was making the analysis. Having to deal, if indirectly, with economic matters, I always skipped money as an economic indicator because of its mobility and ambiguity, trying instead to map the processes through their physical manifestations. I never regretted this choice. To give an example, what about taking the pulse of the economy in physical terms, by measuring its demand for energy? The analysis made by H.B. Stewart of NUTEVCO for the US is reported in Figure 6 where the residuals of primary energy and electricity consumption, with respect to a logistic best fit, are given as percentage deviations. This metabolic map is in my opinion the best objective measure of what is going on, and the synchronization of many different features is very striking, as shown in Figure 7.

To take only one example, if we look at the upper part of the figure, energy prices appear basically constant in constant money with flares every 54 years. These flares always occur in coincidence with the peaks of the sinusoid curve which basically mark the end of the boom periods. The mechanisms of the rise are obviously different for each case and the how's are tendentially sold for the why's. It seems to me instead that a given market configuration, which repeats itself periodically, leaves the upper hand to the sellers, who inevitably take advantage. In other words, the why's are macrocontextual, sheiks and Kissingers

only part of the chronicles. Because the peaks have a limited width, about 10 years, energy prices should fall shortly to secular levels. Let's say approximately 12 US-\$/bbl (1982-\$).

Another observation is that a new primary energy source is introduced at the start of each wave. For the wave coming in the near future we have nuclear energy. For the next one, in 2025, we'll probably have fusion. This cuts the legs to all sorts of alternatives, for contextual reasons which still have to be explored in their detailed mechanisms. People in alternative business already know by direct testing that they took a wrong track. Was this immense waste avoidable if we had had a little more insight into the working of the system?

Financial macro-collapses systematically occur when the sinusoid curve crosses the zero level, when the speed of fall is maximum. The last cross was 1929, and the following one 1983. Crossing fingers, cracking sounds are heard all over the place. The curve will start rising again only in the 1990's.

These results, mostly displayed in Figure 7, give us a fresh and quantitative insight into the cyclic processes of economic activity, and can be used to assess the value of what is being done to handle the consequences, and the potential of what could be done.

The basic cause of conjunctural weakness, as we saw, is saturation of the markets. Can we manage that? Let's take the case of the car to be more specific. The question then boils down to inducing people to possess more cars than they have. Apart from the fact that this would only displace the problem by a few years, I am convinced there is a configurational maximum, the internal logic of which starts to be unveiled [Cahavi 1981].

The first thing governments are called on to do during a recession is to help revive the show. This is usually done by deficit spending. The intellectual credit is usually given to Keynes, but it is such a natural thing to do when so many are asking. Deficit spending means that the state takes money from people who saved it for lack of spending imagination to give it around in the hope somebody else has got this imagination. This money will never come back, it is well known. One of the best governments in the world in financial matters, that of the US, last gave back the principal in 1833. One of the worst, in financial matters, the Italian, has already spent in deficit about 70 percent of all available credit in the nation.

There would be nothing wrong with deficit spending if it were not for two facts: the process is self-priming and the recession is too long. In other words, the medicine will finish long before the patient is healthy again. It is 100 percent clear that Italy cannot operate the next ten years as it did for the last ten, but the US may reach a similar position only five years from now. And the years to go are at least ten.

Furthermore, as I said, the saturation points for the various markets most probably cannot be displaced sprinkling the system with money, so the process doesn't work even short-term.

The fact that so much money is available for dubious customers like the states, raises the question of why so much money was available for dubious customers in general. A rough estimate is that a trillion dollars of international loans will never come home. Double that figure for internal debts. The simplest explanation is that in a phase of boom this money would have gone to AEG or GM, just to drop names, but with markets saturating, industries did not really

need capital, so it went to customers able to promise high interest rates, if with improbable collateral.

These loans can also be seen as a form of deficit spending. Because the markets were saturating at home, developing countries were given the money to buy goods (unsaleable) to face-lift with proper business formalism an actual give-away Marshall plan style. This mega-lie will finally strike back destructively on the world banking system when the circular guarantees game will no longer be able to hold a minimum of credibility.

What I fear most in the process is social unrest stemming from the breakdown of the mechanism keeping millions of people alive when they are not really a part of the productive system any more.

Another form of give-away is to enhance the production of arms, objects to be destroyed, and ~~sorry~~ to destroy. Also in this area the temptation is strong, and the pressures from the industrial establishment considerable. A market of mutually destroying gadgets is just ideal as it never saturates. If one compounds to that the political necessity of loosening the Gordian knots of social dissatisfaction and the readiness to recheck in a violent way the international pecking order, the situation becomes scary. The shallows (and peaks) in Figure 7 have been time of international aggressivity, culminating, for example, in World War II, just toward the end of the previous recession (better depression) period. A war in the middle 1990's is something we should certainly find a way to avoid.

A natural question at this point is how the insight that the analysis gave us into the mechanisms of the recession may be used to rationalize the patch-up in order to reach the next boom with a minimum of damage. One point is very clear in the

analysis: that the process consists of a transfer of tasks and skills from a class of activities in phase-out configuration to one in phase-in. The keyword of this transition phase should then be flexibility and adaptability.

This breaks down into a host of possible initiatives. Instead of giving money (from banks or state) to e.g. ailing car industries, like Chrysler paying people to stay on a sinking ship, it would be much wiser to give the money to the employees themselves to help them resettle and perhaps start their own little business. The first procedure can be seen as a freeze, the second as a fluidification. Through such a procedure, e.g. Olivetti--once a monoculture in the Ivrea area in Italy--has seeded a host of small enterprises, very active and very useful, due to their extreme flexibility, for supporting still newer initiatives. The clever Japanese follow this second policy.

During the recession of the thirties the keyword for state intervention was public works. Certainly, during the hectic years of the booms much public is neglected in favor of private, so there is no lack of objectives. They have to be chosen for their lasting value, however. In Germany, construction of autoroutes got the limelight in the thirties. Europe is now quite well served with autoroutes, and as my study on cars shows, the car population is not likely to grow in the next twenty years. Building autoroutes on the grand scale could be just a pitfall nowadays.

To make suggestions on the constructive side, cities grew and developed at a hectic pace during the last thirty years, and they tend to be messy beyond description. Reoptimizing them at the measure of man, and improving their comfort and aesthetics is probably one of the most fruitful tasks the public can devote it-

self this time. Beauty releases stresses and defuses aggressivity. The growth will continue. World population is collapsing into the cities. A second look at underground transportation may open an area for vast, long, and expensive infrastructure investments.

Coming to industrial tasks, as Figure 4 shows, energy systems live through two cycles. We know that natural gas and nuclear are the staple for the next fifty years. Natural gas is expanding at maximum rate now, in absolute terms, and requires vigorous expansion of the infrastructure, from fields to final consumer. Instead of patchworking on it following instant demand, the infrastructure could be constructed with a long-term vision, just like the German autoroutes in the thirties as a social investment. This would give some oxygen to the now ailing construction and steel industries.

Still in the field of energy, electricity consumption will pick up again in the nineties. Nuclear power stations require construction times of a decade nowadays. This means we should start constructing them now to have them ready for the next boom. Mechanical and electro-mechanical industries, deep in the doldrums at present, would certainly welcome the move, and are in fact pushing in that direction. I chose this couple of easy examples only to show the links between general features and actual decisions.

Entrepreneurs will sow the seeds of the upswing during the next twenty years by launching new products. About a hundred of them according to my estimates. Why not help by giving them money, making them heroes and perhaps detaxing them? As they will have a lot of technical problems to solve to start their things,

why not put at their disposal, for nominal fees, the research arsenals of the states? Incidentally, the invention curve of the 1980 wave shows that practically all inventions going into our innovation wave are already made. What's necessary is development, and that's where the arsenals are at best.

Despite all measures an awful lot of people have to hover between the sinking old and the emerging new. Thirty-five million people are now officially out of work in western countries, and they may reach seventy millions five years from now. Feather-bedding them with almost full salaries as it is done now in Europe, can be very Christian but cannot last. This has been felt already, e.g. in Italy, where the economy is rapidly going underground. This does not mean a rebellion, but only that the rules are readjusted to the new boundary conditions short-circuiting institutional rigidity. That of the unions to start with. Or institutional greed like stifling taxation. It is good to see the system fighting to survive at the grass roots level. And the system in power cannot avoid accepting realities. It would obviously have been wiser to precede them.

A very important issue in my opinion will be that of keeping people correctly informed. The Harvard Economic Society, e.g., was writing in its Weekly Letters "a serious depression like that of 1920-21 is outside the range of probability" (November 2, 1929). "Business will turn for the better this month or next, recovering vigorously in the third quarter and end the year at a level substantially above normal" (May 17, 1930). "Stabilization of present depression levels is clearly possible" (October 31, 1931). "The recession is just about over" (Fortune, March 22, 1982). Not to forget, 1983 is in the same structural position of 1929!



Small lies and procrastinations may finally lead to rage and the call for a strong man to recreate order. This did happen in the thirties, to a point even in a seasoned democracy like the US.

Simple institutional changes could greatly help. Part-time work, to give one, so bitterly rejected by unions in the past, not only could keep more people above the bread line, but would give them the chance to hop into a new activity holding a life line in case they miscalculated. In other words, it increases mobility and creativity. Mobility could also be implemented via a proper correction of current housing rules where now people "in" have infinite privileges and people "out" none, so that nobody moves. Work opportunities are often hundred miles away.

Deficit spending, as I said, can be seen as a confiscation of money saved, redistributed for social reasons. In this form it may not last long. But the redistribution could still be obtained by more natural and honest means, in particular by providing a certain class of services, still in great demand, be it baby-sitting or plumbing or house restoration. The corresponding jobs went out of fashion when industrial myth proposed nut fastening as a supreme accomplishment and social liberation. Realizing that the tunnel is very long may revamp them. Institutions and media could certainly help.

By changing weights I am also perhaps incautiously stating that Reaganomics, Thatcheromics, Mitterandomics, etc., are bound to fail, as are the monetarists who are nervously turning disconnected knobs. It is obviously a tall order, but I can't help it. I'm only a student of the system.

## REFERENCES

- Kautsky, K. Krisentheorien. Neue Zeit, XX. Jahrgang, 1901-2.
- Kondratieff, N.D., Die langen Wellen der Konjunktur. Archiv für Socialwissenschaft und Sozialpolitik. Band 56, Tübingen 1926.
- Kondratieff, N.D. Die Preisdynamik der industriellen und landwirtschaftlichen Waren. Archiv für Sozialwirtschaft und Sozialpolitik. Band 60, Tübingen 1928.
- Marchetti, C. und N. Nakicenovic. The Dynamics of Energy Systems and the Logistic Substitution Model. RR-79-13. International Institute for Applied Systems Analysis, Laxenburg, Austria. December 1979.
- Marchetti, C. Society as a Learning System: Discovery, Invention, and Innovation Cycles Revisited. RR-81-29. International Institute for Applied Systems Analysis, Laxenburg, Austria. November 1981.
- Marchetti, C. The Car in a System Context. The Last 80 Years, and the Next 20. WP-82-5. International Institute for Applied Systems Analysis, Laxenburg, Austria, January 1982.
- Schumpeter, J.A. Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process. Vol. 1, 2. New York 1939
- Trotzky, L. Vestnik Sotsialisticheskoi Akademii. N.4, April-June 1923.
- Zahavi, Y. The UMOT - Urban Interactions. DOT-RSPA-DPB, 10/7. U.S. Department of Transportation, Washington, D.C. January 1981.

Figure 1.  
CAR POPULATION IN ITALY  
(IN MILLIONS)

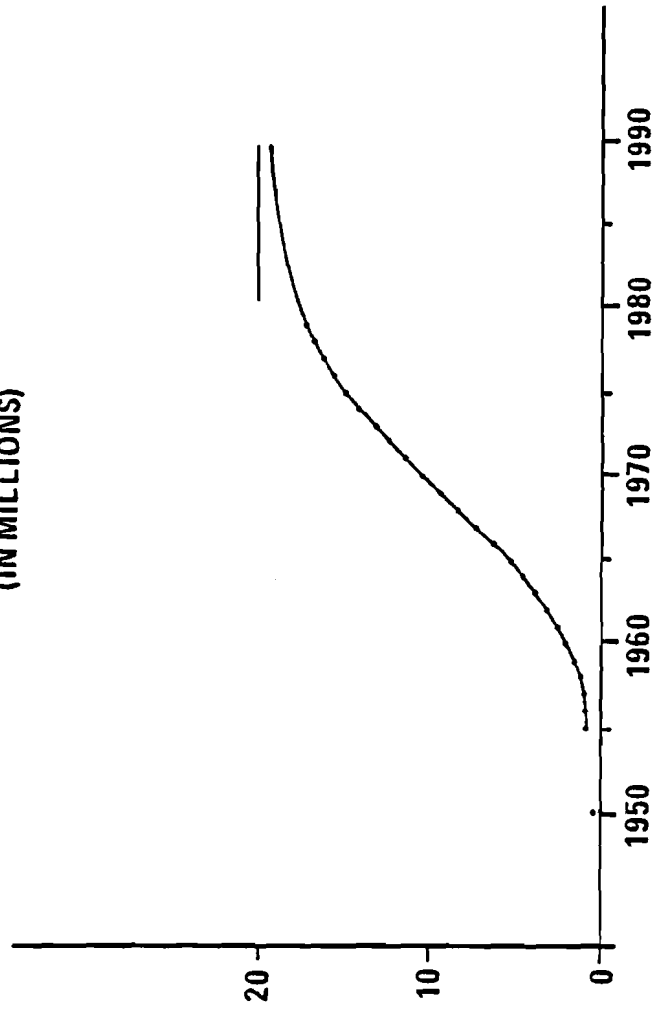


Figure 2.

CAR POPULATION IN SIX DIFFERENT COUNTRIES  
AS PERCENTAGE OF SATURATION LEVEL

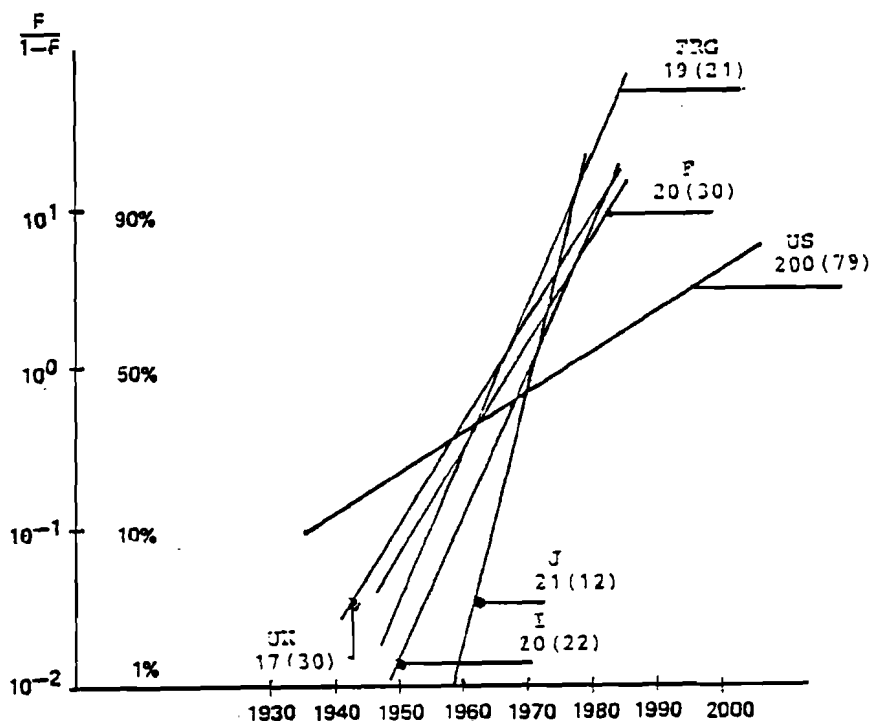
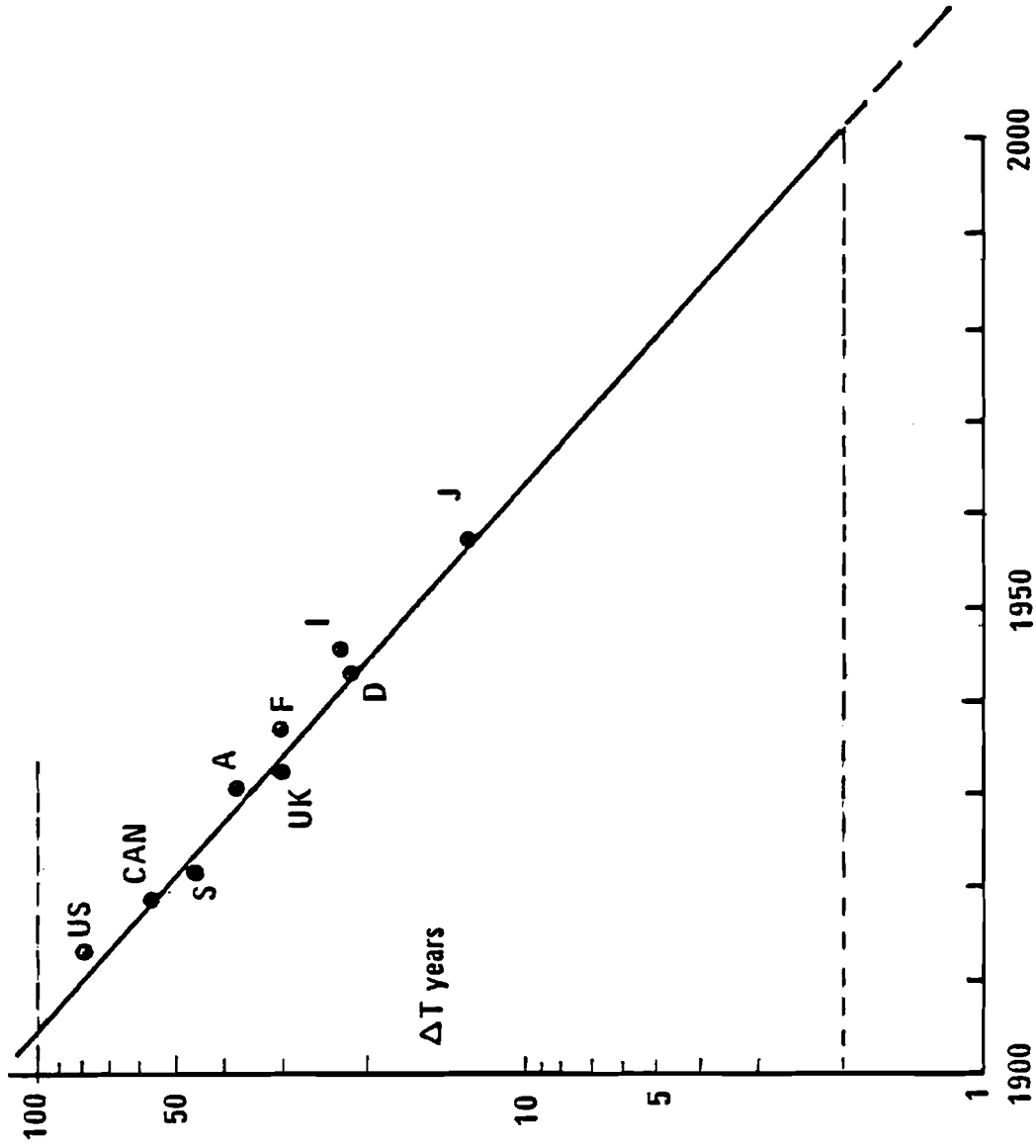


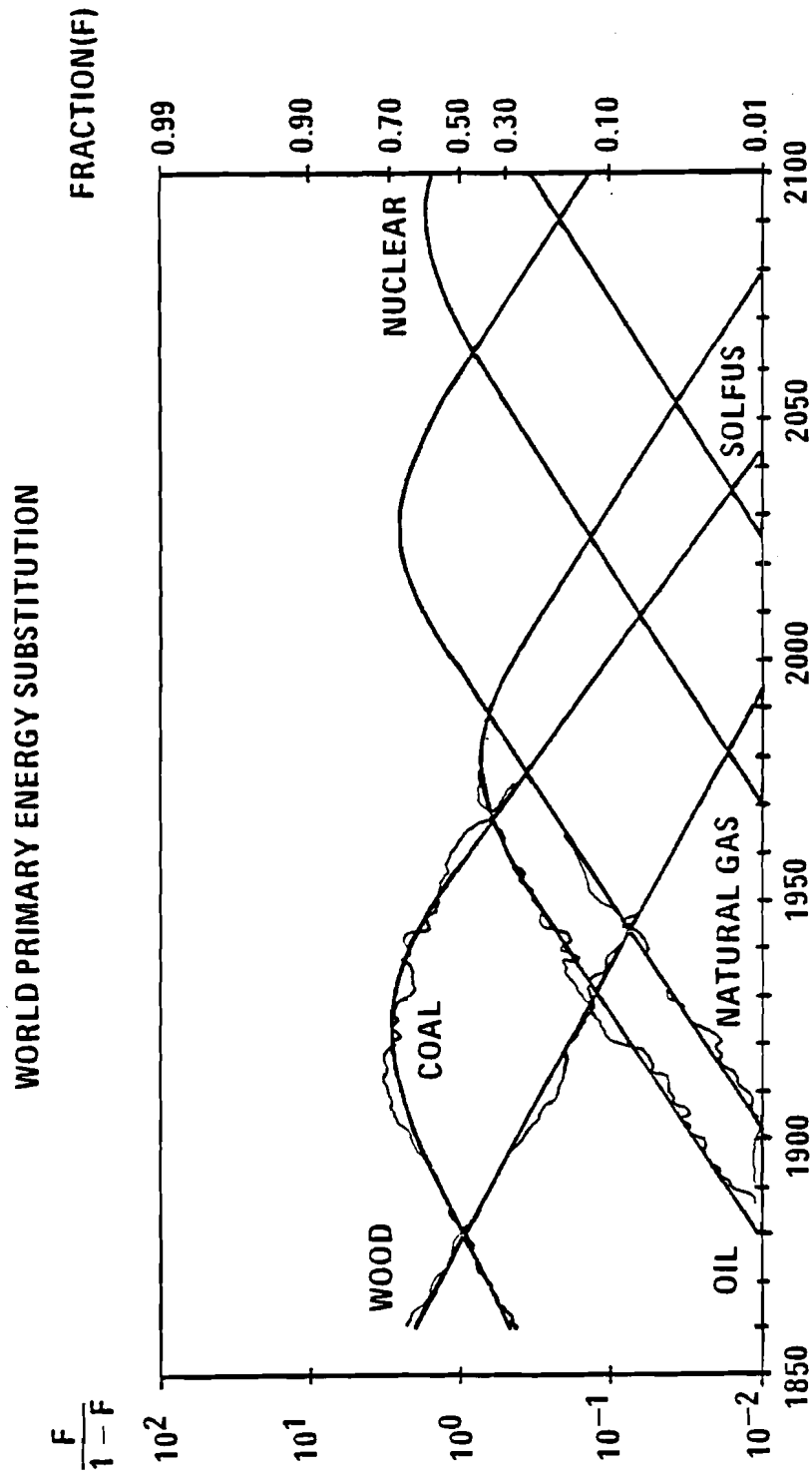
Figure at left represents saturation point in million cars. Figure in parenthesis is time constant for penetration, in years. F is fraction of saturation level.

Figure 3.  
**RELATION BETWEEN  $\Delta T$  AND TIME WHEN CAR POPULATION WAS 1% OF SATURATION**



$\Delta T$  is the time constant for penetration from 10% to 90% of the market, as expressed in Figure 2. It is reported vs. the year when penetration was 1% of the saturation level in the respective market.

Figure 4.



CALCULATED BY N. NAKICENOVIC, 1982.

Market shares  $F$  of primary energy sources, expressed in terms of energy.

# INVENTION AND INNOVATION WAVES - THE SECULAR SET

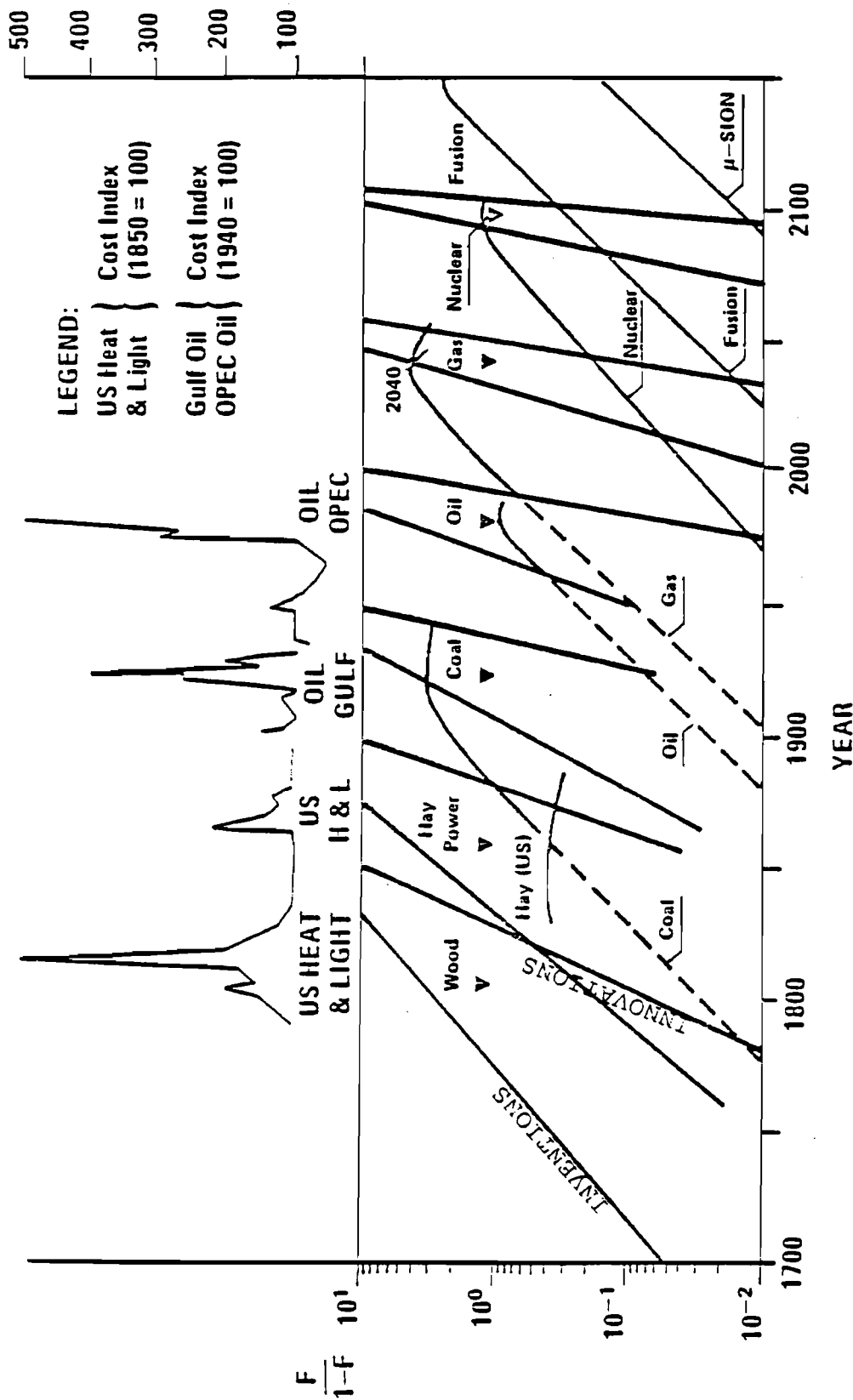


Figure 5. The first three waves of the series are historical. We live in the fourth. The following two are indicated to show the interlocking of the various components. In the upper part of the figure the indexed prices for energy are reported to show the precise match between energy price flaring and wave centers. By analogy one should expect a rapid fall of real price for oil in the next few years. (See text for further explanation.)

Source for the US cost index: Historical Statistics of the United States, U.S. Department of Commerce, 1975. For the Gulf and OPEC Oil Cost Index the source is A.F. Bejidorff and J.H. Lukasz, Energy Price: Pervasive Carrier of Information, Group Planning, Shell International Petroleum Company, Shell Centre, London.

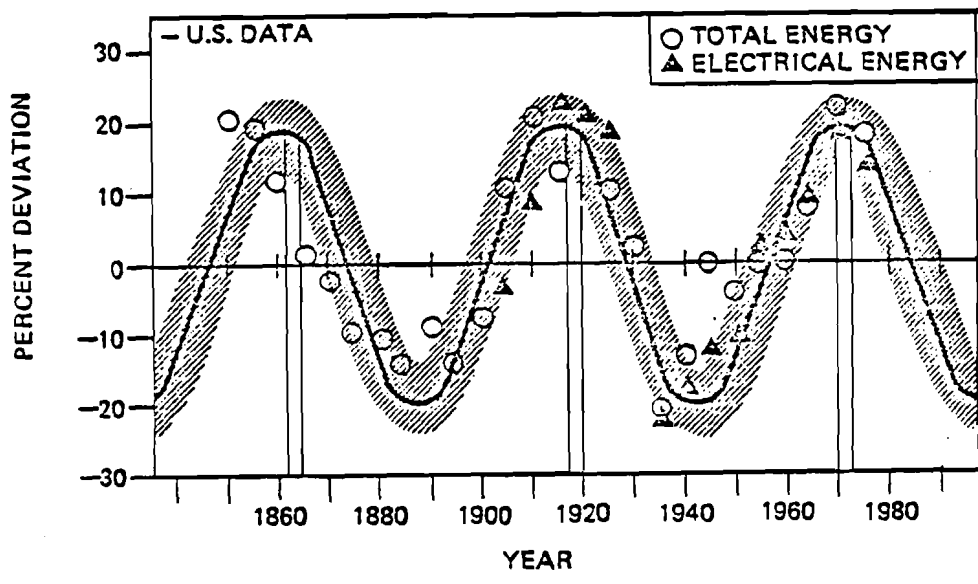


Figure 6. Oscillation of primary energy demand in US around the fundamental exponential growth curve, expressed as percent deviation.



Figure 7.

**INVENTION AND INNOVATION WAVES – THE SECULAR SET**

